

Expert opinion - Alard Roebroek

drawn up for the purpose of the purchase of equipment

„Delivery of 3T experimental human whole-body MR scanners for CEITEC MU“

as part of the project entitled “CEITEC – Central European Institute of Technology”,
project reg. CZ.1.05/1.1.00/02.0068.

Ordering party

Name: Masarykova univerzita, CEITEC MU
Head office: Žerotínovo nám. 9, 601 77 Brno,
Reg. No.: 00216224,
Tax reg. No.: CZ00216224,
Representative/deputy: prof. RNDr. Jaroslav Koča, DrSc.,
Contact person: JUDr. Pavel Vacek,
Tel./Fax: 549 493 669,
E-mail: pavel.vacek@ceitec.muni.cz

Expert

Name: Dr. Alard Roebroek,
Address: Oxfordlaan 55, Maastricht, Netherlands

Sworn expert on: Dr. Alard Roebroek, the expert giving his opinion, is an assistant professor at the Dept. of Cognitive Neuroscience of Maastricht University and MR lab Director for Scannexus B.V., the Netherlands. He has been intensively involved in the MR system specifications, comparison between MR system vendors, and MR system acquisition for Maastricht University's new MRI research lab Brains Unlimited, operated by Scannexus. The lab now operates a Siemens Prisma Fit, a Siemens Magnetom 7T and a Siemens Magnetom 9.4T. Dr. Roebroek's institute has a Master Research Agreement in place with Siemens Healthcare and collaborates actively with Siemens Healthcare in the Netherlands and in Germany.

In Maastricht on 18 November 2013



Signature, expert's seal

Based on a written application of the ordering party from October 29, 2013, the following expert opinion has been drawn up for the needs of realizing the project called “**CEITEC – Central European Institute of Technology**”, reg. No CZ.1.05/1.1.00/02.0068, whose aim and subject-matter is the evaluation of the uniqueness of the equipment “**Delivery of 3T experimental human whole-body MR scanners for CEITEC MU**” and price adequacy of the standing offer.

Technical specification

General requirements	
<p>Two new whole-body MR scanners with magnetic field induction of 3T, with superconducting zero-boiloff actively shielded magnet equipped with higher order shims, dedicated to human whole-body diagnostics and research. The set of diagnostic examinations must include state-of-the-art experimental and clinical neurology/neuroscience exams (e.g. functional MRI, multidirectional diffusion measurement with the option of diffusion tensor mapping, 3D tractography, localized proton spectroscopy and spectroscopic imaging, extensibility to multinuclear spectroscopy, anatomical imaging T1, T2 and PD weighted, with high spatial resolution), native a contrast angiography, spine and spinal cord imaging. Adequate hardware, including high-performance gradients and high sensitivity RF coils must be provided. Compatibility with the installation site is required.</p> <p>System A: functional MRI incl. BOLD effect and ASL perfusion, contrast enhanced perfusion, spectroscopy, SWI</p> <p>System B: functional MRI incl. BOLD effect and ASL perfusion, diffusion-based tractography</p> <p>Workstation: shared use for both systems A and B, equipped for data analysis and method development</p>	
Required technical and functional properties	Required value
<p>(The offers must meet all the requirements listed below. The value of evaluated parameters must be in the range indicated as the 'required value'; values beyond the 'threshold value' will be evaluated as the threshold value.)</p>	
Magnet	
Magnet with field 2.8-3.0 T, with active shielding	yes
Zero boil-off system - liquid helium consumption in liters during 5 years of service	
Max. distance from the iso-center with magnetic field exceeding 0,5 mT	in axis x, y max. 2.7 m, in axis z max. 3.7 m
Min. room height	max. 3.0 m
Weight	max. 15000 kg
Patient tunnel diameter in the narrowest position	min. 60 cm
Scanning volume, FOV in each axis (x, y, z)	min. 45 cm in each axis
Field stability in time	≤ 0,1 ppm/h
Static field homogeneity Vrms (root mean square deviation on a spherical surface, determined from at least 24 measurement in 24 parallel planes), DSV 100 cm	≤ 0,03 ppm
Static field homogeneity Vrms (root mean square deviation on a spherical surface, determined from at least 24 measurement in 24 parallel planes), DSV 20 cm	≤ 0,07 ppm
Static field homogeneity Vrms (root mean square deviation on a spherical surface, determined from at least 24 measurement in 24 parallel planes), DSV 30 cm	≤ 0,50 ppm

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Static field homogeneity V_{rms} (root mean square deviation on a spherical surface, determined from at least 24 measurement in 24 parallel planes), DSV 40 cm	≤ 1,40 ppm
Max. content of iron in the floor	min. 80 kg/m ²
Cooling by institutional cooling water circuit?	yes
Gradient system	
Number of active shims of the 2nd or higher orders	min. 5
Sufficiently high shim power for off-isocentre spectroscopy?	yes
Gradient system	
Max. gradient field amplitude in any and each direction	min. 75 mT/m
Max. slew rate for the amplitude of 75 mT/m in all directions	min. 200 T/m/s
Max. gradient duty cycle	100%
Actively shielded?	yes
Cooling by institutional cooling water circuit?	yes
Radiofrequency system	
Digital with high precision	yes
Number of receiver channels	min. 32, extensible
Number of independent transmit channels	min. 2
Bandwidth of each independent RF receiver channel	min. 1MHz
Max. transmitter power	min. 35 kW
Possibility of multinuclear spectroscopy (31P, 23Na, 19F, 13C)	yes
Patient table	
Designated for whole-body diagnostics	yes
Max. load	min. 200 kg
RF coils corresponding to the required range of exams	
Multichannel coil for head diagnostics, RF field shimming, number of channels	min. 32 channels
Head exam coil T/R	yes
Whole spine coil	yes
Electronic coil switching	yes
Automatic coil recognition	yes
Acquisition system	
Color LCD monitor	diagonal min. 19"
Modern CPU (min. 2,4 GHz), hardware acceleration (s.a. GPU)	yes
RAM	min. 4 GB
HD	min 400 GB
Network interface	1 Gbit/s
Image reconstruction	min. 5000 images/s for image matrix 256x256
Exam parameters can be copied into new acquisitions	yes
Studies can be repeated with parameter duplication	yes
Data archivation on DVD/CD	yes
ECG triggering	yes
Respiration triggering	yes
Acquisition matrix size at least 64x64 to 1024x1024	yes
Image format and protocol DICOM, incl. Worklist	yes
Required exams, sequences	

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Standard sequences such as 2D, 3D acquisition of T1, T2 (FSE, SE), PD, GRE for MR angiography native and contrast, SSFSE, TOF, DWI, EPI, SWI	yes
Angiography (native and contrast) of brain and neck vessels	yes
Water diffusion in the brain (single shot / high resolution multi-shot, diffusion tensor imaging) and calculations (ADC, DTI maps)	yes
High spatial resolution exams of brain regions, spine, MR myelography	yes
Sequences for functional MR measurements (BOLD, ASL)	yes
MR spectroscopy single-voxel, multi-voxel, 2D, 3D; stimulated echo, spin echo based, magnetization preparation (water, fat, outer volume suppression)	yes
Contrast enhanced perfusion imaging (DCE, DSC) - measurement and hemodynamic map calculation	yes
Creation of own user's pulse sequences and protocols possible	yes
Raw data accessible	yes
Min. slice thickness 2D	max. 0.5 mm
Min. slice thickness 3D	max. 0.1 mm
Independent workstation software	
Software (data browsing and analysis) for an independent workstation	yes
PACS integration requirements	
Ethernet interface, norm IEE 802.3	speed min. 100 Mb/s
	connector RJ45 or metallic interface (100BASE-TX, 1000BASE-T)
	Multi-Mode optical interface with connectors ST, SC, MTRJ, LC, E2000 (100BASE-FX, 100BASE-SX, 1000BASE-SX)
Protocol TCP/IP version 4 communication	yes
Communication with protocol DICOM version 3.0 or later	yes
Support for these DICOM properties	DICOM Verification service
	Storage of DICOM objects on a remote DICOM system
	Commitment of stored DICOM objects on a remote DICOM system
	Querying for data on a remote DICOM system
	Retrieval of DICOM objects from a remote DICOM system
	Basic Worklist Management
"DICOM Conformance Statement" certification	ano
Other requirements	
Line power distributor	yes
RF shielding cabin incl. observation window, door and necessary internal equipment (suspended ceiling, wall panels, lights, floor)	yes
Helium quench pipe	yes

Magnet room camera for subject monitoring, displayed in the control room, recording possible (e.g. external digital recorder)	yes
Filter passage with removable or flap covers between the RF cabin and the control room	2 routes, diameter at least 5 cm each
Filter passage with removable or flap covers between the RF cabin and the technical room	2 routes, diameter at least 5 cm each
Filter passage with a removable covers for image projection into the magnet (optical stimulation for fMRI)	yes

Equipment configuration (summary of the offer by Siemens)

System A	System B	Workstation A
<p>MAGNETOM Prisma - System</p> <ul style="list-style-type: none"> - 3T magnet (whole-body, superconductive, actively shielded, zero helium boil-off, 50 cm FOV) - XR 80/200 gradient system (actively shielded, water cooled, force compensation) - 1st and 2nd order shims - TimTX TrueShape + syngo ZOOMit + ZOOMit EPI + ZOOMit SPACE - Tim 4G [204x64] + Dot - RF Transmit/Receive System (DirectRF™ technology) - Tim 4G RF coils with Dual-Density Signal Transfer Technology (Head/Neck 20 DirectConnect, Spine 32 DirectConnect, Body 18, Flex Large 4, Flex Small 4) - Tim Table - Dot (Day Optimizing Throughput) Engine - Dot Display and Dot Control Centers - Dot technology - Brain Dot Engine - High performance image reconstruction computer incorporating GPU technology - Tim Application Suite 	<p>MAGNETOM Prisma - System</p> <ul style="list-style-type: none"> - 3T magnet (whole-body, superconductive, actively shielded, zero helium boil-off, 50 cm FOV) - XR 80/200 gradient system (actively shielded, water cooled, force compensation) - 1st and 2nd order shims - TimTX TrueShape + syngo ZOOMit + ZOOMit EPI + ZOOMit SPACE - Tim 4G [204x64] + Dot - RF Transmit/Receive System (DirectRF™ technology) - Tim 4G RF coils with Dual-Density Signal Transfer Technology (Head/Neck 20 DirectConnect, Spine 32 DirectConnect, Body 18, Flex Large 4, Flex Small 4) - Tim Table - Dot (Day Optimizing Throughput) Engine - Dot Display and Dot Control Centers - Dot technology - Brain Dot Engine - High performance image reconstruction computer incorporating GPU technology - Tim Application Suite 	<p>syngo MR Workplace #T+D</p>

(syngo TimCT FastView, Neuro Suite, Angio Suite, Cardiac Suite, Body Suite, Onco Suite, Breast Suite, Ortho Suite, Pediatric Suite, Scientific Suite, Whole Body Suite) - syngo MR software - Sequences - Patient Communication - Computer system - Installation	(syngo TimCT FastView, Neuro Suite, Angio Suite, Cardiac Suite, Body Suite, Onco Suite, Breast Suite, Ortho Suite, Pediatric Suite, Scientific Suite, Whole Body Suite) - syngo MR software - Sequences - Patient Communication - Computer system - Installation	
Tim [204x64] XR Gradients #P	Tim [204x64] XR Gradients #P	
PC Keyboard US English #Tim	PC Keyboard US English #Tim	PC Keyboard US English
Tim Table #P 1	Tim Table #P 1	
Flow Quantification #Tim	Flow Quantification #Tim	Argus Flow MRWP
Neuro Perfusion Package #T+D		Neuro Perfusion Evaluation MRWP#T+D
RESOLVE #T+D	RESOLVE #T+D	
Arterial Spin Labeling 3D #T+D	Arterial Spin Labeling 3D #T+D	
Arterial Spin Labeling 2D	Arterial Spin Labeling 2D	
SWI #Tim		
Spectroscopy Package #T+D		Spectroscopy Eval. syngo MRWP
Multinuclear Support #Sk		
Multinuclear Spectroscopy #Sk		
SpectroShim Support #P		
	Transmit/Receive Head Coil	
Head/Neck 64 #P,Sk	Head/Neck 64 #P,Sk]	
MAGNETOM Prisma Install., EUR	MAGNETOM Prisma Install., EUR	
Separator 60kW	Separator 60kW	
RF-Cabin, Steel #3T	RF-Cabin, Steel #3T	
RF-Cabin Installation, EUR #3T	RF-Cabin Installation, EUR #3T	
Inline BOLD Imaging #Tim	Inline BOLD Imaging #Tim	BOLD 3D Evaluation syngo MRWP #T+D
3D PACE syngo #Tim	3D PACE syngo #Tim	
Diffusion Tensor Imaging #P		DTI Evaluation MRWP #Tim
	DTI Package #P - Diffusion Tensor Imaging - DTI Tractography syngo - DTI Evaluation	DTI Tractography syngo MRWP #Tim
fMRI Trigger Converter	fMRI Trigger Converter	
Third year of warranty	Third year of warranty	Third year of

		warranty
IDEA Development License	IDEA Development License	IDEA Development License

Quoted price (according to Siemens' offer)

104 million CZK excluding VAT

Based on a detailed research, personal knowledge and market survey, the following opinion is given:

1) Rationale for the uniqueness of technology, device, or rights, and an explanation stating that there is really not more than a sole supplier on the market able to provide such goods

In the 'SPECIFICATION OF MR SYSTEMS AND RESEARCH TOPICS FOR CORE FACILITY MAFIL' it becomes clear that functional MRI (fMRI) and diffusion MRI (dMRI) applied to the human brain are very central techniques to the CEITEC's research goals and thus the acquired machines must deliver top-of-the-line performance for these techniques. Excellent performance in *both* these techniques for the purpose of high-end research depends crucially on the simultaneous availability of: high gradient amplitude, high gradient slew rate, high long term gradient stability and dedicated head or head/neck coils with a high number of radio-frequency (RF) receive channels. Here 'high' is subject to interpretation, but more/higher is almost always better in these cases. Among the high-end 3T MRI systems provided by the large MRI system vendors, all are able to provide different levels of performance for the different hardware parameters above and all are capable of supporting some form of fMRI and dMRI measurements. However, to the best of my knowledge, the Siemens Prisma is the only system currently on the market that *simultaneously* provides the highest clinically available gradient amplitude (80mT/m), gradient slew rate (200T/m/s) and number of head (32) and head/neck (64) RF receive channels and provide excellent long term gradient stability. This means it has the highest short and long-term potential for the most excellent level of performance of fMRI and dMRI in a research context. This is all the more important because later upgrade of these hardware parameters on a system (if at all possible) require extensive additional investments at a later time after initial installation, delivery and acceptance of the MRI systems (unlike software updates which can be relatively low cost updates).

In receiving answers to my specific questions about the research plans and requirements of the CEITEC/MAFIL I have also understood that there is extensive previous experience with operating Siemens MR systems and, very importantly, expertise in the Siemens specific MR pulse sequence development environment in the (future) CEITIC/MAFIL staff. Especially in the highly specific expertise area of MR pulse sequence development, it takes a long time to train or retrain an engineer or scientist to use a specific platform. It would be highly advisable for the CEITEC/MAFIL to capitalize on the specific expertise already present in its staff, rather than choosing to reinvest in retraining its staff which takes time and additional (indirect) cost. This is important because in the research context local MR pulse sequence development and, through

that, access to non-vendor product state-of-the-art research sequences from other MR research centres (i.e. third parties) is key to the highest standard of excellent results in an internationally competitive context. An important illustrating case-in-point are the MR pulse sequence developments performed in the NIH Human Connectome Project, which makes state-of-the art fMRI and dMRI sequences available to Siemens sites. These sequences provide multi-band (or simultaneous multi-slice) technology available that are transforming the fields of fMRI and dMRI research with large performance increases over any current vendor's product sequences.

2) Reasons proving that it is impossible to use some other, similar and acceptable, devices or technologies

It is never completely impossible to use other vendors' MRI systems. However, it is safe to say that the long term potential for the highest standard of excellence in fMRI and dMRI in a research context (as CEITEC/MAFIL aspires) can only exist if the basic hardware parameters, described above, are matched or exceeded (simultaneously for the same running MR protocol, not separately in different hardware settings for different protocols) by another candidate MR system. To the best of my knowledge, this is not the case for any competing device compared to the Siemens Prisma.

3) Valuation of an item or right being acquired

I have reviewed the specification and quotation of the two Siemens Prisma systems. The specifications are adequate for the CEITEC's goals. Prices must always be judged within a the context of the broader offer of the vendor and circumstances and so I can make only a qualitative judgement. In the context I have knowledge of the quoted prices seem reasonable.

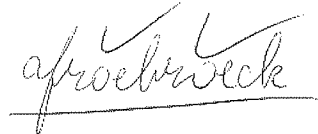
LIST OF ATTACHMENTS:

1. Specification of MR systems and research topics for core facility MAFIL
2. Offer No. 061-13P0095 (Siemens valuation of the delivery)
3. MAGNETOM Prisma-1-A8WMI1-2-A (Detailed technical specification of MR A)
4. MAGNETOM Prisma-1-A8WMI1-4-B (Detailed technical specification of MR B)

Expert's Statement:

The potential for the highest standard of excellence in fMRI and dMRI in a research context (highly important for CEITEC/MAFIL's research goals) is enabled by the unique combination, in the current market, of hardware parameters that the described equipment possesses. In addition, the possibility of building on past expertise and training, especially in MR pulse sequence programming, is an important advantage. The quoted price is in the range expected for this combinations of systems and specifications.

In Maastricht on 18 November 2013

A handwritten signature in black ink, appearing to read 'a. roebroek', written over a horizontal line.

Signature, expert's seal

SPECIFICATION OF MR SYSTEMS AND RESEARCH TOPICS FOR CORE FACILITY MAFIL

GENERAL CHARACTERISTICS OF THE INSTRUMENTS

Two whole body 3T MR systems with superconducting zero boil-off actively shielded magnets certified for clinical use and equipped for advanced research in neuroscience and supporting research in cardiology and a orthopedics, including the installation in designated areas, function tests and personnel training. The delivery includes radiofrequency shielding cabins, a shared data processing console, installed software with appropriate licences for the visualization, analysis and archiving data and for experiment planning and method development on both systems and the data processing console, measurement methods and protocols for diagnostics and research, MR compatible instrumentation for functional imaging. Both scanners must guarantee, above all, high-quality morphological imaging, advance measurement of the parameters of diffusion, BOLD effect based functional imaging, dynamic measurement for perfusion imaging, proton spectroscopy and spectroscopic imaging.

Both scanners must use identical software, provide the possibility of sharing measurement protocols and radiofrequency coils, support synchronization by external signals. Required is the delivery of scanner A equipped for sensitive and fast proton and non-proton imaging, spectroscopy and spectroscopic imaging of the head and neck region. Scanner B will also be equipped for the head and neck region including extended support for the imaging of spinal cord, trunk and joints. Both systems are required to guarantee superb static field homogeneity (supported by at least 2nd order room temperature shims), and excellent parameters of the gradient and radiofrequency subsystems.

For each instrument and software unit, the delivery of comprehensive manuals is required, containing the instructions for their proper operation, maintenance and service guides, guides for protocol and pulse sequence programming, and detailed description of the instruments delivered, including the delivered measurement methods and protocols. These documents are to be delivered in electronic form (in PDF format allowing at least copying, commenting and printing). All technical documentation is to be delivered in English, user's guides also in Czech.

ESTIMATED PRICE

100-105 MCZK + VAT (1 EUR = 25 CZK)

INTENDED USE

Both systems will constitute the principal imaging modality of the CEITEC core facility MAFIL (Multimodal And Functional Imaging Laboratory¹). Associated with and operated by the Brain and Mind research programme of CEITEC², the primary utilization of both scanners is neurologic research. As parts of a core facility, both scanners will also support the research of other programmes of CEITEC, Masaryk University, or their research partners. The core facility will also participate in translational research further supported by dedicated animal scanners (such as 9.4T MR) and animal facilities (placed at the Institute of Scientific Instruments - ISI). CEITEC core facility together with ISI intend to provide part of MRI scanning capacity for external users as a national node of EuroBioImaging Project.

Both systems are required to quickly become the instrumental basis for cutting-edge neuroscience research and are expected to support also other research in CEITEC that may profit from multiparametric high-quality human MR imaging. They should retain such a position for at least 8-12 years, which is today the typical moral lifetime of such systems. All recent history of MR has shown tight linkage between data acquisition quality and speed and progress in MR technology, much of which has resulted from method development at research institutions. Therefore, it is not only required that the system be well equipped with up-to-date measurement protocols at the time of purchase, but also that it will provide the potential to quickly apply recent work implemented by other research institutions after the purchase, and to offer the MAFIL team the possibilities for own method development. This is expected to be a benefit for CEITEC internally, but also for future research partners, and it may also become a subject of collaboration with the system manufacturer. Incorporation of CEITEC in the global MR development environment is seen as both a way of achieving the highest methodological standards, but also of increasing the international visibility of CEITEC. In order to be able to meet such expectations, CEITEC requires full method programmability of the systems, such as that provided by the IDEA license on Siemens' systems. The issuance of this license is known to be based on successful MR system programming training of the staff, organized by Siemens. Such a licensing model, unique to Siemens, has a more than decade-long tradition and is supported by a web-based forum that arranges sharing of the technical knowledge relevant to method development among the developers worldwide. The MAFIL group already has two members (P. Latta, Z. Starcuk) who have passed such a course and have had previous experience with programming these systems, which considerably improves the CEITEC prospects for a quick start in this area; therefore, it is an additional argument for the system selection.

BRAIN AND MIND PROGRAMME GOALS

To promote collaborative theoretical, experimental, and clinical study of the brain from the molecular to the behavioural and cognitive levels. Extensive research will also be performed on cellular, molecular, and clinical aspects of damage and reparation of neural tissue. Interdisciplinary research will be completed in the fields of neurobiology, neuropsychopharmacology, functional neuroanatomy, neurophysiology, neuroimaging, neuropsychology, neurology, psychiatry, and computational neuroscience. Advanced biomedical imaging methods currently start to cross the

¹ <http://www.ceitec.eu/headquarters/multimodal-and-functional-imaging-laboratory/z10>

² <http://www.ceitec.eu/ceitec-mu/brain-and-mind-research/v8>

formerly unreachable boundary of microscopic and molecular level. Their applications can substantially contribute to better understanding of physiological and pathological changes in the nervous system, multi-level study of animal and human behaviour, and translational research with a strong impact on the management of neuropsychiatric diseases. The programme is committed to providing excellence in research and education in brain and mind research.

CURRENT TOPICS

- **Topic 1: Multimodal study of structural and functional connectivity under physiological, boundary, and pathological conditions in perspectives of behavioural and social neuroscience.**

The objective in this field is to establish a partnership with psychologists and sociologists as well as the joint projects in social and behavioural neuroscience dealing with various aspects of social cognition and brain connectivity of healthy individuals and neuropsychiatric patients alike. The specifics of the research into empathy, motivation and decision making; irrational aspects of human brain function; neuroeconomics and the development of application possibilities in this field.

Experimental: functional MRI (BOLD+ASL), simultaneous scanning in social interaction, diffusion tensor (or DSI) imaging, anatomic versus functional connectivities in the brain, linking changes in function (fMRI) and structure (morphometric studies, structural connectivity).

- **Topic 2: Application of neuroscience, incl. development of multimodal MRI protocols established to identify disease-related biomarkers of neuropsychiatric diseases (neurodegeneration of Parkinson's disease and schizophrenia), and of neuropathic pain.**

The current objective is to develop reliable biomarkers of early-stage Parkinson's disease (PD), to study structural and functional changes in brain networks in schizophrenia, and to establish a laboratory for pain research. The human research will follow the translational research in animal models (with transgenic or toxic mouse models) into the mechanisms at molecular and cellular level. The multimodal MRI approach have the potential to distinguish symptomatic from disease-modifying effects of therapeutic interventions, and gauge their effectiveness quickly and objectively. Unique and complementary information is provided by each of these modalities on overall atrophy, microstructure, function and chemical composition; therefore a multi-modal MRI approach is expected to generate a comprehensive picture of the progressive alterations, as well as treatment effects on the pathology

Experimental: Correlation of electrophysiological measurements with behavioural and cognitive testing, functional imaging methods (especially resting state fMRI is of interest), diffusion tensor techniques for quantitative assessment of diffusion parameters and tractography and others rather complementary MR measurements (ASL perfusion, MR spectroscopy, morphometric studies, structural connectivity).

- **Topic 3: Complex cortico-subcortical interactions in health and disease.**

Research into the processes of attention, memory, decision making, inhibition of habitual responses, cognitive functions. The focus will be on primarily cortical (epilepsy) and primarily subcortical (PD) diseases. Better understanding of cortico-subcortical interactions will result in more precise neuromodulation techniques (optimal indication, minimization of side effects).

Experimental: Intracranial recordings, fMRI, multiparametric methods for brain mapping, functional MR spectroscopy, ASL perfusion.

- **Topic 4: Development in MR technology, advanced data processing, and methods for multimodal/multiparametric data integration**

Oriented to maximum utilization of the spatial, spectral and temporal resolution available under the specific challenges of high-field MR (such as RF field limitation and B1 shimming, contrast alteration in high field, full use of parallel detection), serving the needs of structural and functional imaging of in-vivo and ex-vivo subjects. Special attention will be paid to efficient techniques for robust and fast MR spectroscopic imaging, to image data postprocessing methods for the characterization of brain connectivity, and quantitative MRI.

Experimental: Electrophysiological data, all techniques of MRI/MRS including computational neuroanatomy and modeling/simulations of dynamic changes in Brain (functional and effective connectivity).

- **Topic 5: Advanced techniques of the spine and muscle imaging**

- The main objective is to employ several advanced imaging techniques for the spinal cord imaging to study ultrastructural changes and pathophysiological processes of the spinal cord in vivo within various pathological conditions. The main focus will lie on the study of pathophysiology and natural course of the spondylotic cervical myelopathy, other types of myelopathy will be studied for the purpose of the correct classification and improvement of the diagnostic accuracy.

Furthermore, various pathologies of the musculoskeletal muscles will be studied using diffusion and diffusion tensor imaging as it appears to be a promising techniques for detection of the ultrastructural abnormalities of the muscles.

- Experimental: Diffusion tensor imaging, perfusion imaging and spectroscopy; the imaging parameters will be adapted for the specific anatomic regions and the new data processing approaches will be developed.

OTHER RESEARCH PROGRAMMES

Target drugs and contrast agents: testing the utility of agents tested in preclinical ultra high field system in a clinical setup.

Artificial materials in the body: such as cartilage at clinical field strength.

INTENDED CONFIGURATION OF MR SCANNERS

MAGNETOM PRISMA - SYSTEM A / B

System A	System B
MAGNETOM Prisma System <ul style="list-style-type: none"> - 3T magnet - XR Gradients - TimTX TrueShape + syngo ZOOMit + ZOOMit EPI + ZOOMit SPACE - Tim 4G+Dot - DirectRF - RF Transmit/Receive System - Tim 4G Coils (Head/Neck 20, Body 18, Spine 32, Flex Large 4/ Flex Small 4) - Tim Table - Dot (Day Optimizing Throughput) Engine - Dot Control Centers and Dot Display - Dot Technology - Brain Dot Engine - Tim Application Suite (syngo TimCT FastView, Neuro Suite, Angio Suite, Cardiac Suite, Body Suite, Onco Suite, Breast Suite, Ortho Suite, Pediatric Suite, Scientific Suite, Whole Body Suite) - Sequences - Patient Communication - Computer system - Installation 	MAGNETOM Prisma System <ul style="list-style-type: none"> - 3T magnet - XR Gradients - TimTX TrueShape + syngo ZOOMit + ZOOMit EPI + ZOOMit SPACE - Tim 4G+Dot - DirectRF - RF Transmit/Receive System - Tim 4G Coils (Head/Neck 20, Body 18, Spine 32, Flex Large 4/ Flex Small 4) - Tim Table - Dot (Day Optimizing Throughput) Engine - Dot Control Centers and Dot Display - Dot Technology - Brain Dot Engine - Tim Application Suite (syngo TimCT FastView, Neuro Suite, Angio Suite, Cardiac Suite, Body Suite, Onco Suite, Breast Suite, Ortho Suite, Pediatric Suite, Scientific Suite, Whole Body Suite) - Sequences - Patient Communication - Computer system - Installation
Tim [204x64] XR Gradients #P [14432224]	Tim [204x64] XR Gradients #P [14432224]
PC Keyboard US English #Tim [08464872]	PC Keyboard US English #Tim [08464872]
Tim Table #P 1 [14432226]	Tim Table #P [14432226]
Flow Quantification #Tim [08464740]	
Argus Flow [07365419]	
Neuro Perfusion Package #T+D [14416946]	
Neuro Perfusion Evaluation #T+D [14426290]	
DTI Package #P [14436656]	Diffusion Tensor Imaging #P
Neuro fMRI Package #T+D [14416943]	Inline BOLD Imaging #Tim 3D PACE syngo #Tim fMRI Trigger Converter
RESOLVE #T+D [14430391]	RESOLVE #T+D [14430391]

Arterial Spin Labeling 3D #T+D [14416965]	Arterial Spin Labeling 3D #T+D [14416965]
Arterial Spin Labeling 2D [14409110]	Arterial Spin Labeling 2D [14409110]
SWI #Tim [14402527]	
Spectroscopy Package #T+D [14416941]	
Multinuclear Support #Sk [14430398]	
Multinuclear Spectroscopy #Sk [14430399]	
SpectroShim Support #P [14432229]	
Head/Neck 64 #P,Sk [14432234]	Head/Neck 64 #P,Sk [14432234]
MAGNETOM Prisma Install., EUR [14436659]	MAGNETOM Prisma Install., EUR [14436659]
Separator 60kW [14418489]	Separator 60kW [14418489]
RF-Cabin, Steel #3T [14413606]	RF-Cabin, Steel #3T [14413606]
RF-Cabin Installation, EUR #3T [14401488]	RF-Cabin Installation, EUR #3T [14401488]
syngo MR Workplace #T+D	
transmit/receive head coil	
warranty for 3 years	warranty for 3 years

CEITEC, s.r.o.

Žerotínovo náměstí 617/9

602 00 Brno

Date 25th October 2013

Offer No. 061-13P0095

Dear business partners,

Thank you for your request following which we are sending the following offer.

The subject of the delivery consists of items specified below.

MAGNETOM Prisma according to specification No. **1-A8WMI1-2-A** (CZK 55,371,380 ex VAT)

MAGNETOM Prisma according to specification No. **1-A8WMI1-4-B** (CZK 48,371,320 ex VAT)

Total price ex VAT CZK 103,742,700.00

VAT 21% CZK 21,785,967.00

Total price including VAT CZK 125,528,667.00

Total price is conditional on ordering both devices.

VAT shall be charged according to the regulations in force at the date of taxable supply

By making out an order you agree that the delivery be provided according to the conditions given below.

The price includes transport to the place of delivery within the Czech Republic in compliance with DAP Incoterms® 2010, transport insurance, customs clearance, assembly, installation, operator training, and the warranty of 36 months from the date of handover.

Terms of delivery:

The equipment will be delivered within 10-12 weeks after the contract is signed

Terms of payment:

The price will be paid following an invoice with a maturity of 30 days made out by the Supplier upon the delivery of goods.

Validity of the offer:

Three months from drawing up this price offer.

The offer hereof is, within the meaning of section 43a of the Act No. 40/1964 Sb., as amended, not a draft contract and its implementation is subject to concluding relevant contractual documentation or to making another bilateral written agreement.

Siemens, s.r.o.
Sektor Healthcare
www.siemens.cz
Tel.: +420 23303 3303
Fax: +420 23303 1112



Address:
Siemens, s.r.o.
Sektor Healthcare
Siemensova 1
155 00 Praha 13

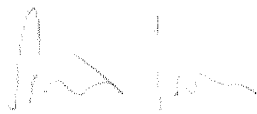
Siemens, s.r.o. – Managing Directors: Ing. Eduard Pališek, Ph.D., MBA, Rudolf Fischer – registered in Commercial Register of Municipal Court in Prague, Section C, File No. 625, Registered office: Siemensova 1, 155 00 Praha 13, Czech Republic
Company No.: 00268577, TAX ID No.: CZ00268577, bank: UniCredit Bank Czech Republic a.s., Želetavská 1525/1, 140 92 Praha 4
CZK Account No.: 1013384001/2700, EUR Account No.: 1013384394/2700

The contractual relationship based on the offer hereof follows "Delivery terms and conditions of Siemens, s.r.o., Healthcare Sector, version of 1st July 2012" (hereinafter referred to as "DTC"), which can be found on

<https://www.cee.siemens.com/web/cz/cz/corporate/portal/home/healthcare/Pages/Healthcare.aspx>

Customer is required to familiarize themselves with the DTC and to express their approval by making out an order pursuant to this offer. Any terms of business on the part of the Customer are not a part of business relationship established under or in connection with this contractual relationship even though they are not excluded either expressly or in writing by the Supplier at concluding purchase contract. Any deviations from this arrangement must be provided in writing and confirmed by both contractual parties.

With kind regards,
Siemens, s.r.o.



Ing. Vratislav Švorčík
Director of Healthcare Sector



Ing. Karel Kopejtko
CFO of Healthcare Sector

Siemens, s.r.o.
Sektor Healthcare
www.siemens.cz
Tel.: +420 23303 3303
Fax: +420 23303 1112



Address:
Siemens, s.r.o.
Sektor Healthcare
Siemensova 1
155 00 Praha 13

Siemens, s.r.o. – Managing Directors: Ing. Eduard Pališek, Ph.D., MBA, Rudolf Fischer – registered in Commercial Register of Municipal Court in Prague, Section C, File No. 625, Registered office: Siemensova 1, 155 00 Praha 13, Czech Republic
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SIEMENS

Healthcare

Siemens s.r.o., Siemensova 1, 155 00 Praha 13

CEITEC
Žerotínovo nám. 9
601 77 Brno

Jméno	Lubos Tuma
Oddelení	H IM&WS Sales
Telefon	+420233032025
Fax	
Mobil	+420603870068
E-mail	lubos.tuma@siemens.com
Váš dopis	yr
Naše značka	1-A8WMF9
Datum	17.10.2013

Quote: 1-A8WMI1-2

Předmět

MAGNETOM Prisma

Lubos Tuma

Siemens s.r.o.
Management: Ing. Eduard Palíšek, Ph.D., MBA
Sektor Healthcare
Divize Imaging & Workflow Solutions; management: Ing. Vratislav Švorčík

Siemensova 1
155 00 Praha 13
Česká republika

Tel.: +420 23303 3303
Fax: +420 23303 1112
www.siemens.cz/imws

Siemens s.r.o. - Jednatel: Ing. Eduard Palíšek, Ph.D., MBA, Dipl. Kfm. Rudolf Fischer - registrace v ob. rejstříku, vedeném Městským soudem v Praze, oddíl C, vložka 825
Sídlo: Siemensova 1, 155 00 Praha 13, Česká republika
IČ: 00268577, DIČ: CZ00268577, bankovní spojení: UniCredit Bank Czech Republic a.s., Na Příkopě 858/20, 113 80 Praha 1
Č. účtu CZK: 1013384001/2700, č. účtu EUR: 1013384394/2700

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MAGNETOM Prisma

- 1 MAGNETOM Prisma - System
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MAGNETOM Prisma
The 3T PowerPack for exploration.

MAGNETOM Prisma is the most powerful 3T system ever built. Based on the benchmark 3T magnet, it provides the highest homogeneity across the large 50 cm FOV and incorporates state-of-the-art zero helium boil-off technology. Additionally, the XR 80/200 gradient engine generates the highest performance among all commercially available 3T scanners. TimTX TrueShape provides more degrees of freedom to explore new applications. Tim 4G the coil technology with state of the art accuracy, speed and flexibility across all MR applications. Dot - reproducibility for clinical studies guarantees consistency across different images. In all, MAGNETOM Prisma is the complete package, enabling its users the power to outperform, the power to explore and the power to succeed.

The standard components are:

- Whole-body, superconductive Zero Helium Boil-Off 3T magnet
- 50cm FOV, with the industry best homogeneity
- XR 80/200 gradient system providing the highest whole-body gradient performance available
- Actively shielded gradient system with high performance water-cooling for each gradient axis
- TimTX TrueShape with syngo ZOOMit
- Tim 4G [204x64]
- DirectRF™ technology
- All-new coil architecture including Dual-Density Signal Transfer Technology
- Head/Neck 20 DirectConnect, Spine 32 DirectConnect, Body 18, Flex Large/Small 4
- High performance image reconstruction computer incorporating GPU technology
- Dot technology
- Brain Dot Engine
- Dot Display and Dot Control Centers for efficient patient preparation

Additional features include:

- Tim Application Suite
- syngo MR software
- State of the art host computer

The system (magnet, electronics and control room) can be installed in less than 33sqm space. For system cooling either the Eco Chiller options or the Separator is required.

MAGNETOM Prisma - The 3T PowerPack for exploration - integrates our most recent innovations in MRI, enabling the power to outperform, the power to explore and the power to succeed.

The system includes:

The Benchmark in 3T magnets

- Whole-body superconductive 3T magnet with active shielding (AS) technology with counter coils
- Zero Helium Boil-off Technology
- External Interference Shielding (E.I.S.)

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- Excellent homogeneity enabled magnet design which allows for a cylindrically optimized homogeneity volume resulting in higher image quality (50 × 50 × 50 cm³ DSV, typ. 1.1 ppm based on the 24-plane plot method)
- The magnet has a helium capacity of approximately 933l liters and a typical Helium boil-off rate of 0 l/yr during typical, undisturbed clinical operation depending on the sequences used and examination time, and provided the system is serviced in regular intervals.
- It has an integrated magnet cooling system.
- The combination of standard active shim with 3 linear channels (1st order) and 5 non linear channels (2nd order) and passive shim allows for maximized magnetic field homogeneity and consistently high image quality for a wide range of applications

XR Gradients: an unmatched gradient system

- Maximum amplitude of 80 mT/m and maximum slew rate of 200 T/m/s on each axis simultaneously
- Actively shielded water-cooled with dedicated cooling for each gradient axis
- All axes force compensated for lowest vibrations and acoustic performance
- Outstanding performance and stability for long duration scans

TimTX TrueShape

TimTX TrueShape is Siemens' architecture for parallel transmit (pTX) technology. TimTX TrueShape allows dynamic parallel transmission of radio frequency (RF) pulses, shaping the RF excitation field locally and thus enabling selective excitation.

It enables benefits for MR imaging and spectroscopy applications through optimized image homogeneity or efficient selective excitation.

TimTX TrueShape Applications

- *syngo* ZOOMit is the first application utilizing TimTX TrueShape. It allows "zooming into" a part of the image.
- ZOOMit realized by selective excitation, i.e. avoiding infolding artifacts in phase encoding directions, improving image quality locally with fewer distortions and speeding up acquisition time by lowering the requirements on spatial encoding.
- ZOOMit SPACE realized by inner volume excitation.

Tim 4G+Dot

Tim 4G provides increased patient comfort and optimized workflow efficiency. Only one patient setup, no repositioning, no changing of coils. Ultra-light-weighted coils with high density of coil elements for maximized patient comfort and increased SNR. Feet-first positioning for almost all examinations possible reduces anxiety and claustrophobia.

Tim 4G is 4G flexibility, accuracy and speed and brings image quality and acquisition speed to a new level.

Dot takes away the complexity in MRI scanning and provides consistent reproducible results by patient personalization, user guidance and process automation. Optimized scan strategies can be selected based on patient condition, which allows for high quality exams even when conditions change. Integrated decision points allows the user to easily add or remove one or a group of protocols with one click. Step by step real-time on board guidance guides novice users even through the most complicated exams. Process automation allows optimal timing for breathing, scanning, planning or contrast arrival. Dot can be easily customized to follow the individual standards of care.

Dot is personalized, guided and automated and designed to improve workflow efficiency and image consistency.

DirectRF - RF Transmit/Receive System:

- Fully integrated Transmit- and Receive path in the magnet housing including extremely

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- compact water-cooled solid state amplifier with 50kW peak power
- High dynamic range
- Real time feedback loop for inline sequence adaptation
- Integrated no tune transmit/receive Body Coil

The revolutionary Tim 4G technology allows connecting up to 204 coil elements simultaneously enabling higher SNR and iPAT in all directions. No repositioning of patients is needed even for large Field of View examinations.

- Dual-Density Signal transfer enables ultra-high density coil design by integrating key RF components into the local coil.

Tim 4G Coils:

The new Tim 4G coil technology with Dual-Density Signal Transfer, DirectConnect and SlideConnect technology combines key imaging benefits:

Excellent image quality, high patient comfort, and unmatched flexibility

The Tim 4G coils are designed for highest image quality combined with easy handling. The high element density of the coils increases SNR and reduces examination times. DirectConnect and SlideConnect™ technology reduce patient set up time significantly. The coils are designed with the patient in mind. Light weight coils with an open design ensure highest patient comfort resulting in better patient cooperation and image quality. No coil changing with multi-exam studies saves patient setup- and table time.

AutoCoilSelect for dynamic, automatic, or interactive selection of the coil elements within the Field of View fastens the exam preparation at the host.

All coils are time-saving "no-tune" coils.

A comprehensive set of pads for comfortable and stable patient positioning together with safety straps are included.

- Head/Neck 20

The 20-channel coil with its 20 integrated pre-amplifiers ensures excellent signal-to-noise ratio. The unique DirectConnect technology allows users connecting the 20 coil elements of the Head/Neck 20 without cables. The patient friendly open design allows for maximum patient comfort which is supported in addition by a look-out mirror for claustrophobic patients. The high channel coil is iPAT compatible in all directions.

The open and light design of the upper coil part increases patient comfort and is removable for easy patient handling. The lower coil part may remain on the table for most of the examinations can be used without the upper part. The Head/Neck 20 and Spine 32 are smoothly integrated into the patient table, thus enabling high flexibility in imaging and fewer coil changes and easy handling when switching patients. The Head /Neck 20 coil is equipped with two removable cushioned head stabilizers for stable and comfortable patient positioning.

The Head/ Neck 20 can be used for applications like head examinations, neck examinations, MR Angiography, combined head/neck examinations or for imaging of the TMJ (temporomandibular joints).

Typically combined with the Spine 32 and Body 18 or Peripheral Angio 36 but also other combinations eg with flexible coils like the Flex Large 4 are possible.

- Body 18

The 18-channel coil with its 18 integrated pre-amplifiers ensures maximum signal-to-noise ratio. The 18 coil elements of the Body 18 with only one SlideConect Plug allows for fast and easy patient preparation resulting in less table time. Fast acquisition times enabled by iPAT in

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all directions. The light-weighted coil ensures highest patient comfort.

Body 18 operates in an integrated fashion with the Spine 32 as an 30 channel body coil

Body 18 can be combined with further Body 18 coils for larger coverage and positioned in different orientations (0°, 90°, 180°, 270°) for patient specific adaptations

The Body 18 is typically used in combination with the Spine 32 for examinations of the thorax, abdomen, pelvis or hip and operates as a 30 channel body coil (3 rings 10 elements). The Body 18 can also be used for cardiac or vascular applications. Through its perfect combinability with the Spine 32, further Body 18 (optional), the Peripheral Angio 36 (optional), but also the Head/Neck 20 and all flexible coils (e.g. Flex Large 4, Flex Small 4) it contributes for a broad range of indications up to whole-body imaging.

- Spine 32
The 32-channel coil with its 32 integrated pre-amplifiers ensures maximum signal-to-noise ratio. The unique DirectConnect technology allows connecting the 32 coil elements of the Spine 32 without the need to plug in any cable. The patient friendly ergonomical design allows for maximum patient comfort. The high element coil is iPAT compatible in all directions.

Smoothly integrated into the patient table the Spine 32 may remain on the patient table for nearly all exams.

The Spine 32 is typically combined with Body 18, Head/Neck 20, Peripheral Angio 36 or Flex Large 4, Flex Small 4.

- Flex Large 4/ Flex Small 4
Light-weighted, very flexible, iPAT compatible, 4-element no-tune receiver coils which are made of soft and smooth material. The coils can be wrapped around or used flat.

Both coils can be connected via Flex Coil interface. One Flex Coil interface is already delivered as standard.

The coils can be used for different examinations ranging from examinations of the extremities to abdominal examinations.

Tim Table

- The maximum scan range of the Tim Table is 280 cm.
- The maximum patient weight of 250 kg (550 lbs) is valid for horizontal and vertical movements, which ensures maximized patient comfort for obese patients.
- The patient table can be lowered to a minimum height of 64 cm from the floor, for easier patient positioning and better accessibility for geriatric, pediatric or immobile patients. An infusion stand is integrated to ensure fast patient set up also for critical patients.
- Multiple Tim4G coils can be connected at once for efficient and patient friendly examinations.
- The Tim Table can be moved with two clicks into the isocenter - one click to the upmost position and one click into the isocenter.

Dot (Day Optimizing Throughput) Engine

Dot multiplies the power of Tim resulting in greater image consistency and diagnostic confidence

Dot Control Centers and Dot Display

- The ergonomically designed Dot Control Centers are integrated left and right into the front covers for controlling table movement and interaction with the Dot Display. The Dot Control

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- Centers are well illuminated for easy visual recognition.
- Automated table move up to upmost position, to center position or Home position facilitate smooth patient preparation and will reduce table time
 - Variable (6 levels) ventilation and lighting inside the magnet bore or volume adjustments are possible for increased patient comfort
 - The Dot Display provides on board guidance for patient set up where it's needed - directly at the scanner. Information such as Patient name or exam type or required patient position, guidance for ECG set up and immediate visualization of physiological curves will be provided for convenient operation.
 - Almost all table control functions, including ventilation and illumination of the magnet bore, can be also controlled from the operator console for convenient operation.

Dot Technology

Dot makes it easy to get the best possible results for virtually any type of patient. Dot gives uniquely tailored, optimized scans configurable to patient condition or clinical question. Dot provides patient personalization, user guidance and process automation and is of course configurable by the user to adapt to the different clinical needs and standards of care.

Brain Dot Engine

The Brain Dot Engine simplifies general brain examinations with guided and automated workflows customized to the site specific standards of care. The Brain Dot Engine supports the user in achieving reproducible image quality with increased ease of use and time efficient exams. The brain workflow can be personalized to the individual patient condition and clinical need. Several predefined strategies are included, which can be easily selected with one click. They can be changed at any time during the brain workflow Protocols tailored for use of contrast media are integrated.

- Standard: Standard examination with 2D protocols
- Resolution focus: Examination with 3D protocols (with e.g. SPACE) for detailed views
- Speed focus: Examination with fast 2D protocols (with e.g. HASTE) for further speeding up the exam
- Limited patient capabilities: Examination with *syngo* BLADE protocols
- to minimize and correct or the effects of motion automatically

Step-by-step user guidance is seamlessly integrated. Example images and guidance text are displayed for each individual step of the scanning workflow. Both - images and text - are easily configurable by the user.

Easy positioning of the patient with AutoPosition. The patient is automatically placed at the isocenter without any laser marking required.

AutoAlign Head allows automatically slice positioning and aligns on the anatomically derived sagittal, coronal, and axial slices of the localizer. The operator-free alignment and anatomical marking are consistent, independently of patient age, head position, or disease.

Automatic real-time calculation of trace-weighted images and ADC maps with Inline DiffusionTechnology.

Easy rerun or repeat with functionality allows for reduced table time even in case of patients with pain or claustrophobia. An image inside the examination UI can be selected and a rerun of the corresponding series can be triggered with identical sequences or parameters. Alternatively an exam can be repeated with a changed strategy.

The Brain Dot Engine as all Dot Engines can be modified by the user to their individual standard of

care.

Tim Application Suite

The Tim Application Suite offers a complete range of clinically optimized sequences, protocols and workflow functionalities for all body regions. Excellent head-to-toe imaging can be accomplished with the sequences and features included in this application suite. To enable this comprehensive application range, ten dedicated application packages have been included.

- *syngo* TimCT FastView
- Neuro Suite
- Angio Suite
- Cardiac Suite
- Body Suite
- Onco Suite
- Breast Suite
- Ortho Suite
- Pediatric Suite
- Scientific Suite
- Whole Body Suite

***syngo* TimCT FastView**

syngo TimCT FastView is a "one go" localizer for the whole body or large body regions such as the whole spine or the whole abdomen. It acquires the complete extended Field of View in one volume with isotropic resolution. Transversal, coronal and sagittal reformats of the volume are calculated inline and displayed for planning subsequent exams. Moreover, while planning is underway, adjustments are acquired automatically for further time savings in subsequent measurements. *syngo* TimCT FastView runs without laser light positioning to further streamline the workflow for several indications.

Neuro Suite

Comprehensive head and spine examinations can be performed with dedicated programs. High resolution protocols and fast protocols for uncooperative patients are provided. The Neuro Suite also includes protocols for diffusion imaging, perfusion imaging, and fMRI. It includes for example:

- EPI sequences and protocols for diffusion, perfusion and fMRI for advanced neurological applications.
Diffusion weighted imaging is possible with up to 16 b-values in the orthogonal directions
Dynamic Analysis software (included in standard configuration) enables calculation of:
 - ADC maps
 - t-test maps from the EPI images for fMRI
 - Time-to-Peak maps for perfusion analysis.
- Whole spine protocols acquire in multiple steps via software controlled table movement in a single click.
- 3D isotropic resolution volume imaging using T1 3D MPRAGE / 3D FLASH, SPACE DarkFluid, T2 SPACE and 3D TSE
- T2-weighted high resolution 3D Restore protocols optimized for inner ear examinations
- Whole-spine protocols in multiple steps with software controlled table movement
- 2D and 3D MEDIC protocols for T2-weighted imaging, particularly for C-spine examinations in axial orientation where reproducibility is difficult due to CSF pulsations and blood flow artifacts
- 3D Myelograms with 3D HASTE and 3D True-FISP for anatomical details
- Dynamic sacro-iliac joint imaging after contrast administration using a fast T1-weighted FLASH 2D sequence
- Spine diffusion protocols to differentiate osteoporosis versus tumor infiltration and post-radiotherapy changes versus residual tumor with PSIF sequence

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- Precision filter for high spatial accuracy e.g. for neuro intra-operative imaging and stereotactic planning
- 3D CISS (Constructive Interference in Steady State) for excellent visualization of fine structures such as cranial nerves. High resolution imaging of inner ear and spine
- AutoAlign Head LS providing a fast, easy, standardized, and reproducible patient scanning supporting reading by delivering a higher and more standardized image quality

Angio Suite

Excellent MR Angiography can be performed to visualize arteries and veins with or without contrast agent.

Contrast-enhanced MRA

- 3D contrast-enhanced MRA protocols for e.g. single step, dynamic, peripheral, whole body MRA with the shortest TR and TE. The strong gradients make it possible to separate the arterial phase from the venous phase.
- TestBolus workflow for optimized bolus timing and superb image quality.
- CareBolus functionality for accurate determination of the bolus arrival time and the "Stop and Continue" of the 3D ce-MRA protocol after the 2D bolus control scan.
- Dynamic ce-MRA for 3D imaging over time.

Non-contrast-MRA and venography

- 2D and 3D Time-of-Flight (ToF) protocols for MRA for the Circle of Willis, carotids, neck vessels, and breath-hold protocols for abdominal vessels
- Triggered 2D ToF sequences for non-contrast MRA, particularly of the abdomen and the extremities
- 2D/3D Phase-Contrast
- MR venography with 2D/3D Time-of-Flight (ToF) and Phase-Contrast
- TONE (Tilted Optimized Non-saturation Excitation) and MTC (Magnetization Transfer Contrast) techniques for improved Contrast-to-Noise Ratio (CNR)

Image processing tools

- MPR, MIP, MinIP, and 3D SSD
- Inline MIP for immediate results
- Inline subtraction of pre- and post-contrast measurements
- Inline standard deviation maps of Phase-Contrast measurements for delineation of arteries and veins

Cardiac Suite

The cardiac suite covers comprehensive 2D routine cardiac applications, ranging from morphology and ventricular function to tissue characterization. Featuring *syngo* BEAT 2D in conjunction with iPAT and T-PAT techniques.

Cardiac views

- Fast acquisition of the basic cardiac orientations for further examination planning
- Cardiac scouting provides users with a step-by-step procedure for the visualization and planning of typical cardiac views, e.g. based on TrueFISP or Dark Blood TurboFLASH: short axis, 4-chamber and 2-chamber views.

syngo BEAT

- Unique tool for fast and easy cardiovascular MR imaging
- E.g. 1 click change from FLASH to TrueFISP for easy contrast optimization
- 1-click to switch arrhythmia rejection on / off
- 1-click change from Cartesian to radial sampling to increase effective image resolution (e.g. in pediatric patients) and avoid folding artifacts in large patients

Visualization of structural cardiovascular pathologies with CMR - syngo BEAT

- Breath-hold and free breathing techniques for strong contrast between the blood and vascular structures. Dark Blood TSE and HASTE imaging are available for the structural evaluation of the cardiothoracic anatomy, including vessels or heart valves. Cine techniques (FLASH &

- TrueFISP) for high-resolution valve evaluation
- Multiple contrasts such as T1- and T2-weighted imaging for use in diseases such as myocarditis (inflammation / hyperaemia), ARVD (fibrous-fatty degeneration) or acute myocardial infarction (edema)
- Dark-blood TSE with motion compensation for high-quality vessel wall imaging in small or large vessels

Tools for rapid evaluation of left or right ventricular function

- Acquisition of a stack of short-axis slices (standard segmented FLASH, or advanced segmented TrueFISP)
- Automatic adjustment of the acquisition window to the current heart rate
- Use of the Inline ECG for graphical ECG triggering setup
- Retrospective gating with cine sequences (TrueFISP, FLASH)
- Protocols for whole-heart coverage
- iPAT integration for highest temporal and spatial resolution
- Real-time imaging in case the patient is not able to hold his breath

Dynamic imaging and tissue characterization with syngo BEAT

- Protocols for high-contrast and high-resolution tissue characterization
- Protocols for stress and rest imaging with TrueFISP or TurboFLASH contrast support the acquisition of multiple slices with high resolution and arbitrarily adjustable slice orientation for each slice
- T-PAT with mSENSE and GRAPPA for advanced parallel imaging provides fast high-resolution dynamic imaging
- Segmented IR TrueFISP / FLASH with TI scout for optimization of tissue contrast
- Advanced tissue characterization with 2D phase-sensitive IR (PSIR) sequences TrueFISP and FLASH contrast. Magnitude and phase-sensitive images with one acquisition
- Simple: no adjustment of inversion time (TI) necessary with PSIR technique
- Ungated single-shot PSIR imaging for tissue characterization under difficult conditions: free-breathing technique that can be applied even in case of arrhythmia

Physiological Measurement Unit (PMU) - Wireless Physio Control

- Synchronizes the measurement with the physiological cycles (triggering to minimize motion artifacts caused by cardiac and respiratory movements)
- Wireless Sensors
- Wireless Vector ECG / respiration and pulse sensors for physiologically synchronized imaging, rechargeable battery-powered - for optimized patient handling
- Physiological Signals Display
- ECG (3 channels)
- Pulse
- Respiration
- External Trigger Input Display

ECG Triggering:

- Acquisition of multiple slices, e.g. of the heart, at different phases of the cardiac cycle
- Excellent image quality by synchronizing data acquisition with cardiac motion
- Peripheral Pulse Triggering: Reduces flow artifacts caused by pulsatile blood flow
- Excellent image quality by synchronizing data acquisition to the pulsatile blood flow
- Respiratory Triggering: Excellent image quality by synchronizing data acquisition with the respiratory motion
- External Triggering: Interface for trigger input from external sources (e.g. Patient Monitoring System) inside the examination room
- Interface for trigger input from external sources (e.g. pulse generator, trigger sources for fMRI) outside the examination room
- Optical trigger output for fMRI

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- Retrospective gating for ECG, peripheral pulse, and external trigger input

Breast Suite

MR imaging has proven a very high sensitivity for breast lesions and is the gold standard for the examination of silicone implants. Extremely high spatial and temporal resolution can be achieved in very short measuring times by using iPAT with GRAPPA.

Excellent soft tissue differentiation, customized protocols (e.g. with fat saturation or water excitation or silicone excitation), as well as flexible multiplanar visualization allow for fast, simple and reproducible evaluation of MR breast examinations.

This package includes:

- Quantitative evaluation and fast analysis of the data with colorized Wash-in, Wash-out, Time-To-Peak, Positive-Enhancement-Integral, MIPTIME and combination maps with Inline technology or for offline calculation
- High-resolution 2D protocols for morphology evaluation
- High-resolution 3D protocols covering both breasts simultaneously
- Protocols to support interventions (fine needle and vacuum biopsies, wire localization)
- Protocols for evaluating breasts with silicone implants
- Automatic and manual frequency adjustment, taking into account the silicone signal
- Detection of the silicone signal either to suppress the silicone signal, if the surrounding tissue is to be evaluated, or to suppress the tissue signal in order to detect an implant leakage
- SPAIR - robust fat sat (robust fat suppression using an adiabatic frequency selective inversion pulse)
- DIXON - 2-point Dixon with 3D VIBE, the following contrasts can be obtained: in-phase, opposed phase, fat and water image.
- iPAT with GRAPPA for maximum resolution in short time
- Inline subtraction and MIP display
- Offline subtraction, MPR and MIP display
- *syngo* REVEAL: diffusion imaging for breast exams
- iPAT Extension that allows state-of-the-art sagittal breast imaging
- iPAT Extension allows bilateral 3D sagittal breast imaging with Fat Sat or Water excitation

The Breast Suite also includes:

***syngo* VIEWS (Volume Imaging with Enhanced Water Signal)**

- bilateral - both breasts are examined simultaneously
- axial - the milk ducts are directly displayed
- fat-saturated or water-excited - fat complicates clinical evaluation and is suppressed
- near-isotropic 3D measurement - the same voxel size in all three directions for reconstruction in any slice direction
- submillimeter voxel - highest resolution for precise evaluation

Body Suite

Body Suite covers your needs for clinical body applications. Ultrafast high resolution 2D and 3D protocols are provided for abdomen, pelvis, MR Colonography, MRCP, dynamic kidney, and MR Urography applications. Siemens unique 2D PACE technique makes body imaging easy allowing for multi-breath hold examinations as well as free breathing during the scans. Motion artifacts are greatly reduced with 2D PACE Inline technology.

This package includes:

- Free breathing 2D PACE applications with 2D/3D HASTE (RESTORE) and 2D/3D TSE (RESTORE)
- Optimized fast single shot HASTE protocols and high-resolution 3D RESTORE protocols based on SPACE and TSE for MRCP and MR Urography examinations

ABDOMEN:

2D:

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- T1w (FLASH) breath-hold scans +/- Fat Sat (SPAIR, Q-FatSat, in-/opp-phase)
- T2w (HASTE, TSE/BLADE, EPI) breath-hold scans +/- Fat Sat (SPAIR, FatSat, STIR)
- T1w (TFL) triggered scans (2D PACE free breathing) in-/opp-phase
- T2w (HASTE, TSE/BLADE, EPI) triggered scans (2D PACE free breathing) +/- Fat Sat (SPAIR, FatSat, STIR) as well as HASTE- and TSE-multi-echo
- Optimized fast single shot HASTE protocols and high-resolution 3D RESTORE protocols based on SPACE and TSE for MRCP and MR urography examinations

3D:

- Dixon (VIBE 2pt-Dixon) breath-hold scans, following contrasts can be obtained: in-phase, opposed phase, fat and water image.
- Dynamic (VIBE + Q-FatSat) protocols for best visualization of focal lesions with high spatial and temporal resolution
- Colonography dark lumen with T1-weighted VIBE
- CAIPIRINHA enables VIBE sequence with improved iPAT2 algorithm to improved abdominal dynamic scans as well as SNR. Reduced patient stress can be achieved through reduced acquisition (and breathhold) times.

PELVIS:

- High-resolution T1w, T2w pelvic imaging (prostate, cervix)
- Isotropic T2w SPACE 3D protocols for tumor search in the pelvis
- Dynamic volume examinations with 3D VIBE
- *syngo* REVEAL: diffusion imaging for liver and whole body exams

Onco Suite

MR imaging has an excellent advantage of soft tissue contrast, multi-planar capabilities and the possibility of selectively suppressing specific tissue e.g. fat or water. This helps visualize pathologies, particularly metastases. The Onco Suite features a collection of sequences as well as protocols and evaluation tools that guide through a detailed screening of clinical indications, such as in hepatic neoplasms.

This package includes:

- STIR TSE and HASTE, FLASH in-phase and opposed-phase protocols with a high sensitivity to metastases visualization
- Dynamic imaging protocols for assessment of the kinetic behavior for lesion visualization and characterization
- Quantitative evaluation and fast analysis of the data with colorized Wash-in, Wash-out, Time-To-Peak, Positive-Enhancement-Integral, MIPTIME and combination maps with Inline technology or for offline calculation
- Display and analysis of the temporal behavior in selected regions of interest with the included MeanCurve postprocessing application. This includes the capability of using additional datasets as a guide for defining regions of interest even faster and easier than before.
- *syngo* REVEAL: diffusion imaging for liver and whole body exams

Dedicated prostate protocols for detection, localization, and staging of tumors and recurrences

- *syngo* REVEAL (diffusion-weighted imaging)
- Protocols with high temporal resolution allow time course evaluation based on pharmacokinetic modeling

Ortho Suite

Ortho Suite is a comprehensive collection of protocols for joint and spine imaging. MR imaging is especially suitable for avascular necrosis and internal derangements. The protocols included in this Suite can also be applied for imaging of tumors and infections.

This package includes:

- 2D TSE protocols for PD, T1 and T2-weighted contrast with high in-plane resolution and thin

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slices

- 3D MEDIC, 3D TrueFISP protocols with water excitation for T2-weighted imaging with high in-plane resolution and thin slices
- High resolution 3D VIBE protocol for MR arthrography (knee, shoulder and hip)
- 3D MEDIC, 3D TrueFISP, 3D VIBE protocols with water excitation having high isotropic resolution, optimized for 3D post-processing
- PD SPACE with fat saturation and T2 SPACE with high isotropic resolution optimized for 3D post-processing
- Whole spine single-step or multi-step protocols
- Excellent fat suppression in off-center positions, e.g. in the shoulder due to high magnet homogeneity
- Dynamic TMJ and ilio-sacral joint protocol
- Susceptibility-insensitive protocols for imaging in the presence of a prosthesis
- Multi-Echo SE sequence with up to 32 echoes for the calculation of T2 time maps (calculation included in the Scientific Suite)
- High resolution 3D DESS (Double Echo Steady State): T2 / T1-weighted imaging for excellent fluid-cartilage differentiation

syngo WARP Susceptibility Artifact Reduction

- 2D TSE sequences with high bandwidth protocols tailored to reduce susceptibility artifacts. Available protocols include T1-weighted, T2-weighted, proton density and STIR contrast.

Pediatric Suite

The parameters for pediatric imaging vary significantly in comparison to the parameters for adults. The reasons are developing tissues, body size, faster heart rates and restricted compliance with breath-hold commands. Protocols can be adapted for imaging infants.

Scientific Suite

Scientific Suite supports the scientifically oriented user with an easy access to application-specific data for further processing and advanced image computation methods.

- Support of USB memory sticks
- Access to the file system by means of a secure and convenient browser
- Anonymization of patient data
- Easy generation of AVIs and screenshots for integration into presentations and training videos
- Export function for tables, statistics and signal-time-courses in a communal format (MeanCurve, Spectroscopy, DTI evaluation)
- Advanced image computation methods such as T2 and T1 time calculation, addition, subtraction, multiplication, division, and integration of images

Whole Body Suite

Tim and the Tim Whole Body Suite enable for true whole body MR scanning for head-to-toe imaging. Whole body imaging with highest image quality without patient repositioning and without the need to change a single coil, not even once, this means whole body imaging without compromise.

- The all-new Tim Table or Tim Dockable Table enable a full Field-of-View with coverage up to 280 cm (6' 9"). The table top has the same length as the standard system without whole body capabilities. Additional free space is required at the rear part of the magnet to ensure, that the table movement is not limited by the rear wall.
- Table movement to its full extent can be remotely controlled from the operator console either by the operator or by sequence protocols.
- Protocols and programs for whole body MR angiography and morphology e.g. for metastasis visualization and preventive care examinations.
- Whole body MR Angiography is possible with high speed, high resolution and high image

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- contrast on the entire volume combining high speed gradients and iPAT.
- The large FoV of 205 cm supports the assessment of metastases distribution in the body with sequences such as TIRM (Turbo Inversion Recovery).

The sequences, features and techniques for acquisition and reconstruction included in the Tim Application Suite are described in detail below.

Sequences

Spin Echo family of sequences:

- Spin Echo (SE) - Single, Double, and Multi Echo (up to 32 echoes); Inversion Recovery (IR)
- 2D / 3D Turbo Spin Echo (TSE) - Restore technique for shorter TR times while maintaining excellent T2 contrast; TurboIR: Inversion Recovery for STIR, DarkFluid T1 and T2, TrueIR; Echo Sharing for dual-contrast TSE
- 2D / 3D HASTE (Half-Fourier Acquisition with Single Shot Turbo Spin Echo) - Inversion Recovery for STIR and DarkFluid contrast
- SPACE for 3D imaging with high isotropic resolution with T1, T2, PD, and DarkFluid Contrast

Gradient Echo family of sequences:

- 2D / 3D FLASH (spoiled GRE) - dual echo for in- / opposed phase imaging 3D VIBE (Volume Interpolated Breathhold Examination) - quick fat saturation; double echo for in-phase / opposed phase 3D imaging; DynaVIBE: Inline 3D elastic motion correction for multi phase data sets of the abdomen; Inline Breast Evaluation
- 2D / 3D MEDIC (Multi Echo Data Image Combination) for high resolution T2 weighted orthopedic imaging and excellent contrast
- 2D / 3D TurboFLASH - 3D MPRAGE; single shot T1 weighted imaging e.g. for abdominal imaging during free breathing
- 3D GRE for field mapping
- 2D / 3D FISP (Fast Imaging with Steady State Precession)
- 2D / 3D PSIF - PSIF Diffusion
- Echo Planar Imaging (EPI) - diffusion-weighted; single shot SE and FID e.g. for BOLD imaging and Perfusion-weighted imaging; 2D / 3D Segmented EPI (SE and FID)
- ce-MRA sequence with Inline subtraction and Inline MIP
- 2D / 3D Time-of-Flight (ToF) Angiography - single slab and multi slab; triggered and segmented
- 2D / 3D Phase Contrast Angiography •
- syngo BEAT Tool - TrueFISP segmented; 2D FLASH segmented;
- Magnetization-prepared TrueFISP (IR, SR, FS); IR TI scout; Retrogating

Standard Fat/Water Imaging:

- Fat and Water Saturation. Additional frequency selective RF pulses used to suppress bright signal from fatty tissue. Two selectable modes: weak, strong
- Quick FatSat
- SPAIR: robust fat suppression for body imaging using a frequency selective inversion pulse
- Fat / Water Excitation. Spectral selective RF pulses for exclusive fat / water excitation
- Dixon technique for fat and water separation - available both based on VIBE (2 point Dixon)

Standard Techniques:

- True Inversion Recovery to obtain strong T1-weighted contrast
- Dark Blood inversion recovery technique that nulls fluid blood signal
- Saturation Recovery for 2D TurboFLASH, gradient echo, and T1-weighted 3D TurboFLASH with short scan time (e.g. MPRAGE)
- Freely adjustable receiver bandwidth, permitting studies with increased signal-to-noise ratio
- Freely adjustable flip angle. Optimized RF pulses for image contrast enhancement and

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- increased signal-to-noise ratio
- MTC (Magnetization Transfer Contrast). Off-resonance RF pulses to suppress signal from certain tissues, thus enhancing the contrast. Used e.g. in MRA
- Argus viewer for reviewing cine studies
- Report Viewer for DICOM structured reports including report editing
- Dynamic Analysis for addition, subtraction, division, standard deviation, calculations of ADC maps, T1 and T2 values, TTP, t-Test, etc.
- Image Filter
- 3D post-processing MPR, MIP, MinIP, SSD
- Flexible film formats and paper print
- Data storage of images and cine AVI files on CD / DVD with DICOM viewer as the viewing tool for hand out to the patients or referrals
- Selectable centric elliptical phase reordering via the user interface
- Inversion Recovery to nullify the signal of fat, fluid or any other tissue
- Multiple Direction Diffusion Weighting (MDDW) - perform diffusion tensor imaging with multiple diffusion weightings and up to 12 directions for generating data sets.

Standard techniques for Flow Artifact reductions:

- LOTA (LongTerm Data Averaging) technique to reduce motion and flow artifacts
- Pre-saturation techniques using RF saturation pulses to suppress flow and motion artifacts
- Tracking SAT bands maintain constant saturation of venous and/or arterial blood flow eg. for 2D/3D sequential MRA
- TONE (Tilted Optimized Non-saturating Excitation - variable excitation flip angle to compensate inflow saturation effects in 3D MRA - selectable on desired flow direction and speed
- Gradient Motion rephasing permitting effective reduction of flow artifacts

Standard Motion Correction:

- *syngo* BLADE - improves image quality by minimizing and correcting for the effects of motion during an MR sequence acquisition. e.g. head, spine, orthopedic imaging and the abdomen
- 1D PACE (Prospective Acquisition CorrEction) allows examination of patients with free breathing
- 2D PACE (Precise Motion Correction) detects and corrects respiratory motion eg of the heart or liver

MAGNETOM Prisma runs *syngo* MR software. *syngo*® is the unique software platform for medical applications. Parallel working and one-click exams are efficiently supported and increase productivity. Parallel scanning and reconstruction are standard.

The unique Phoenix technique is the easiest way to exchange protocol data. It supports intelligent extraction of sequence parameters from images acquired on a MAGNETOM Prisma system. Inline technologies, *scan@center* or *AutoVoiceCommands* speed up the workflow further.

The context-sensitive "Online Help" function and *syngo* Scan Assistant offer support and propose solutions to MR-specific questions and parameter conflicts.

Studies can be easily networked and managed using the standard DICOM 3.0 protocol for efficient support of workflow. The following standard functions are supported: Send/Receive, Query/Retrieve, Basic Print for DICOM-compatible laser cameras (Camera is not included in the basic unit. Verify if existing camera is compatible or order separately.), DICOM Worklist, DICOM Storage Commitment (SC) DICOM Modality Perform Procedure Step (MPPS), DICOM Structured Report (SR), DICOM Study Split

Patient Communication

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- The intercom system includes an ergonomically designed patient communication unit for desktop positioning on the *syngo* Acquisition Workplace and pneumatic headphones for the patient.
- Active Noise Cancellation allows for increased user comfort in the control room combined with comprehensive patient supervision.
- Control features include an emergency table stop, volume control of speaker and headphones in the examination room, volume control of speaker in the control room, response to the patient's activation of the assistance-call button and provides a connection to an external audio system for music playback (external audio system is not included in the basic unit) .

Computer system

The high performance host computer and the new high performance measurement and reconstruction system are ideally suited for even the most demanding applications. The PC-based computer system uses the intuitive *syngo* MR user interface. The computer system includes the following components:

High-performance measurement and reconstruction system

- Two Intel Quadcore Processors \geq E 5690
- Clock rate of $\geq 2 \times 3.46$ GHz
- Main memory (RAM) ≥ 128 GB,
- Hard disk for raw data ≥ 750 GB
- Hard disk for system software ≥ 100 GB
- Parallel Scanning and Reconstruction of up to 8 data sets

GPU driven image reconstruction system with 2x Tesla C2075 GPGPU:

- Single Precision Performance: 515 GFLOPS
- Double Precision Performance: 1030 GFLOPS
- Memory Bandwidth: 148 GB/s
- Memory size: 6 GB GDDR5
- CUDA Cores: 448

- Reconstruction speed
 - 20,761 recons per second (256 x 256 FFT, full FoV)
 - 100,000 recons per second (256 x 256 FFT, 25 % recFoV)

High-performance host computer

- Intel Xeon processor \geq W3520 QuadCore
- clock rate ≥ 2.66 GHz
- Main Memory (RAM) ≥ 6 GB
- three hard disks
 - system SW ≥ 300 GB SAS
 - data base ≥ 300 GB SAS
 - images ≥ 300 GB SAS
- DVD-R writer for CD-R (approx. 4000 images 256² DICOM Standard, ISO 9660) and DVD-R (approx. 25 000 images 256² DICOM Standard, ISO 9660) storage of DICOM data or other data like AVI files
 - DVD-ROM drive
 - Mouse.

- The combination of host computer and the measurement and reconstruction system offers a truly powerful imaging system designed for large image matrix sizes of up to 1024 x 1024. The unrestricted multitasking capability allows time-saving parallel scanning and reconstruction.
- High-resolution 19" color LCD flatscreen monitor with 1280 x 1024 pixel display, integrated gamma correction for optimum display of radiographic grayscale images and automatic backlight

control for longterm brightness stability.

Installation:

- The compact integrated design allows for short installation times and reduces the required space to less than 33 sqm (334 sq. ft.) for the entire installation. The necessary room height clearance is 273 cm.
- MAGNETOM Prisma allows siting of the system without a dedicated computer room - no additional cooling or floor requirements.
- MAGNETOM Prisma combines state-of-the-art performance with peace of mind. High system availability is ensured by the expert, highly trained Siemens MR service engineers;
- Your Siemens service contract (not included in the basic unit) offers a comprehensive range of benefits such as Uptime Remote Diagnostics for improved productivity and maximum uptime.

2 Tim [204x64] XR Gradients #P 14432224

Tim [204x64] XR gradients performance level

Tim 4G's RF system and innovative coil architecture enables high resolution imaging and increased throughput. Up to 204 simultaneously connected coil elements allow in combination with the fully integrated 64 independent RF channels for the most flexible parallel imaging and support the most demanding applications. Maximum SNR is ensured through the new Tim 4G matrix coil technology.

XR gradients

The XR 80/200 gradients are the most powerful commercially available gradients of any clinical scanner currently on the market. The XR gradients combine a maximum gradient amplitude of 80 mT/m with a 200 T/m/s slew rate, capable of driving higher SNR throughout all regions of the body. Even under the highest stress conditions, the XR gradients bring the best performance thanks to a rock-solid design. Dedicated force compensation on each axis yields low vibrations and low acoustic noise while the high-performance cooling for each individual axis allows full duty cycle over long-term measurements with outstanding stability. The XR 80/200 gradients push the limits of performance to a new level.

Tim 4G offers DirectRF - a completely redesigned RF architecture. This new all digital-in/ digital-out design integrates all RF transmit and receive components at the magnet, eliminating analog cables for true signal purity. This compact and efficient design enables an dynamic feedback control for temporal stability and power linearity.

The all-new innovative coil architecture packs more coil elements in a smaller space and allows for simultaneous connection of up to 204 coil elements. Combined with the 64 independent RF channels advanced iPAT capabilities and SNR are enabled.

An additional benefit of multiple coil elements and receiver channels is improved performance in multi-directional, i.e. three dimensional, high-speed, high-resolution iPAT in the head-feet, anterior-posterior or left-right directions.

XR gradients

Siemens XQ gradients provide actively shielded, water cooled worldclass gradients. All axes are force-compensated.

The XR gradients have:

- Maximum gradient amplitude of 80 mT/m, per axis, i.e. 139 mT/m vector summation gradient performance,
- Maximum slew rate 200 T/m/s per axis, i.e. 346 T/m/s vector summation,
- Minimal rise time 400 μ s, from 0 to 80 mT/m amplitude
- Maximum output voltage for each of the gradient axes 2250 V

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- Maximum output current for each of the gradient axes 900 A
- Separate cooling channels that simultaneously cool primary and secondary coils allow the application of extremely gradient intensive techniques in a new class of performance.
- 100% duty cycle for fast and demanding techniques such as ultra-short TE MRA in continuous operation, thin slice single
- breath-hold liver studies and EPI imaging techniques (all optional in appropriate clinical packages).
- Variable Field-of-View selection from 0.5 cm to 50 cm for optimal coverage and highest spatial resolution in diagnostic. The minimum slice thickness in 2D and 3D is 0.1 mm and 0.05 mm, respectively.
- Acquisition of sagittal, transverse, coronal, single oblique and double oblique slices with highest resolution.
- The extremely compact water-cooled gradient amplifier features a modular expandable design with excellent linearity and pulse reproducibility. It is digitally controlled and has very low switching losses due to ultrafast solid state technology.

- 3 PC Keyboard US English #Tim
08464872
Standard PC keyboard with 101 keys.

The keys of the numerical key panel are assigned to syngo-specific functions and labeled with the corresponding syngo icons. The keyboard supports the country specific special characters.

- 4 Tim Table #P
14432226

The new Tim Table is designed for maximized patient comfort and smooth patient preparation. The unique design of the Tim Table can support up to 250 kg (550 lbs) patients without restricting the vertical or horizontal movement.

The new MAGNETOM Prisma table with its light appealing design allows for a fast patient preparation and maximized patient comfort.

It provides unobstructed foot space for attending staff and direct access to the patient. The patient table can be lowered to a minimum height of 64 cm from the floor, for easier patient positioning and better accessibility for geriatric, pediatric or immobile patients. The Tim Table can be moved with two clicks into the isocenter - one click to the upmost position and one click into the isocenter. The tabletop travels beyond the rear end of the system, enabling additional patient access. An infusion stand is integrated to allow for fast patient set up of critical patients.

Multiple Tim 4G coils can be connected at once for efficient and patient friendly examinations. The seamless integration of multiple Tim 4G coils is possible via 4 SlideConnect and 4 DirectConnect connector slots, which are embedded in the table. This allows for comprehensive examinations without the need of repositioning.

- 5 Flow Quantification #Tim
08464740
Special sequences for quantitative assessment of flow.

Flow Quantification enables the acquisition of flow encoded images and the evaluation of blood as well as of cerebro-spinal fluid (CSF).

Sequences include:

- ECG triggered 2D phase contrast with iPAT support
- Retrospective reconstruction algorithms for full R-R interval coverage

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- Maxwell Term Compensation

**6 Neuro Perfusion Package #T+D
14416946**

The Neuro Perfusions Package helps to streamline the clinical workflow by inline post-processing in dynamic susceptibility contrast (DSC) based perfusion imaging. This makes it possible to see perfusion maps immediately.

Perfusion parameter maps are based on a Local Arterial Input function. A corrected relCBV map calculation and motion correction is provided.

Neuro Perfusion Package provides a modified sequence and image reconstruction for motion correction and post-processing in dynamic susceptibility contrast (DSC) based perfusion imaging. Depending on whether motion correction is switched on, the following uncorrected or motion corrected perfusion maps can be calculated: time-to-peak (TTP), relative cerebral blood volume (relCBV), relative cerebral blood flow (relCBF), relative mean transit time (MTT), relative corrected cerebral blood volume (relCCBV) and bolus plots.

Perfusion parameter maps are calculated based on a Local Arterial Input Function. The algorithm selects many AIFs per slice and volume based on a number of built-in criteria. This removes the need for manual selection of AIF voxels to calculate the cerebral perfusion parameters and allows the calculation to be performed in-line at the end of the measurement. It also minimizes deconvolution errors due to the effects of delay and dispersion of the contrast agent bolus. Additionally, in cases of contrast extravasations due to a disrupted blood-brain barrier, the postprocessing allows a correction to be applied during calculation of the relCBV maps.

**7 RESOLVE #T+D
14430391**

RESOLVE is a diffusion-weighted, readout-segmented EPI sequence optimized towards high resolution imaging with reduced distortions.

The sequence uses a very short echo-spacing compared to single-shot EPI, substantially reducing susceptibility effects. A 2D-navigator correction is applied to avoid artefacts due to motion-induced phase errors. This combination allows diffusion weighted imaging of the breast, prostate, brain and spine with a high level of detail and spatial precision.

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Additionally, an automatic reacquisition of data with large phase errors can be used to ensure that diffusion-weighted images of the brain are not affected by CSF pulsation.

**8 Arterial Spin Labeling 3D #T+D
14416965**

ASL is a non contrast enhanced brain perfusion technique. A 3D volume is acquired with high SNR by using a turbo gradient spin echo technique and an ASL preparation module to achieve clinically feasible scan times.

3D acquisition of non-contrast enhanced brain perfusion with a TGSE sequence for minimal susceptibility and full brain coverage. Higher SNR, optimized contrast uniformity and reduced motion sensitivity. Inline calculation of PWI (perfusion weighted images) for a qualitative

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assessment of brain perfusion.

9 Arterial Spin Labeling 2D
14409110

ASL is a non contrast enhanced brain perfusion technique. EPI sequence enhanced for PASL (Pulsed Arterial Spin Labeling) with preparation module (inversion pulse, saturation pulses) and selectable prospective motion correction. Perfusion-weighted color maps and relative cerebral blood flow (relCBF) color maps are calculated with Inline technology.

2D multi-slice EPI sequence with full iPAT compatibility for rapid assessment of relative CBF. Consists of a spatially selective inversion pulse combined with different types of saturation pulses (slice presaturation, label slab saturation) and can be classified under PASL (Pulsed Arterial Spin Labeling). Fully automated Inline calculation of relCBF color maps for assessment of perfusion. Prospective motion correction and spatial filtering can be applied to the inline calculation to improve the image quality.

10 SWI #Tim
14402527

Susceptibility Weighted Imaging is a high-resolution 3D imaging technique for the brain with ultra-high sensitivity for microscopic magnetic field inhomogeneities caused by deoxygenated blood, products of blood decomposition and microscopic iron deposits. Among other things, the method allows for the highly sensitive proof of cerebral hemorrhages and the high-resolution display of venous cerebral blood vessels.

Despite a strong sensitivity for local magnetic field inhomogeneities Susceptibility Weighted Imaging (SWI) as a 3D technology keeps up the signal near large susceptibility leaps due to very thin slices and high resolution in the slice (high image quality e.g. in the area of the forebrain near the frontal sinus).

Moreover, the phase information of the MR signal is integrated in the image display. In order to further increase sensitivity for localized microscopic magnetic field inhomogeneities, large-area magnetic field inhomogeneities (e.g. caused by susceptibility leaps near the sinus) are specifically suppressed in the phase images.

This allows even smallest amounts of deoxygenated hemoglobin (e.g. in cerebral veins) or from products of hemoglobin decomposition (e.g. from hemorrhages) to be displayed.

Interesting measuring times for the ultra-high-resolution 3D protocols are achieved through parallel imaging with iPAT (GRAPPA).

The Susceptibility Weighted Imaging package includes:

- SWI measuring sequence, iPAT compatible
- optimized measuring protocols for the head
- inline-postprocessing for automatic calculation of relevant images within the scope of image reconstruction:
 - calculation of susceptibility-weighted images
 - venous angiography: MIP of a thin slice block

SWI has been optimized for clinical use to support diagnostics with cerebrovascular diseases (e.g. cerebral insult), venous malformation, brain trauma and tumors.

11 Spectroscopy Package #T+D
14416941

The Spectroscopy Package is a comprehensive software package which bundles Single Voxel Spectroscopy, 2D Chemical Shift Imaging, 3D Chemical Shift Imaging and syngo Spectroscopy Evaluation.

Sequences and protocols for proton spectroscopy, 2D and 3D proton chemical shift imaging (2D

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CSI and 3D CSI) to examine metabolic changes in the brain (e.g. in tumors and degenerative diseases) and in the prostate are included. Furthermore included is the comprehensive syngo Spectroscopy Evaluation Software which enables fast evaluation of spectroscopy data on the syngo Acquisition Workplace.

The Single Voxel Spectroscopy option is used to measure proton spectra from single voxels. The spectra may show alterations in brain metabolism e.g. in brain tumors, in degenerative changes of the brain and in metabolic diseases. The possibility of automatic adjustment, measurement and evaluation permits near automatic spectroscopy measurements. The whole procedure, including the evaluation of the spectra using the mandatory spectroscopy evaluation option, takes approx. 6 minutes and can be done by doctors or technologists.

The 2D Chemical Shift Imaging option is used to measure 2D proton spectroscopic data to generate metabolite images e.g. in brain tumors, metabolic diseases of the brain and degenerative changes in brain metabolism. The whole procedure, including the generation of metabolite images using the spectroscopy evaluation takes approximately 8 minutes.

The 3D Chemical Shift Imaging option is used to measure 3D proton spectroscopic data and allows for the evaluation of the spectra in measured volumes and the generation of metabolite images and spectral maps, e.g. in cases of brain tumors, metabolic diseases of the brain and degenerative changes in brain metabolism. The whole procedure, including the generation of metabolite images using the spectroscopy evaluation takes approximately 10-16 minutes
Optimized protocols for 3D CSI in the prostate are also included.

The evaluation software is fully integrated in *syngo* MR.

Evaluation protocols adapted to the scan protocols carry out a complete and automatic evaluation of the measured data.

The following functions are included:

- Subsequent water suppression with optional phase correction
- Apodization
- Zero filling
- Fourier transformation
- Base line correction
- Automatic or manual phase correction
- Curve fitting and peak labeling
- Summaries in tabular form of the essential results specifying the metabolites, their position, integrals and signal ratios in relation to a selectable reference.
- Capability of exporting spectroscopy header information and data into a documented external format.
- Automated peak normalization to tissue, water or reference.

For CSI the following functions are included:

- Spectra of selected voxels are automatically calculated, corrected for possible B0 deviations and displayed.
- Spectral fit is automatically optimized for each voxel.
- CSI data can be represented as spectral maps and colored metabolite images that can be superposed onto anatomical images.

12 Multinuclear Support #Sk 14430398

Hardware and software package to prepare the MR system for spectroscopy and nuclear imaging with the nuclei ^3He , ^7Li , ^{13}C , ^{17}O , ^{19}F , ^{23}Na , ^{31}P , and ^{129}Xe .

Coils with preamplifier and transmit switch as well as optimized pulse sequences for the individual nuclei are not included.

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The package includes the generation of RF pulses for the nuclei ^3He , ^7Li , ^{13}C , ^{17}O , ^{19}F , ^{23}Na , ^{31}P and ^{129}Xe and their reception on the frequency bands of the nuclei ^3He , ^7Li , ^{13}C , ^{17}O , ^{19}F , ^{23}Na , ^{31}P and ^{129}Xe .

The measurement system software supports reception ranges of different frequencies and transmitting on two different frequency bands within one pulse sequence (each ^1H + other nucleus). The patient-specific adjustments of the measuring system support multinuclear applications through dedicated frequency adjustment, transmitter voltages that can be set permanently for nuclei other than ^1H and automatic ^1H coil selection for shim adjustment.

This enables the following:

- Operation of mono-resonant transmit/receive coils via the Tim Coil Interface MNO
- Operation of dual-resonant transmit/receive coils (^1H + other nucleus)
- Imaging with the nuclei ^3He , ^7Li , ^{13}C , ^{17}O , ^{19}F , ^{23}Na , ^{31}P and ^{129}Xe
- Spectroscopy with the nuclei ^7Li , ^{13}C , ^{17}O , ^{19}F and ^{31}P
- Spectroscopic and imaging experiments utilizing the ^1H nuclear Overhauser effect (not applicable for ^{17}O)
- Spectroscopic and imaging ^1H decoupling experiments (applicable only for ^{13}C , ^{23}Na , ^{31}P)

A basic pulse sequence is included that can serve as a starting point for proprietary development of optimized pulse sequences for spectroscopy with different nuclei.

The optional "IDEA" development environment is required for the proprietary development of pulse sequences.

13 Multinuclear Spectroscopy #Sk 14430399

Software package for CSI spectroscopy with ^7Li , ^{13}C , ^{17}O , ^{19}F , and ^{31}P nuclei.

The "Multinuclear Spectroscopy" software package includes a Multinuclear Chemical Shift Imaging (CSI) spectroscopy sequence that can measure signals on the frequency bands of the nuclei ^3He , ^7Li , ^{13}C , ^{17}O , ^{19}F , ^{23}Na , ^{31}P , and ^{129}Xe . A non-localizing Multinuclear FID sequence can also be used. Measuring protocols and matching postprocessing protocols are available.

This package enables:

- Multinuclear FID and Multinuclear CSI sequences:
 - double oblique slice orientation, freely adjustable
 - ECG triggering
 - 2D and 3D CSI with resolution $\geq 6 \times 6 \times 12.5 \text{ mm}^3$
 - ^1H decoupling experiments (WALTZ or CW) and Nuclear Overhauser Effect (heteronuclear) to improve signal-to-noise-ratio and spectral resolution (not applicable for ^{17}O).
- Basic measurement and postprocessing protocols for spectroscopy with ^7Li , ^{13}C , ^{17}O , ^{19}F , and ^{31}P

14 SpectroShim Support #P 14432229

The SpectroShim option provides additional shimming power to further improve inhomogeneities caused by the patient, volunteer, or measurement object.

SpectroShim support includes both a fully integrated hardware solution and the software support. The SpectroShim provides additional shim amplifier current for in vivo shimming in the most challenging anatomic regions such as the hippocampus and prostate. Additional power amplifiers

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control 5 shim channels with up to 10 A of current to achieve an increased homogeneity in the region of interest.

15 Head/Neck 64 #P,Sk
14432234

Tim 4G coil technology with Dual Density Signal Transfer and DirectConnect Technology combines key benefits translating into excellent image quality: highest SNR, extreme iPAT performance, high patient comfort, and unmatched flexibility.

The 64-channel head/neck coil with its 64 integrated pre-amplifiers ensures an outstanding signal-to-noise ratio. The unique DirectConnect and SlideConnect technologies allow users to connect 64 coil elements of the Head/Neck 64 with just one cable. The very open design ensures its patients will feel comfortable, while the anatomic design ensures highest signal-to-noise.

The Head /Neck 64 features:

- 64-element design with 64 integrated preamplifiers, 40 elements in the head region 24 elements in the neck region.
- Integrated SlideConnect and DirectConnect technology
- Combined head/neck coil for an optimized workflow
- Upper coil part removable
- Lower coil part usable without upper part for highly claustrophobic patients
- Smoothly integrates into the patient table with Spine 32
- Open patient-friendly design
- Cushioned head stabilizers (removable)
- No coil tuning
- iPAT-compatible in all directions
- Optimized for sequences using iPAT²
- Dual-Density Signal Transfer enables ultrahigh density coil designs by integrating key RF components into the local coil
- Rear opening for up to 128 EEG electrode leads
- Detachable look-out mirror

Applications:

- Head examination
- Neck examination
- Cervical spine examination
- MR Head Angiography, also time-resolved
- MR Neck Angiography
- Combined head/ neck examination
- TMJ (temporo mandibular joints)

Typically combined with:

Spine 32, Body 18, Peripheral Angio 36 (during whole body imaging) or flexible coils such as Flex Large 4

The Head /Neck 64 supports high quality imaging with an 64-element design and 64 integrated preamplifiers. The DirectConnect and SlideConnect technology enables fast and easy patient set up.

The open and light design of the upper coil part increases patient comfort and is removable for easy patient handling.

The lower coil part may remain on the table for most of the examinations can be used without the

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upper part.

The Head/Neck 64 and Spine 32 coils are smoothly integrated into the patient table, thus enabling high flexibility in imaging and facilitating fewer coil changes and easy handling when switching patients.

The Head /Neck 64 coil is equipped with two removable cushioned head stabilizers for stable and comfortable patient positioning. A detachable look-out mirror for increased patient comfort. The double mirror design shows all objects in their correct up/down and left/right orientation. It might also be used for visual fMRI studies. The open design is great for claustrophobic patients and allows for easy integration of the coil with existing stimulation devices e.g., NNL goggles. It attaches to the upper part of the coil and enables the patient to look outside even when his head is in the center of the magnet. No tuning of the fully iPAT-compatible Head/Neck 64 is necessary. The coil is equipped with a rear opening to accommodate up to 128 electrode leads for use in a combo MR/EEG examination.

The Head/Neck 64 can be used for applications like head examinations, neck examinations, MR Angiography, combined head/neck examinations (or for imaging of the TMJ (temporo mandibular joints). Typically combined with the Spine 32 and Body 18 or Peripheral Angio 36. Furthermore the combination of flexible coils like the Flex Large 4 is possible. The improvements in neck imaging (C spine) will be clearly visible due to the aggressively tailored anatomical design of the coil.

The dimensions of the Head/Neck 64 are 435 mm × 395 mm × 350 mm (L x W x H), its weight is less than 5.2 kg (11 lbs).

16 Tx/Rx CP Head Coil #Sk
14426333

This enables studies with very high spatial resolution and very short scan time. The upper part of the coil is detachable and can be fitted with a mirror allowing the patient a rear view out of the magnet. Displaceable cushions are provided with the coil for positioning. The coil is suited for head proton imaging and brain spectroscopy.

17 MAGNETOM Prisma Install., EUR
14436659

Transport, delivery, rigging, installation and cabling of all system components in appropriately prepared rooms according to the installation instructions supplied with the system are carried out by our service providers Hegele or UPS SCS.

These jobs include among others:

- Positioning of the components
- Installation and fastening of the MR System
- Installation and cabling of the hardware options
- Installation and cabling of the MR components in the RF cabin, operator room and control room
- Installation of filter plate
- Installation of magnet cover
- Finally, after the magnet has been positioned, (e.g. disposal of used packaging material), return of reusable pallets to Erlangen (e.g. the pallet for the filter plate)

Installation requirements are given in the Planning Guide.

For jobs not covered by the installation lump-sum please refer to Info **M 9-050-2**, „**INSTALLATION**“, Chapter „**MAGNETOM Installation**“.

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18 Separator 60kW
14418489

The SEP (Separation cabinet) has to be used if a central hospital chilled water supply is available or if a chiller of any brand/type is already available.

The SEP is the interface between the on-site water chiller (of any brand or type) or the interface to the central hospital cooling water supply.

For the above-mentioned cases the SEP is mandatory!

In these cases, the primary water specifications must fulfill the requirements (i.e. 63 kW heat dissipation; 100+-10l/min flow; 6 to 12°C water temperature; pH value 6 to 8, max. working pressure 6 bar).

Dimensions: 1950mm x 650mm x 650mm (height x width x depth)

Weight: approx. 340kg

Function:

- Interface between the on-site water chiller (of any brand/type) or
- Interface to the central hospital chilled water supply.

Delivery volume:

- Separator
- Two 3.0 m hoses (forward and return) for connecting the SEP to the local cooling water supply system
- Separation cabinet
- With the SEP configuration, the helium compressor is built into the SEP cabinet and connected internal
- Regional specific adapter for connection to the hospital installation

RF cabins MAGNETOM systems and Biograph mMR

19 RF-Cabin, Steel #3T
14413606

Steel full-room RF cabin, module method of building, for MAGNETOM Trio a Tim System, Verio and Prisma.

Standard cabin outside dimensions:

L x W x H = 7.590 x 4.590 x 3.000 mm

Screen damping value:

90 dB (Co-Siting 100 dB) at 15 until 130 MHz.

The following elements are included in the standard scope of supply:

- floor, side and ceiling panels including contact material
- floor panels with standard floor (without floor covering)
- sound protection door [>44 dB(A)] with door handle and lock, 1,200 x 2,100 mm
- filter panel with 1 pc. frame for the filter plate, including 3 pcs. tube leads (d=50 mm) for medical gases
- observation window (W x H = 1,200 x 800 mm) in the side panel
- tube lead d=150 mm with 2 pcs. flanges for quench tube
- 2 pcs. honeycombs 514 x 289 mm for the air conditioning
- insulated ring bolts for ceiling panel suspension
- 1 pc. plastic foil for insulated cabin installation

20 RF-Cabin Installation, EUR #3T

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14401488

Installation of an RF cabin in modular construction from Albatross Projects GmbH.

Cabin size: L x W x H = 7600 x 4600 x 3000 mm.

Scope of supply:

- Floor, wall and ceiling setup
- Fitting of door, observation window and RF feed-throughs
- Fitting of honeycomb window inserts and mounting of fixing brackets for internal completion
- RF test measurements and documentation thereof

21 Inline BOLD Imaging #Tim

07820090

The BOLD imaging package is based on blood oxygen level dependent (BOLD) contrast-sensitive single-shot EPI sequences.

Inline technology enables the automatic real-time calculation and display of statistical (t-value) images during the measurement of BOLD paradigms (including 3D motion correction and spatial filtration). The mosaic image format is supported. Clinical protocols are prepared. With Inline BOLD Imaging, functional brain mapping can be optimally integrated into clinical routine, e.g. prior to neurosurgical interventions.

The BOLD imaging package allows the user to define protocols which, apart from the measurement, configure automatic evaluation of the measured data during the scan. With Inline Technology it is thus possible to generate statistical images (t-value) based on 3D motion corrected and spatially filtered data automatically in real time without any further user interaction. The Inline display of activation cards allows the user to decide during the scan whether enough statistical power has built up for his brain mapping task or if the examination is corrupted by motion. As a result examinations will be shorter with a higher success rate. Functional brain mapping can be easily integrated into the clinical routine e.g. prior to neurosurgical interventions.

Additional Features:

- Inline retrospective 3D motion detection and correction in 3 rotational and 3 translational directions
- Inline t-statistics calculation for variable paradigms and display of t-value images
- Statistical evaluation by means of "General Linear Model (GLM)"
- Paradigms can be configured
- Transitions between passive and active states can be modeled by the hemodynamic response function
- Correction of low-frequency trends
- Allows for time delays due to the BOLD-EPI slice order during a measurement
- Display of GLM design matrix
- Display of a continuously updated t-value card during measurement
- Display of colored activation cards continuously updated during measurement, overlaid over the respective BOLD images using Inline technology
- MOSAIC image mode for accelerating display, processing and storage of images

22 3D PACE syngo #Tim

14405330

3D PACE (Prospective Acquisition CorrEction) enhances Inline BOLD imaging with motion correction during the acquisition of a BOLD exam. In contrast to a retrospective motion correction that corrects previously acquired data, the unique 3D PACE tracks the head of the patient, correcting for motion in real time during the acquisition.

By tracking the patients head 3D PACE reduces motion resulting in increased data quality beyond

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what can be achieved with a retrospective motion correction. As a result the sensitivity and specificity of BOLD experiments are increased.

Features:

- Real time prospective motion correction: Highest accuracy real time motion detection algorithm feeding a real time feed back loop to the acquisition system with updated positioning information
- 3D motion correction for 6 degrees of freedom (3 translation and 3 rotation)
- Motion related artifacts are avoided in first place instead of correcting for them retrospectively
- Significant reduction of motion-related artifacts in statistical evaluations
- Increased sensitivity and specificity of BOLD experiments

**23 Diffusion Tensor Imaging #P
14432244**

Diffusion Tensor Imaging provides a Single Shot EPI sequence for measuring diffusion-weighted data sets with up to 256 directions of diffusion weighting. Based on these data sets, the diffusion tensor itself and parametric maps derived from it (e.g. fractional anisotropy) are calculated automatically and in real-time. The package supports both clinical applications regarding diseases of the white matter (e.g. multiple sclerosis, brain maturation disorders, or displacement of nerve fiber tracts through masses) and advanced research applications.

Diffusion spectrum imaging (DSI), an extension of diffusion tensor imaging, is included in this package. DSI expands on the DTI acquisition capabilities by providing the ability to resolve white matter fiber crossings.

Diffusion Tensor Imaging allows for a complete description of the diffusion properties of the brain within the scope of the tensor diffusion model, both for anisotropic and isotropic diffusion. Efficient diffusion direction schemes are pre-defined to allow for optimal diffusion directional resolution. Schemes with up to 256 directions can be selected.

Inline technology enables automatic and immediate calculation of the diffusion tensor, including grey-scale and colored "fractional anisotropy" (FA) map derived from it.

With the addition of DSI, it is possible to acquire diffusion data in up to 514 different directions each with independent b-values.

Details:

- Measurements with up to 256 different directions and with up to 16 different b-values
- Inline calculation of tensor, grey-scale and colored FA map, ADC map and trace-weighted image
- Support of parallel imaging (iPAT)
- Clinical protocols with full head coverage, incl. inline calculation of tensor, FA, ADC and trace-weighted images in 4 minutes.

**24 syngo MR Workplace #T+D
14418490**

syngo MR Workplace based on the newest generation syngo host computer consisting of:

- Color LCD monitor, 19" flat screen.
- syngo MR Workplace computer system with Quad Core Xeon™, 2.66 GHz, >= 6 GB RAM, Quad Core host computer incl. one 300 GB system hard disk, one 300 GB hard disk for image data, one CD/DVD-R drive for image storage, one DVD-ROM drive and electronic mouse.
- syngo MR Maestro class user interface for optimized clinical workflow.

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The *syngo* MR Workplace computer system includes:

- High-performance host computer of the latest Intel Xeon CPU generation Quad Core processor with 2.66 GHz clock rate, \geq 6 GB RAM, one 300 GB system hard disk, one 300 GB hard disk, one CD/DVD-R drive for uncompressed image storage on CD/DVD-R in DICOM format (ISO 9660 Level 1), one DVD-ROM drive and electronic mouse.
- High resolution color LCD flat screen monitor with 1280 x 1024 pixel display, integrated gamma correction for optimum display of radiographic grayscale and automatic backlight control for longterm brightness stability.

The new *syngo* MR software includes among others the following features relevant for the *syngo* MR Workplace:

- The "Task Card" concept permits structured processes with several patients by means of simplified image exchange between the task-specific interfaces.
- The image view card permits image data from up to three patients to be administered viewed, and processed simultaneously.
- The "Dynamic Analysis" evaluation software permits functions such as addition/subtraction, division/multiplication, T1 and T2 calculations, and standard deviation to be performed.
- The "Mean Curve" can be used to analyze dynamic examinations, e.g. employing contrast media.
- The "Breast Evaluation" software can be used to calculate colored representations of different dynamic parameter maps, like Wash-in, Wash-out, Time-to-Peak.
- Post-processing software for filtration of MR images. The software includes an adaptive image filter which automatically adapts the filtration to the local image contents. Three filters can be selected: soft, medium or sharp. These three filter types can be changed individually by means of the parameters "smoothing" and "edge enhancement" from 1 - 5. Three different filter strengths can be stored in addition to the three basic settings.
For filtration also individual or multiple images as well as complete series can be selected simultaneously. The current calculation status and a preview of the already filtered images is displayed via an additionally selectable window.
- Precision filter for high spatial accuracy. The precision filter increases the spatial accuracy of MR data sets for surgical planning, stereotactical procedures, therapy planning and multi modality fused visualization. The filter can correct image distortions in the image plane as well as across the slices.
Functions:
 - Offline correction of 3D data sets.
 - Offline correction of 2D data sets, whose inter-slice gap is not larger than the slice thickness.
 - Corrected data set is saved as a new series.
 - Correction of images from all SIEMENS gradient systems that were available at the release of the software.
- The Argus Viewer allows users to load a large list of dynamic data sets and view it comfortably. For example cardiac images are automatically sorted into user definable reading configurations after loading. Re-sorting and re-display can be changed instantaneously, either automatically or manually. Integrated 8-on-1 movie provides efficient review of data. AVI creation of movie loops (up to 4-on-1) is possible.
Creating and editing reports which can be stored together with the images or printed is possible.
- The 3D post-processing card includes basic functionalities for manual MPR, MIP, MinIP, and SSD image reconstruction (Multiplanar Reconstruction, Maximum Intensity Projections, Minimum Intensity Projections and Shaded Surface Display).
- Efficient filming is possible directly from the different user interfaces and can be controlled by minimum user interaction. There is a wide range of different film layouts with regular and

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irregular formats. Selectable Mother and Child function which allows you to display the position of the measured slice in a scout showing a small image in the upper right-hand or the lower left-hand corner of the larger image (image within an image).

The drag-and-drop functions allows the images to be positioned anywhere on the film from the Patient Browser. The images can be moved, enlarged, and tiled directly on the film sheet. As an additional aid to orientation, a reference image can be included in the upper right-hand corner of the image segment. (Camera not part of the basic equipment. Verify if existing camera is compatible or order separately.)

- The standard implementation of the DICOM 3.0 protocol permits examinations to be easily transferred to and from a network for managing them, thus effectively supporting more efficient workflow.

The following functions are supported as part of this standard implementation:

Send/Receive, Query/Retrieve, Basic Print for DICOM-compatible laser cameras (Camera not part of the basic equipment. Verify if existing camera is compatible or order separately.), DICOM Worklist, DICOM Storage Commitment (SC).

- 25 PC Keyboard US English
07275931
Standard PC keyboard with 101 keys.

The keys of the numerical key panel are assigned to syngo-specific functions and labeled with the corresponding syngo icons. The keyboard supports the country specific special characters.

- 26 Spectroscopy Eval. syngo MRWP
07585065
Comprehensive software package for evaluation of spectroscopy data on the syngo MR Workplace.

This fully *syngo* integrated application with common data base access eliminates the need for time consuming data transfer to a separate workstation. Evaluation protocols adapted to the scan protocols carry out a complete and automatic evaluation of the measured spectroscopy data. As a result the fitted spectra are displayed with labeled metabolite peaks.

The following functions are included:

- Subsequent water suppression with optional phase correction
- Apodization
- Zero filling
- Fourier transformation
- Base line correction
- Automatic or manual phase correction
- Curve fitting and peak labeling
- Summaries in tabular form of the essential results specifying the metabolites, their position, integrals and signal ratios in relation to a selectable reference.
- Capability of exporting spectroscopy header information and data into a documented external format

For CSI the following functions are included:

- Spectra of selected voxels are automatically calculated, corrected for possible B0 deviations and displayed.
- Spectral fit is automatically optimized for each voxel
- CSI data can be represented as spectral maps and colored metabolite images that can be superposed onto anatomical images.

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27 DTI Evaluation MRWP #Tim
14402525

DTI Evaluation provides advanced post-processing and visualization of Diffusion Tensor Imaging (DTI) data. DTI Evaluation includes the possibility to calculate tensor data from a DTI dataset retrospectively and enables calculation of different diffusion parameter maps. Furthermore it facilitates joint ROI-based evaluation of parameter images and anatomical images, as well as color-coded display and fused 3D visualization in the anatomical context.

Clinical applications are supported by a dedicated DTI evaluation mode to support diagnostics of white matter diseases (e.g. multiple sclerosis and brain maturation disorders). Based on the tensor, in addition to the already inline-calculated parameter maps, further maps characterizing the anisotropy of diffusion properties can be calculated and stored. Multiple diffusion parameter maps (e.g. Fractional Anisotropy, ADC, $b=0$) and an anatomical image are displayed next to each other in the same slice position for comparison. The images can be evaluated together based on ROIs and the results can be documented in a table. The display options include 2D and 3D tensor graphics, colour-coded images and overlay images on the anatomical images.

In addition, the package offers the scientific user full flexibility of 2- and 3-dimensional visualization of the diffusion tensor with measures of isotropic and anisotropic (fractional and relative) diffusion, Eigen vectors (E1, E2, E3) of the diffusion tensor and shape-descriptive measures of the diffusion tensor (linear, planar, spherical).

28 DTI Tractography syngo MRWP #Tim
14407255

syngo DTI Tractography allows the visualization of multiple white matter tracts of the human brain based on diffusion tensor imaging data. DTI Tractography is optimized to support the presurgical planning and to allow for neuro physiological research with respect to connectivity and white matter pathology.

syngo DTI Tractography is optimized for the clinical use by providing advanced 3D visualization of white matter tracts in the context of 2D or 3D anatomical datasets and DTI datasets. DTI data sets can be explored fast and intuitively using the interactive QuickTracking. QuickTracking instantaneously displays the tract originating from the mouse pointer position while moving over the DTI data set. This also allows identifying qualified regions to place seeding ROIs. Seed points can be set to assess connectivity by tracking with single ROI and with multiple ROIs. Furthermore they can be placed in fused views displaying the anatomical reference and e.g. the colored FA map simultaneously.

Texture Diffusion, a highly versatile in-plane visualization of white matter tracts, allows to display and read DTI Tractography results on PACS reading stations and in the OR.

At the same time the package provides the scientific user with the flexibility to configure the tracking algorithm and to change display settings for the tracts. Tract and seeding ROI statistics are included to support publications (e.g. mean/max FA value, min/mean/max ADC value). All views can be exported as DICOM images or bitmaps. Tract and seeding ROI statistics can be exported as html files.

29 Neuro Perfusion Evaluation MRWP#T+D
14418564

Neuro Perfusion Evaluation syngo provides a task card for detailed post-processing of brain perfusion data sets. Color display of the relative Mean Transit Time (relMTT), relative Cerebral Blood Volume (relCBV), corrected rel CBV, and relative Cerebral Blood Flow (relCBF) is supported. Flexible selection of the Arterial Input Function (AIF) for more reliable analysis taking into account the dynamics over time of the contrast agent enhancement. Furthermore a calculation of maps using automatically selected local Arterial Input Functions (AIF) is provided to reduce the

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amount of user interactions.

The detailed evaluation of brain perfusion data sets generates parameter maps for TTP and PBP and for the hemodynamic parameters relMTT, relCBV, rel CBVcor and relCBF. These may show perfusion deficits and assist in the diagnosis and grading of e.g. vascular deficiencies and brain tumors.

This fully *syngo* integrated application with common data base access eliminates the need for time consuming data transfer to a separate workstation.

Post-processing features:

- Flexible selection of the Arterial Input Function (AIF) by the user.
- Pixelwise calculation of the hemodynamic parameters relative Mean Transit Time (relMTT), relative Cerebral Blood Volume (relCBV), relative Cerebral Blood Flow (relCBF), corrected relative Cerebral and Blood Flow (relCBF) for compensation of blood brain barrier leakage.
- Pixelwise calculation of maximum signal loss due to contrast agent enhancement (Percentage of Baseline at Peak, PBP) and of the time to the maximum signal loss (Time-To-Peak, TTP).
- Display of the global signal time course (averaged over all slices) to assess the quality of the exam.
- Predefined post-processing protocols available, user definable post-processing protocol are possible.

Visualization features:

- Colored display of relMTT-, relCBV-, relCBF-, relCBFcor, PBP- and TTP-maps.
- Zoom, pan, annotate.
- Colored images can be saved as DICOM images.

30 Argus Flow MRWP 07364370

Evaluation software for automated image analysis of blood and cerebrospinal fluid (CSF) flow.

Integrated, *syngo* based image analysis tool with common data base access, allowing direct image analysis right after image acquisition without the need for time consuming data transfer to a separate workstation.

The combination of automated contouring and easy-to-use editing tools, provides users with a rapid way to quantify parameters of interest.

Argus flow includes:

- Calculation of flow and velocity parameters (e.g. mean and max velocity, mean, cumulative, prograde, retrograde flow) for large and small vessels.
- Semi-automatic detection of regions of interest over time
- Color-coded display of velocity values.
- Calculation of flow and velocity parameters (e.g. peak velocity, average velocity, flow, integral flow)
- Graphical and tabular display of the results (e.g. flow-time curves).
- Integration of the results in Argus structured report and storage in DICOM format for documentation.

31 BOLD 3D Evaluation syngo MRWP #T+D 14418674

BOLD 3D Evaluation syngo is the comprehensive processing and visualization package for BOLD fMRI. It provides a full set of features for clinical fMRI, as well as advanced features for more

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research oriented applications.

The package provides statistical map calculations from BOLD datasets. It enables the visualization of task-related areas of activation with 2D or 3D anatomical data, allowing, in real time, to assess the spatial relation of eloquent cortices with cortical landmarks or brain lesions.

Integrated, *syngo* based image analysis tool with common data base access together with the *syngo* acquisition workplace, allowing direct image analysis right after image acquisition without the need for time consuming data transfer to a separate workstation.

All tasks from statistical evaluation of the fMRI datasets to reading and exporting results are supported by BOLD 3D Evaluation *syngo*:

Generation of statistical maps:

- In cases an inline calculated statistical map is not available a statistical map can be generated easily using processing protocols. An intuitive editor UI allows the paradigm definition and offers the selection of head motion correction, image filters and statistical evaluation.
- Predefined processing protocols and paradigms are available, which can be edited if required.

Statistical evaluation using General Linear Model (GLM)

- Transitions between passive and active states modeled by the hemodynamic response function.
- Correction of low-frequency trends.
- Corrects for time delays due to the BOLD-EPI slice order during a measurement.
- Output of a t-value map and the GLM design matrix

Inline monitoring of the fMRI exam

- During an ongoing BOLD imaging exam results are calculated (by Inline BOLD imaging) and displayed in real time.
- The results are displayed and continuously updated as an overlay on online adjustable, free angulated cut planes through the anatomical 3D data set.
- The evolving signal time courses in task-related areas of activation can be displayed and monitored.

Visualization of fMRI Results

- Visualization with 3D volume rendering.
- Superimposing on cut planes through the volume.
- Interactive Navigation: Zoom, pan and rotate in 3D without noticeable delay. Free double oblique angulation of up to 6 cut planes.
- Cine display of the BOLD time series and of EPI volumes in 3 orthogonal cuts for evaluation of non-corrected head motion.

Data Quality Monitoring

- Based on the B0 field map, loaded automatically with the fMRI data, areas with less reliable results are indicated.

32 fMRI Trigger Converter 14405316

An optical trigger signal is available to trigger external stimulation devices in fMRI experiments. With the "fMRI Trigger Converter" this signal can be converted to an electrical signal (TTL/BNC and RS 232 interface for PC; modes: toggle or impulse).

SIEMENS

Healthcare

Siemens s.r.o., Siemensova 1, 155 00 Praha 13

CEITEC

Žerotínovo nám. 9
601 77 Brno

Jméno	Lubos Tuma
Oddelení	H IM&WS Sales
Telefon	+420233032025
Fax	
Mobil	+420603870068
E-mail	lubos.tuma@siemens.com

Váš dopis	yr
Naše značka	1-A8WMI1-4
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Předmět

MAGNETOM Prisma

Lubos Tuma

Siemens s.r.o.
Management: Ing. Eduard Pališek, Ph.D., MBA
Sektor Healthcare
Divize Imaging & Workflow Solutions; management: Ing. Vratislav Švorčík

Siemensova 1
155 00 Praha 13
Česká republika

Tel.: +420 23303 3303
Fax: +420 23303 1112
www.siemens.cz/imws

Siemens s.r.o. - Jednatel: Ing. Eduard Pališek, Ph.D., MBA, Dipl. Kfm. Rudolf Fischer - registrace v ob. rejstříku, vedeném Městským soudem v Praze, oddíl C, vložka 625
Sídlo: Siemensova 1, 155 00 Praha 13, Česká republika
IČ: 00268577, DIČ: CZ00268577, bankovní spojení: UniCredit Bank Czech Republic a.s., Na Příkopě 858/20, 113 80 Praha 1
Č. účtu CZK: 1013384001/2700, č. účtu EUR: 1013384394/2700

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MAGNETOM Prisma

- 1 MAGNETOM Prisma - System
14432220
MAGNETOM Prisma
The 3T PowerPack for exploration.

MAGNETOM Prisma is the most powerful 3T system ever built. Based on the benchmark 3T magnet, it provides the highest homogeneity across the large 50 cm FOV and incorporates state-of-the-art zero helium boil-off technology. Additionally, the XR 80/200 gradient engine generates the highest performance among all commercially available 3T scanners. TimTX TrueShape provides more degrees of freedom to explore new applications. Tim 4G the coil technology with state of the art accuracy, speed and flexibility across all MR applications. Dot - reproducibility for clinical studies guarantees consistency across different images. In all, MAGNETOM Prisma is the complete package, enabling its users the power to outperform, the power to explore and the power to succeed.

The standard components are:

- Whole-body, superconductive Zero Helium Boil-Off 3T magnet
- 50cm FOV, with the industry best homogeneity
- XR 80/200 gradient system providing the highest whole-body gradient performance available
- Actively shielded gradient system with high performance water-cooling for each gradient axis
- TimTX TrueShape with syngo ZOOMit
- Tim 4G [204x64]
- DirectRF™ technology
- All-new coil architecture including Dual-Density Signal Transfer Technology
- Head/Neck 20 DirectConnect, Spine 32 DirectConnect, Body 18, Flex Large/Small 4
- High performance image reconstruction computer incorporating GPU technology
- Dot technology
- Brain Dot Engine
- Dot Display and Dot Control Centers for efficient patient preparation

Additional features include:

- Tim Application Suite
- syngo MR software
- State of the art host computer

The system (magnet, electronics and control room) can be installed in less than 33sqm space. For system cooling either the Eco Chiller options or the Separator is required.

MAGNETOM Prisma - The 3T PowerPack for exploration - integrates our most recent innovations in MRI, enabling the power to outperform, the power to explore and the power to succeed.

The system includes:

The Benchmark in 3T magnets

- Whole-body superconductive 3T magnet with active shielding (AS) technology with counter coils
- Zero Helium Boil-off Technology
- External Interference Shielding (E.I.S.)
- Excellent homogeneity enabled magnet design which allows for a cylindrically optimized homogeneity volume resulting in higher image quality (50 × 50 × 50 cm³ DSV, typ. 1.1 ppm)

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based on the 24-plane plot method)

- The magnet has a helium capacity of approximately 933l liters and a typical Helium boil-off rate of 0 l/yr during typical, undisturbed clinical operation depending on the sequences used and examination time, and provided the system is serviced in regular intervals.
- It has an integrated magnet cooling system.
- The combination of standard active shim with 3 linear channels (1st order) and 5 non linear channels (2nd order) and passive shim allows for maximized magnetic field homogeneity and consistently high image quality for a wide range of applications

XR Gradients: an unmatched gradient system

- Maximum amplitude of 80 mT/m and maximum slew rate of 200 T/m/s on each axis simultaneously
- Actively shielded water-cooled with dedicated cooling for each gradient axis
- All axes force compensated for lowest vibrations and acoustic performance
- Outstanding performance and stability for long duration scans

TimTX TrueShape

TimTX TrueShape is Siemens' architecture for parallel transmit (pTX) technology. TimTX TrueShape allows dynamic parallel transmission of radio frequency (RF) pulses, shaping the RF excitation field locally and thus enabling selective excitation.

It enables benefits for MR imaging and spectroscopy applications through optimized image homogeneity or efficient selective excitation.

TimTX TrueShape Applications

- *syngo* ZOOMit is the first application utilizing TimTX TrueShape. It allows "zooming into" a part of the image.
- ZOOMit EPI realized by selective excitation, i.e. avoiding infolding artifacts in phase encoding directions, improving image quality locally with fewer distortions and speeding up acquisition time by lowering the requirements on spatial encoding.
- ZOOMit SPACE realized by inner volume excitation.

Tim 4G+Dot

Tim 4G provides increased patient comfort and optimized workflow efficiency. Only one patient setup, no repositioning, no changing of coils. Ultra-light-weighted coils with high density of coil elements for maximized patient comfort and increased SNR. Feet-first positioning for almost all examinations possible reduces anxiety and claustrophobia.

Tim 4G is 4G flexibility, accuracy and speed and brings image quality and acquisition speed to a new level.

Dot takes away the complexity in MRI scanning and provides consistent reproducible results by patient personalization, user guidance and process automation. Optimized scan strategies can be selected based on patient condition, which allows for high quality exams even when conditions change. Integrated decision points allows the user to easily add or remove one or a group of protocols with one click. Step by step real-time on board guidance guides novice users even through the most complicated exams. Process automation allows optimal timing for breathing, scanning, planning or contrast arrival. Dot can be easily customized to follow the individual standards of care.

Dot is personalized, guided and automated and designed to improve workflow efficiency and image consistency.

DirectRF - RF Transmit/Receive System:

- Fully integrated Transmit- and Receive path in the magnet housing including extremely compact water-cooled solid state amplifier with 50kW peak power
- High dynamic range

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- Real time feedback loop for inline sequence adaptation
- Integrated no tune transmit/receive Body Coil

The revolutionary Tim 4G technology allows connecting up to 204 coil elements simultaneously enabling higher SNR and iPAT in all directions. No repositioning of patients is needed even for large Field of View examinations.

- Dual-Density Signal transfer enables ultra-high density coil design by integrating key RF components into the local coil.

Tim 4G Coils:

The new Tim 4G coil technology with Dual-Density Signal Transfer, DirectConnect and SlideConnect technology combines key imaging benefits:
Excellent image quality, high patient comfort, and unmatched flexibility

The Tim 4G coils are designed for highest image quality combined with easy handling. The high element density of the coils increases SNR and reduces examination times. DirectConnect and SlideConnect™ technology reduce patient set up time significantly. The coils are designed with the patient in mind. Light weight coils with an open design ensure highest patient comfort resulting in better patient cooperation and image quality. No coil changing with multi-exam studies saves patient setup- and table time.

AutoCoilSelect for dynamic, automatic, or interactive selection of the coil elements within the Field of View fastens the exam preparation at the host.

All coils are time-saving "no-tune" coils.

A comprehensive set of pads for comfortable and stable patient positioning together with safety straps are included.

- Head/Neck 20

The 20-channel coil with its 20 integrated pre-amplifiers ensures excellent signal-to-noise ratio. The unique DirectConnect technology allows users connecting the 20 coil elements of the Head/Neck 20 without cables. The patient friendly open design allows for maximum patient comfort which is supported in addition by a look-out mirror for claustrophobic patients. The high channel coil is iPAT compatible in all directions.

The open and light design of the upper coil part increases patient comfort and is removable for easy patient handling. The lower coil part may remain on the table for most of the examinations can be used without the upper part. The Head/Neck 20 and Spine 32 are smoothly integrated into the patient table, thus enabling high flexibility in imaging and fewer coil changes and easy handling when switching patients. The Head /Neck 20 coil is equipped with two removable cushioned head stabilizers for stable and comfortable patient positioning.

The Head/ Neck 20 can be used for applications like head examinations, neck examinations, MR Angiography, combined head/neck examinations or for imaging of the TMJ (temporomandibular joints).

Typically combined with the Spine 32 and Body 18 or Peripheral Angio 36 but also other combinations eg with flexible coils like the Flex Large 4 are possible.

- Body 18

The 18-channel coil with its 18 integrated pre-amplifiers ensures maximum signal-to-noise ratio. The 18 coil elements of the Body 18 with only one SlideConnect Plug allows for fast and easy patient preparation resulting in less table time. Fast acquisition times enabled by iPAT in all directions. The light-weighted coil ensures highest patient comfort.

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Body 18 operates in an integrated fashion with the Spine 32 as an 30 channel body coil

Body 18 can be combined with further Body 18 coils for larger coverage and positioned in different orientations (0°, 90°, 180°, 270°) for patient specific adaptations

The Body 18 is typically used in combination with the Spine 32 for examinations of the thorax, abdomen, pelvis or hip and operates as a 30 channel body coil (3 rings 10 elements). The Body 18 can also be used for cardiac or vascular applications. Through its perfect combinability with the Spine 32, further Body 18 (optional), the Peripheral Angio 36 (optional), but also the Head/Neck 20 and all flexible coils (e.g. Flex Large 4, Flex Small 4) it contributes for a broad range of indications up to whole-body imaging.

- Spine 32

The 32-channel coil with its 32 integrated pre-amplifiers ensures maximum signal-to-noise ratio. The unique DirectConnect technology allows connecting the 32 coil elements of the Spine 32 without the need to plug in any cable. The patient friendly ergonomical design allows for maximum patient comfort. The high element coil is iPAT compatible in all directions.

Smoothly integrated into the patient table the Spine 32 may remain on the patient table for nearly all exams.

The Spine 32 is typically combined with Body 18, Head/Neck 20, Peripheral Angio 36 or Flex Large 4, Flex Small 4.

- Flex Large 4/ Flex Small 4

Light-weighted, very flexible, iPAT compatible, 4-element no-tune receiver coils which are made of soft and smooth material. The coils can be wrapped around or used flat.

Both coils can be connected via Flex Coil interface. One Flex Coil interface is already delivered as standard.

The coils can be used for different examinations ranging from examinations of the extremities to abdominal examinations.

Tim Table

- The maximum scan range of the Tim Table is 280 cm.
- The maximum patient weight of 250 kg (550 lbs) is valid for horizontal and vertical movements, which ensures maximized patient comfort for obese patients.
- The patient table can be lowered to a minimum height of 64 cm from the floor, for easier patient positioning and better accessibility for geriatric, pediatric or immobile patients. An infusion stand is integrated to ensure fast patient set up also for critical patients.
- Multiple Tim4G coils can be connected at once for efficient and patient friendly examinations.
- The Tim Table can be moved with two clicks into the isocenter - one click to the upmost position and one click into the isocenter.

Dot (Day Optimizing Throughput) Engine

Dot multiplies the power of Tim resulting in greater image consistency and diagnostic confidence

Dot Control Centers and Dot Display

- The ergonomically designed Dot Control Centers are integrated left and right into the front covers for controlling table movement and interaction with the Dot Display. The Dot Control Centers are well illuminated for easy visual recognition.
- Automated table move up to upmost position, to center position or Home position facilitate

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- smooth patient preparation and will reduce table time
- Variable (6 levels) ventilation and lighting inside the magnet bore or volume adjustments are possible for increased patient comfort
 - The Dot Display provides on board guidance for patient set up where it's needed - directly at the scanner. Information such as Patient name or exam type or required patient position, guidance for ECG set up and immediate visualization of physiological curves will be provided for convenient operation.
 - Almost all table control functions, including ventilation and illumination of the magnet bore, can be also controlled from the operator console for convenient operation.

Dot Technology

Dot makes it easy to get the best possible results for virtually any type of patient. Dot gives uniquely tailored, optimized scans configurable to patient condition or clinical question. Dot provides patient personalization, user guidance and process automation and is of course configurable by the user to adapt to the different clinical needs and standards of care.

Brain Dot Engine

The Brain Dot Engine simplifies general brain examinations with guided and automated workflows customized to the site specific standards of care. The Brain Dot Engine supports the user in achieving reproducible image quality with increased ease of use and time efficient exams. The brain workflow can be personalized to the individual patient condition and clinical need. Several predefined strategies are included, which can be easily selected with one click. They can be changed at any time during the brain workflow Protocols tailored for use of contrast media are integrated.

- Standard: Standard examination with 2D protocols
- Resolution focus: Examination with 3D protocols (with e.g. SPACE) for detailed views
- Speed focus: Examination with fast 2D protocols (with e.g. HASTE) for further speeding up the exam
- Limited patient capabilities: Examination with *syngo* BLADE protocols
- to minimize and correct or the effects of motion automatically

Step-by-step user guidance is seamlessly integrated. Example images and guidance text are displayed for each individual step of the scanning workflow. Both - images and text - are easily configurable by the user.

Easy positioning of the patient with AutoPosition. The patient is automatically placed at the isocenter without any laser marking required.

AutoAlign Head allows automatically slice positioning and aligns on the anatomically derived sagittal, coronal, and axial slices of the localizer. The operator-free alignment and anatomical marking are consistent, independently of patient age, head position, or disease.

Automatic real-time calculation of trace-weighted images and ADC maps with Inline DiffusionTechnology.

Easy rerun or repeat with functionality allows for reduced table time even in case of patients with pain or claustrophobia. An image inside the examination UI can be selected and a rerun of the corresponding series can be triggered with identical sequences or parameters. Alternatively an exam can be repeated with a changed strategy.

The Brain Dot Engine as all Dot Engines can be modified by the user to their individual standard of care.

Tim Application Suite

The Tim Application Suite offers a complete range of clinically optimized sequences, protocols and workflow functionalities for all body regions. Excellent head-to-toe imaging can be accomplished with the sequences and features included in this application suite. To enable this comprehensive application range, ten dedicated application packages have been included.

- *syngo* TimCT FastView
- Neuro Suite
- Angio Suite
- Cardiac Suite
- Body Suite
- Onco Suite
- Breast Suite
- Ortho Suite
- Pediatric Suite
- Scientific Suite
- Whole Body Suite

syngo TimCT FastView

syngo TimCT FastView is a "one go" localizer for the whole body or large body regions such as the whole spine or the whole abdomen. It acquires the complete extended Field of View in one volume with isotropic resolution. Transversal, coronal and sagittal reformats of the volume are calculated inline and displayed for planning subsequent exams. Moreover, while planning is underway, adjustments are acquired automatically for further time savings in subsequent measurements. *syngo* TimCT FastView runs without laser light positioning to further streamline the workflow for several indications.

Neuro Suite

Comprehensive head and spine examinations can be performed with dedicated programs. High resolution protocols and fast protocols for uncooperative patients are provided. The Neuro Suite also includes protocols for diffusion imaging, perfusion imaging, and fMRI. It includes for example:

- EPI sequences and protocols for diffusion, perfusion and fMRI for advanced neurological applications.
Diffusion weighted imaging is possible with up to 16 b-values in the orthogonal directions
Dynamic Analysis software (included in standard configuration) enables calculation of:
 - ADC maps
 - t-test maps from the EPI images for fMRI
 - Time-to-Peak maps for perfusion analysis.
- Whole spine protocols acquire in multiple steps via software controlled table movement in a single click.
- 3D isotropic resolution volume imaging using T1 3D MPRAGE / 3D FLASH, SPACE DarkFluid, T2 SPACE and 3D TSE
- T2-weighted high resolution 3D Restore protocols optimized for inner ear examinations
- Whole-spine protocols in multiple steps with software controlled table movement
- 2D and 3D MEDIC protocols for T2-weighted imaging, particularly for C-spine examinations in axial orientation where reproducibility is difficult due to CSF pulsations and blood flow artifacts
- 3D Myelograms with 3D HASTE and 3D True-FISP for anatomical details
- Dynamic sacro-iliac joint imaging after contrast administration using a fast T1-weighted FLASH 2D sequence
- Spine diffusion protocols to differentiate osteoporosis versus tumor infiltration and post-radiotherapy changes versus residual tumor with PSIF sequence
- Precision filter for high spatial accuracy e.g. for neuro intra-operative imaging and stereotactic planning

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- 3D CISS (Constructive Interference in Steady State) for excellent visualization of fine structures such as cranial nerves. High resolution imaging of inner ear and spine
- AutoAlign Head LS providing a fast, easy, standardized, and reproducible patient scanning supporting reading by delivering a higher and more standardized image quality

Angio Suite

Excellent MR Angiography can be performed to visualize arteries and veins with or without contrast agent.

Contrast-enhanced MRA

- 3D contrast-enhanced MRA protocols for e.g. single step, dynamic, peripheral, whole body MRA with the shortest TR and TE. The strong gradients make it possible to separate the arterial phase from the venous phase.
- TestBolus workflow for optimized bolus timing and superb image quality.
- CareBolus functionality for accurate determination of the bolus arrival time and the "Stop and Continue" of the 3D ce-MRA protocol after the 2D bolus control scan.
- Dynamic ce-MRA for 3D imaging over time.

Non-contrast-MRA and venography

- 2D and 3D Time-of-Flight (ToF) protocols for MRA for the Circle of Willis, carotids, neck vessels, and breath-hold protocols for abdominal vessels
- Triggered 2D ToF sequences for non-contrast MRA, particularly of the abdomen and the extremities
- 2D/3D Phase-Contrast
- MR venography with 2D/3D Time-of-Flight (ToF) and Phase-Contrast
- TONE (Tilted Optimized Non-saturation Excitation) and MTC (Magnetization Transfer Contrast) techniques for improved Contrast-to-Noise Ratio (CNR)

Image processing tools

- MPR, MIP, MinIP, and 3D SSD
- Inline MIP for immediate results
- Inline subtraction of pre- and post-contrast measurements
- Inline standard deviation maps of Phase-Contrast measurements for delineation of arteries and veins

Cardiac Suite

The cardiac suite covers comprehensive 2D routine cardiac applications, ranging from morphology and ventricular function to tissue characterization. Featuring *syngo* BEAT 2D in conjunction with iPAT and T-PAT techniques.

Cardiac views

- Fast acquisition of the basic cardiac orientations for further examination planning
- Cardiac scouting provides users with a step-by-step procedure for the visualization and planning of typical cardiac views, e.g. based on TrueFISP or Dark Blood TurboFLASH: short axis, 4-chamber and 2-chamber views.

syngo BEAT

- Unique tool for fast and easy cardiovascular MR imaging
- E.g. 1 click change from FLASH to TrueFISP for easy contrast optimization
- 1-click to switch arrhythmia rejection on / off
- 1-click change from Cartesian to radial sampling to increase effective image resolution (e.g. in pediatric patients) and avoid folding artifacts in large patients

Visualization of structural cardiovascular pathologies with CMR - syngo BEAT

- Breath-hold and free breathing techniques for strong contrast between the blood and vascular structures. Dark Blood TSE and HASTE imaging are available for the structural evaluation of the cardiothoracic anatomy, including vessels or heart valves. Cine techniques (FLASH & TrueFISP) for high-resolution valve evaluation
- Multiple contrasts such as T1- and T2-weighted imaging for use in diseases such as

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myocarditis (inflammation / hyperaemia), ARVD (fibrous-fatty degeneration) or acute myocardial infarction (edema)

- Dark-blood TSE with motion compensation for high-quality vessel wall imaging in small or large vessels

Tools for rapid evaluation of left or right ventricular function

- Acquisition of a stack of short-axis slices (standard segmented FLASH, or advanced segmented TrueFISP)
- Automatic adjustment of the acquisition window to the current heart rate
- Use of the Inline ECG for graphical ECG triggering setup
- Retrospective gating with cine sequences (TrueFISP, FLASH)
- Protocols for whole-heart coverage
- iPAT integration for highest temporal and spatial resolution
- Real-time imaging in case the patient is not able to hold his breath

Dynamic imaging and tissue characterization with syngo BEAT

- Protocols for high-contrast and high-resolution tissue characterization
- Protocols for stress and rest imaging with TrueFISP or TurboFLASH contrast support the acquisition of multiple slices with high resolution and arbitrarily adjustable slice orientation for each slice
- T-PAT with mSENSE and GRAPPA for advanced parallel imaging provides fast high-resolution dynamic imaging
- Segmented IR TrueFISP / FLASH with TI scout for optimization of tissue contrast
- Advanced tissue characterization with 2D phase-sensitive IR (PSIR) sequences TrueFISP and FLASH contrast. Magnitude and phase-sensitive images with one acquisition
- Simple: no adjustment of inversion time (TI) necessary with PSIR technique
- Ungated single-shot PSIR imaging for tissue characterization under difficult conditions: free-breathing technique that can be applied even in case of arrhythmia

Physiological Measurement Unit (PMU) - Wireless Physio Control

- Synchronizes the measurement with the physiological cycles (triggering to minimize motion artifacts caused by cardiac and respiratory movements)
- Wireless Sensors
- Wireless Vector ECG / respiration and pulse sensors for physiologically synchronized imaging, rechargeable battery-powered - for optimized patient handling
- Physiological Signals Display
- ECG (3 channels)
- Pulse
- Respiration
- External Trigger Input Display

ECG Triggering:

- Acquisition of multiple slices, e.g. of the heart, at different phases of the cardiac cycle
- Excellent image quality by synchronizing data acquisition with cardiac motion
- Peripheral Pulse Triggering: Reduces flow artifacts caused by pulsatile blood flow
- Excellent image quality by synchronizing data acquisition to the pulsatile blood flow
- Respiratory Triggering: Excellent image quality by synchronizing data acquisition with the respiratory motion
- External Triggering: Interface for trigger input from external sources (e.g. Patient Monitoring System) inside the examination room
- Interface for trigger input from external sources (e.g. pulse generator, trigger sources for fMRI) outside the examination room
- Optical trigger output for fMRI
- Retrospective gating for ECG, peripheral pulse, and external trigger input

Breast Suite

MR imaging has proven a very high sensitivity for breast lesions and is the gold standard for the examination of silicone implants. Extremely high spatial and temporal resolution can be achieved in very short measuring times by using iPAT with GRAPPA.

Excellent soft tissue differentiation, customized protocols (e.g. with fat saturation or water excitation or silicone excitation), as well as flexible multiplanar visualization allow for fast, simple and reproducible evaluation of MR breast examinations.

This package includes:

- Quantitative evaluation and fast analysis of the data with colorized Wash-in, Wash-out, Time-To-Peak, Positive-Enhancement-Integral, MIPtime and combination maps with Inline technology or for offline calculation
- High-resolution 2D protocols for morphology evaluation
- High-resolution 3D protocols covering both breasts simultaneously
- Protocols to support interventions (fine needle and vacuum biopsies, wire localization)
- Protocols for evaluating breasts with silicone implants
- Automatic and manual frequency adjustment, taking into account the silicone signal
- Detection of the silicone signal either to suppress the silicone signal, if the surrounding tissue is to be evaluated, or to suppress the tissue signal in order to detect an implant leakage
- SPAIR - robust fat sat (robust fat suppression using an adiabatic frequency selective inversion pulse)
- DIXON - 2-point Dixon with 3D VIBE, the following contrasts can be obtained: in-phase, opposed phase, fat and water image.
- iPAT with GRAPPA for maximum resolution in short time
- Inline subtraction and MIP display
- Offline subtraction, MPR and MIP display
- *syngo* REVEAL: diffusion imaging for breast exams
- iPAT Extension that allows state-of-the-art sagittal breast imaging
- iPAT Extension allows bilateral 3D sagittal breast imaging with Fat Sat or Water excitation

The Breast Suite also includes:

***syngo* VIEWS (Volume Imaging with Enhanced Water Signal)**

- bilateral - both breasts are examined simultaneously
- axial - the milk ducts are directly displayed
- fat-saturated or water-excited - fat complicates clinical evaluation and is suppressed
- near-isotropic 3D measurement - the same voxel size in all three directions for reconstruction in any slice direction
- submillimeter voxel - highest resolution for precise evaluation

Body Suite

Body Suite covers your needs for clinical body applications. Ultrafast high resolution 2D and 3D protocols are provided for abdomen, pelvis, MR Colonography, MRCP, dynamic kidney, and MR Urography applications. Siemens unique 2D PACE technique makes body imaging easy allowing for multi-breath hold examinations as well as free breathing during the scans. Motion artifacts are greatly reduced with 2D PACE Inline technology.

This package includes:

- Free breathing 2D PACE applications with 2D/3D HASTE (RESTORE) and 2D/3D TSE (RESTORE)
- Optimized fast single shot HASTE protocols and high-resolution 3D RESTORE protocols based on SPACE and TSE for MRCP and MR Urography examinations

ABDOMEN:

2D:

- T1w (FLASH) breath-hold scans +/- Fat Sat (SPAIR, Q-FatSat, in-/opp-phase)
- T2w (HASTE, TSE/BLADE, EPI) breath-hold scans +/- Fat Sat (SPAIR, FatSat, STIR)

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- T1w (TFL) triggered scans (2D PACE free breathing) in-/opp-phase
- T2w (HASTE, TSE/BLADE, EPI) triggered scans (2D PACE free breathing) +/- Fat Sat (SPAIR, FatSat, STIR) as well as HASTE- and TSE-multi-echo
- Optimized fast single shot HASTE protocols and high-resolution 3D RESTORE protocols based on SPACE and TSE for MRCP and MR urography examinations

3D:

- Dixon (VIBE 2pt-Dixon) breath-hold scans, following contrasts can be obtained: in-phase, opposed phase, fat and water image.
- Dynamic (VIBE + Q-FatSat) protocols for best visualization of focal lesions with high spatial and temporal resolution
- Colonography dark lumen with T1-weighted VIBE
- CAIPIRINHA enables VIBE sequence with improved iPAT2 algorithm to improved abdominal dynamic scans as well as SNR. Reduced patient stress can be achieved through reduced acquisition (and breathhold) times.

PELVIS:

- High-resolution T1w, T2w pelvic imaging (prostate, cervix)
- Isotropic T2w SPACE 3D protocols for tumor search in the pelvis
- Dynamic volume examinations with 3D VIBE
- *syngo* REVEAL: diffusion imaging for liver and whole body exams

Onco Suite

MR imaging has an excellent advantage of soft tissue contrast, multi-planar capabilities and the possibility of selectively suppressing specific tissue e.g. fat or water. This helps visualize pathologies, particularly metastases. The Onco Suite features a collection of sequences as well as protocols and evaluation tools that guide through a detailed screening of clinical indications, such as in hepatic neoplasms.

This package includes:

- STIR TSE and HASTE, FLASH in-phase and opposed-phase protocols with a high sensitivity to metastases visualization
- Dynamic imaging protocols for assessment of the kinetic behavior for lesion visualization and characterization
- Quantitative evaluation and fast analysis of the data with colorized Wash-in, Wash-out, Time-To-Peak, Positive-Enhancement-Integral, MIPTIME and combination maps with Inline technology or for offline calculation
- Display and analysis of the temporal behavior in selected regions of interest with the included MeanCurve postprocessing application. This includes the capability of using additional datasets as a guide for defining regions of interest even faster and easier than before.
- *syngo* REVEAL: diffusion imaging for liver and whole body exams

Dedicated prostate protocols for detection, localization, and staging of tumors and recurrences

- *syngo* REVEAL (diffusion-weighted imaging)
- Protocols with high temporal resolution allow time course evaluation based on pharmacokinetic modeling

Ortho Suite

Ortho Suite is a comprehensive collection of protocols for joint and spine imaging. MR imaging is especially suitable for avascular necrosis and internal derangements. The protocols included in this Suite can also be applied for imaging of tumors and infections.

This package includes:

- 2D TSE protocols for PD, T1 and T2-weighted contrast with high in-plane resolution and thin slices
- 3D MEDIC, 3D TrueFISP protocols with water excitation for T2-weighted imaging with high in-

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- plane resolution and thin slices
 - High resolution 3D VIBE protocol for MR arthrography (knee, shoulder and hip)
 - 3D MEDIC, 3D TrueFISP, 3D VIBE protocols with water excitation having high isotropic resolution, optimized for 3D post-processing
 - PD SPACE with fat saturation and T2 SPACE with high isotropic resolution optimized for 3D post-processing
 - Whole spine single-step or multi-step protocols
 - Excellent fat suppression in off-center positions, e.g. in the shoulder due to high magnet homogeneity
 - Dynamic TMJ and ilio-sacral joint protocol
 - Susceptibility-insensitive protocols for imaging in the presence of a prosthesis
 - Multi-Echo SE sequence with up to 32 echoes for the calculation of T2 time maps (calculation included in the Scientific Suite)
 - High resolution 3D DESS (Double Echo Steady State): T2 / T1-weighted imaging for excellent fluid-cartilage differentiation
- syngo WARP Susceptibility Artifact Reduction*
- 2D TSE sequences with high bandwidth protocols tailored to reduce susceptibility artifacts. Available protocols include T1-weighted, T2-weighted, proton density and STIR contrast.

Pediatric Suite

The parameters for pediatric imaging vary significantly in comparison to the parameters for adults. The reasons are developing tissues, body size, faster heart rates and restricted compliance with breath-hold commands. Protocols can be adapted for imaging infants.

Scientific Suite

Scientific Suite supports the scientifically oriented user with an easy access to application-specific data for further processing and advanced image computation methods.

- Support of USB memory sticks
- Access to the file system by means of a secure and convenient browser
- Anonymization of patient data
- Easy generation of AVIs and screenshots for integration into presentations and training videos
- Export function for tables, statistics and signal-time-courses in a communal format (MeanCurve, Spectroscopy, DTI evaluation)
- Advanced image computation methods such as T2 and T1 time calculation, addition, subtraction, multiplication, division, and integration of images

Whole Body Suite

Tim and the Tim Whole Body Suite enable for true whole body MR scanning for head-to-toe imaging. Whole body imaging with highest image quality without patient repositioning and without the need to change a single coil, not even once, this means whole body imaging without compromise.

- The all-new Tim Table or Tim Dockable Table enable a full Field-of-View with coverage up to 280 cm (6' 9"). The table top has the same length as the standard system without whole body capabilities. Additional free space is required at the rear part of the magnet to ensure, that the table movement is not limited by the rear wall.
- Table movement to its full extent can be remotely controlled from the operator console either by the operator or by sequence protocols.
- Protocols and programs for whole body MR angiography and morphology e.g. for metastasis visualization and preventive care examinations.
- Whole body MR Angiography is possible with high speed, high resolution and high image contrast on the entire volume combining high speed gradients and iPAT.
- The large FoV of 205 cm supports the assessment of metastases distribution in the body with

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sequences such as TIRM (Turbo Inversion Recovery).

The sequences, features and techniques for acquisition and reconstruction included in the Tim Application Suite are described in detail below.

Sequences

Spin Echo family of sequences:

- Spin Echo (SE) - Single, Double, and Multi Echo (up to 32 echoes); Inversion Recovery (IR)
- 2D / 3D Turbo Spin Echo (TSE) - Restore technique for shorter TR times while maintaining excellent T2 contrast; TurboIR: Inversion Recovery for STIR, DarkFluid T1 and T2, TrueIR; Echo Sharing for dual-contrast TSE
- 2D / 3D HASTE (Half-Fourier Acquisition with Single Shot Turbo Spin Echo) - Inversion Recovery for STIR and DarkFluid contrast
- SPACE for 3D imaging with high isotropic resolution with T1, T2, PD, and DarkFluid Contrast

Gradient Echo family of sequences:

- 2D / 3D FLASH (spoiled GRE) - dual echo for in- / opposed phase imaging 3D VIBE (Volume Interpolated Breathhold Examination) - quick fat saturation; double echo for in-phase / opposed phase 3D imaging; DynaVIBE: Inline 3D elastic motion correction for multi phase data sets of the abdomen; Inline Breast Evaluation
- 2D / 3D MEDIC (Multi Echo Data Image Combination) for high resolution T2 weighted orthopedic imaging and excellent contrast
- 2D / 3D TurboFLASH - 3D MPRAGE; single shot T1 weighted imaging e.g. for abdominal imaging during free breathing
- 3D GRE for field mapping
- 2D / 3D FISP (Fast Imaging with Steady State Precession)
- 2D / 3D PSIF - PSIF Diffusion
- Echo Planar Imaging (EPI) - diffusion-weighted; single shot SE and FID e.g. for BOLD imaging and Perfusion-weighted imaging; 2D / 3D Segmented EPI (SE and FID)
- ce-MRA sequence with Inline subtraction and Inline MIP
- 2D / 3D Time-of-Flight (ToF) Angiography - single slab and multi slab; triggered and segmented
- 2D / 3D Phase Contrast Angiography •
- *syngo* BEAT Tool - TrueFISP segmented; 2D FLASH segmented;
- Magnetization-prepared TrueFISP (IR, SR, FS); IR TI scout; Retrogating

Standard Fat/Water Imaging:

- Fat and Water Saturation. Additional frequency selective RF pulses used to suppress bright signal from fatty tissue. Two selectable modes: weak, strong
- Quick FatSat
- SPAIR: robust fat suppression for body imaging using a frequency selective inversion pulse
- Fat / Water Excitation. Spectral selective RF pulses for exclusive fat / water excitation
- Dixon technique for fat and water separation - available both based on VIBE (2 point Dixon)

Standard Techniques:

- True Inversion Recovery to obtain strong T1-weighted contrast
- Dark Blood inversion recovery technique that nulls fluid blood signal
- Saturation Recovery for 2D TurboFLASH, gradient echo, and T1-weighted 3D TurboFLASH with short scan time (e.g. MPRAGE)
- Freely adjustable receiver bandwidth, permitting studies with increased signal-to-noise ratio
- Freely adjustable flip angle. Optimized RF pulses for image contrast enhancement and increased signal-to-noise ratio
- MTC (Magnetization Transfer Contrast). Off-resonance RF pulses to suppress signal from

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- certain tissues, thus enhancing the contrast. Used e.g. in MRA
- Argus viewer for reviewing cine studies
 - Report Viewer for DICOM structured reports including report editing
 - Dynamic Analysis for addition, subtraction, division, standard deviation, calculations of ADC maps, T1 and T2 values, TTP, t-Test, etc.
 - Image Filter
 - 3D post-processing MPR, MIP, MinIP, SSD
 - Flexible film formats and paper print
 - Data storage of images and cine AVI files on CD / DVD with DICOM viewer as the viewing tool for hand out to the patients or referrals
 - Selectable centric elliptical phase reordering via the user interface
 - Inversion Recovery to nullify the signal of fat, fluid or any other tissue
 - Multiple Direction Diffusion Weighting (MDDW) - perform diffusion tensor imaging with multiple diffusion weightings and up to 12 directions for generating data sets.

Standard techniques for Flow Artifact reductions:

- LOTA (LongTerm Data Averaging) technique to reduce motion and flow artifacts
- Pre-saturation techniques using RF saturation pulses to suppress flow and motion artifacts
- Tracking SAT bands maintain constant saturation of venous and/or arterial blood flow eg. for 2D/3D sequential MRA
- TONE (Tilted Optimized Non-saturating Excitation - variable excitation flip angle to compensate inflow saturation effects in 3D MRA - selectable on desired flow direction and speed
- Gradient Motion rephasing permitting effective reduction of flow artifacts

Standard Motion Correction:

- *syngo* BLADE - improves image quality by minimizing and correcting for the effects of motion during an MR sequence acquisition. e.g. head, spine, orthopedic imaging and the abdomen
- 1D PACE (Prospective Acquisition CorrEction) allows examination of patients with free breathing
- 2D PACE (Precise Motion Correction) detects and corrects respiratory motion eg of the heart or liver

MAGNETOM Prisma runs *syngo* MR software. *syngo*® is the unique software platform for medical applications. Parallel working and one-click exams are efficiently supported and increase productivity. Parallel scanning and reconstruction are standard.

The unique Phoenix technique is the easiest way to exchange protocol data. It supports intelligent extraction of sequence parameters from images acquired on a MAGNETOM Prisma system. Inline technologies, scan@center or AutoVoiceCommands speed up the workflow further.

The context-sensitive "Online Help" function and *syngo* Scan Assistant offer support and propose solutions to MR-specific questions and parameter conflicts.

Studies can be easily networked and managed using the standard DICOM 3.0 protocol for efficient support of workflow. The following standard functions are supported: Send/Receive, Query/Retrieve, Basic Print for DICOM-compatible laser cameras (Camera is not included in the basic unit. Verify if existing camera is compatible or order separately.), DICOM Worklist, DICOM Storage Commitment (SC) DICOM Modality Perform Procedure Step (MPPS), DICOM Structured Report (SR), DICOM Study Split

Patient Communication

- The intercom system includes an ergonomically designed patient communication unit for desktop positioning on the *syngo* Acquisition Workplace and pneumatic headphones for the

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patient.

- Active Noise Cancellation allows for increased user comfort in the control room combined with comprehensive patient supervision.
- Control features include an emergency table stop, volume control of speaker and headphones in the examination room, volume control of speaker in the control room, response to the patient's activation of the assistance-call button and provides a connection to an external audio system for music playback (external audio system is not included in the basic unit) .

Computer system

The high performance host computer and the new high performance measurement and reconstruction system are ideally suited for even the most demanding applications. The PC-based computer system uses the intuitive *syngo* MR user interface. The computer system includes the following components:

High-performance measurement and reconstruction system

- Two Intel Quadcore Processors \geq E 5690
- Clock rate of $\geq 2 \times 3.46$ GHz
- Main memory (RAM) ≥ 128 GB,
- Hard disk for raw data ≥ 750 GB
- Hard disk for system software ≥ 100 GB
- Parallel Scanning and Reconstruction of up to 8 data sets

GPU driven image reconstruction system with 2x Tesla C2075 GPGPU:

- Single Precision Performance: 515 GFLOPS
- Double Precision Performance: 1030 GFLOPS
- Memory Bandwidth: 148 GB/s
- Memory size: 6 GB GDDR5
- CUDA Cores: 448

- Reconstruction speed
 - 20,761 recons per second (256 x 256 FFT, full FoV)
 - 100,000 recons per second (256 x 256 FFT, 25 % recFoV)

High-performance host computer

- Intel Xeon processor \geq W3520 QuadCore
- clock rate ≥ 2.66 GHz
- Main Memory (RAM) ≥ 6 GB
- three hard disks
 - system SW ≥ 300 GB SAS
 - data base ≥ 300 GB SAS
 - images ≥ 300 GB SAS
- DVD-R writer for CD-R (approx. 4000 images 256² DICOM Standard, ISO 9660) and DVD-R (approx. 25 000 images 256² DICOM Standard, ISO 9660) storage of DICOM data or other data like AVI files
 - DVD-ROM drive
 - Mouse.

- The combination of host computer and the measurement and reconstruction system offers a truly powerful imaging system designed for large image matrix sizes of up to 1024 x 1024. The unrestricted multitasking capability allows time-saving parallel scanning and reconstruction.
- High-resolution 19" color LCD flatscreen monitor with 1280 x 1024 pixel display, integrated gamma correction for optimum display of radiographic grayscale images and automatic backlight control for longterm brightness stability.

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Installation:

- The compact integrated design allows for short installation times and reduces the required space to less than 33 sqm (334 sq. ft.) for the entire installation. The necessary room height clearance is 273 cm.
- MAGNETOM Prisma allows siting of the system without a dedicated computer room - no additional cooling or floor requirements.
- MAGNETOM Prisma combines state-of-the-art performance with peace of mind. High system availability is ensured by the expert, highly trained Siemens MR service engineers;
- Your Siemens service contract (not included in the basic unit) offers a comprehensive range of benefits such as Uptime Remote Diagnostics for improved productivity and maximum uptime.

**2 Tim [204x64] XR Gradients #P
14432224**

Tim [204x64] XR gradients performance level

Tim 4G's RF system and innovative coil architecture enables high resolution imaging and increased throughput. Up to 204 simultaneously connected coil elements allow in combination with the fully integrated 64 independent RF channels for the most flexible parallel imaging and support the most demanding applications. Maximum SNR is ensured through the new Tim 4G matrix coil technology.

XR gradients

The XR 80/200 gradients are the most powerful commercially available gradients of any clinical scanner currently on the market. The XR gradients combine a maximum gradient amplitude of 80 mT/m with a 200 T/m/s slew rate, capable of driving higher SNR throughout all regions of the body. Even under the highest stress conditions, the XR gradients bring the best performance thanks to a rock-solid design. Dedicated force compensation on each axis yields low vibrations and low acoustic noise while the high-performance cooling for each individual axis allows full duty cycle over long-term measurements with outstanding stability. The XR 80/200 gradients push the limits of performance to a new level.

Tim 4G offers DirectRF - a completely redesigned RF architecture. This new all digital-in/ digital-out design integrates all RF transmit and receive components at the magnet, eliminating analog cables for true signal purity. This compact and efficient design enables an dynamic feedback control for temporal stability and power linearity.

The all-new innovative coil architecture packs more coil elements in a smaller space and allows for simultaneous connection of up to 204 coil elements. Combined with the 64 independent RF channels advanced iPAT capabilities and SNR are enabled.

An additional benefit of multiple coil elements and receiver channels is improved performance in multi-directional, i.e. three dimensional, high-speed, high-resolution iPAT in the head-feet, anterior-posterior or left-right directions.

XR gradients

Siemens XQ gradients provide actively shielded, water cooled worldclass gradients. All axes are force-compensated.

The XR gradients have:

- Maximum gradient amplitude of 80 mT/m, per axis, i.e. 139 mT/m vector summation gradient performance,
- Maximum slew rate 200 T/m/s per axis, i.e. 346 T/m/s vector summation,
- Minimal rise time 400 μ s, from 0 to 80 mT/m amplitude
- Maximum output voltage for each of the gradient axes 2250 V
- Maximum output current for each of the gradient axes 900 A
- Separate cooling channels that simultaneously cool primary and secondary coils allow the

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- application of extremely gradient intensive techniques in a new class of performance.
- 100% duty cycle for fast and demanding techniques such as ultra-short TE MRA in continuous operation, thin slice single
- breath-hold liver studies and EPI imaging techniques (all optional in appropriate clinical packages).
- Variable Field-of-View selection from 0.5 cm to 50 cm for optimal coverage and highest spatial resolution in diagnostic. The minimum slice thickness in 2D and 3D is 0.1 mm and 0.05 mm, respectively.
- Acquisition of sagittal, transverse, coronal, single oblique and double oblique slices with highest resolution.
- The extremely compact water-cooled gradient amplifier features a modular expandable design with excellent linearity and pulse reproducibility. It is digitally controlled and has very low switching losses due to ultrafast solid state technology.

- 3 PC Keyboard US English #Tim
08464872
Standard PC keyboard with 101 keys.

The keys of the numerical key panel are assigned to syngo-specific functions and labeled with the corresponding syngo icons. The keyboard supports the country specific special characters.

- 4 Tim Table #P
14432226

The new Tim Table is designed for maximized patient comfort and smooth patient preparation. The unique design of the Tim Table can support up to 250 kg (550 lbs) patients without restricting the vertical or horizontal movement.

The new MAGNETOM Prisma table with its light appealing design allows for a fast patient preparation and maximized patient comfort.

It provides unobstructed foot space for attending staff and direct access to the patient. The patient table can be lowered to a minimum height of 64 cm from the floor, for easier patient positioning and better accessibility for geriatric, pediatric or immobile patients. The Tim Table can be moved with two clicks into the isocenter - one click to the upmost position and one click into the isocenter. The tabletop travels beyond the rear end of the system, enabling additional patient access. An infusion stand is integrated to allow for fast patient set up of critical patients.

Multiple Tim 4G coils can be connected at once for efficient and patient friendly examinations. The seamless integration of multiple Tim 4G coils is possible via 4 SlideConnect and 4 DirectConnect connector slots, which are embedded in the table. This allows for comprehensive examinations without the need of repositioning.

- 5 Flow Quantification #Tim
08464740
Special sequences for quantitative assessment of flow.

Flow Quantification enables the acquisition of flow encoded images and the evaluation of blood as well as of cerebro-spinal fluid (CSF).

Sequences include:

- ECG triggered 2D phase contrast with iPAT support
- Retrospective reconstruction algorithms for full R-R interval coverage
- Maxwell Term Compensation

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- 6 RESOLVE #T+D
14430391
RESOLVE is a diffusion-weighted, readout-segmented EPI sequence optimized towards high resolution imaging with reduced distortions.
The sequence uses a very short echo-spacing compared to single-shot EPI, substantially reducing susceptibility effects. A 2D-navigator correction is applied to avoid artefacts due to motion-induced phase errors. This combination allows diffusion weighted imaging of the breast, prostate, brain and spine with a high level of detail and spatial precision.
- RESOLVE is a diffusion-weighted, readout-segmented EPI sequence optimized towards high resolution imaging with reduced distortions.
The sequence uses a very short echo-spacing compared to single-shot EPI, substantially reducing susceptibility effects. A 2D-navigator correction is applied to avoid artefacts due to motion-induced phase errors. This combination allows diffusion weighted imaging of the breast, prostate, brain and spine with a high level of detail and spatial precision.
- Additionally, an automatic reacquisition of data with large phase errors can be used to ensure that diffusion-weighted images of the brain are not affected by CSF pulsation.
- 7 Arterial Spin Labeling 3D #T+D
14416965
ASL is a non contrast enhanced brain perfusion technique. A 3D volume is acquired with high SNR by using a turbo gradient spin echo technique and an ASL preparation module to achieve clinically feasible scan times.
- 3D acquisition of non-contrast enhanced brain perfusion with a TGSE sequence for minimal susceptibility and full brain coverage. Higher SNR, optimized contrast uniformity and reduced motion sensitivity. Inline calculation of PWI (perfusion weighted images) for a qualitative assessment of brain perfusion.
- 8 Arterial Spin Labeling 2D
14409110
ASL is a non contrast enhanced brain perfusion technique. EPI sequence enhanced for PASL (Pulsed Arterial Spin Labeling) with preparation module (inversion pulse, saturation pulses) and selectable prospective motion correction. Perfusion-weighted color maps and relative cerebral blood flow (relCBF) color maps are calculated with Inline technology.
- 2D multi-slice EPI sequence with full iPAT compatibility for rapid assessment of relative CBF. Consists of a spatially selective inversion pulse combined with different types of saturation pulses (slice presaturation, label slab saturation) and can be classified under PASL (Pulsed Arterial Spin Labeling). Fully automated Inline calculation of relCBF color maps for assessment of perfusion. Prospective motion correction and spatial filtering can be applied to the inline calculation to improve the image quality.
- 9 Head/Neck 64 #P,Sk
14432234
Tim 4G coil technology with Dual Density Signal Transfer and DirectConnect Technology combines key benefits translating into excellent image quality: highest SNR, extreme iPAT performance, high patient comfort, and unmatched flexibility.
- The 64-channel head/neck coil with its 64 integrated pre-amplifiers ensures an outstanding signal-to-noise ratio. The unique DirectConnect and SlideConnect technologies allow users to connect 64 coil elements of the Head/Neck 64 with just one cable. The very open design ensures its patients

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will feel comfortable, while the anatomic design ensures highest signal-to-noise.

The Head /Neck 64 features:

- 64-element design with 64 integrated preamplifiers, 40 elements in the head region 24 elements in the neck region.
- Integrated SlideConnect and DirectConnect technology
- Combined head/neck coil for an optimized workflow
- Upper coil part removable
- Lower coil part usable without upper part for highly claustrophobic patients
- Smoothly integrates into the patient table with Spine 32
- Open patient-friendly design
- Cushioned head stabilizers (removable)
- No coil tuning
- iPAT-compatible in all directions
- Optimized for sequences using iPAT²
- Dual-Density Signal Transfer enables ultrahigh density coil designs by integrating key RF components into the local coil
- Rear opening for up to 128 EEG electrode leads
- Detachable look-out mirror

Applications:

- Head examination
- Neck examination
- Cervical spine examination
- MR Head Angiography, also time-resolved
- MR Neck Angiography
- Combined head/ neck examination
- TMJ (temporo mandibular joints)

Typically combined with:

Spine 32, Body 18, Peripheral Angio 36 (during whole body imaging) or flexible coils such as Flex Large 4

The Head /Neck 64 supports high quality imaging with an 64-element design and 64 integrated preamplifiers. The DirectConnect and SlideConnect technology enables fast and easy patient set up.

The open and light design of the upper coil part increases patient comfort and is removable for easy patient handling.

The lower coil part may remain on the table for most of the examinations can be used without the upper part.

The Head/Neck 64 and Spine 32 coils are smoothly integrated into the patient table, thus enabling high flexibility in imaging and facilitating fewer coil changes and easy handling when switching patients.

The Head /Neck 64 coil is equipped with two removable cushioned head stabilizers for stable and comfortable patient positioning. A detachable look-out mirror for increased patient comfort. The double mirror design shows all objects in their correct up/down and left/right orientation. It might also be used for visual fMRI studies. The open design is great for claustrophobic patients and allows for easy integration of the coil with existing stimulation devices e.g., NNL goggles. It attaches to the upper part of the coil and enables the patient to look outside even when his head is

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in the center of the magnet. No tuning of the fully iPAT-compatible Head/Neck 64 is necessary. The coil is equipped with a rear opening to accommodate up to 128 electrode leads for use in a combo MR/EEG examination.

The Head/Neck 64 can be used for applications like head examinations, neck examinations, MR Angiography, combined head/neck examinations (or for imaging of the TMJ (temporo mandibular joints). Typically combined with the Spine 32 and Body 18 or Peripheral Angio 36. Furthermore the combination of flexible coils like the Flex Large 4 is possible. The improvements in neck imaging (C spine) will be clearly visible due to the aggressively tailored anatomical design of the coil.

The dimensions of the Head/Neck 64 are 435 mm × 395 mm × 350 mm (L x W x H), its weight is less than 5.2 kg (11 lbs).

10 MAGNETOM Prisma Install., EUR 14436659

Transport, delivery, rigging, installation and cabling of all system components in appropriately prepared rooms according to the installation instructions supplied with the system are carried out by our service providers Hegele or UPS SCS.

These jobs include among others:

- Positioning of the components
- Installation and fastening of the MR System
- Installation and cabling of the hardware options
- Installation and cabling of the MR components in the RF cabin, operator room and control room
- Installation of filter plate
- Installation of magnet cover
- Finally, after the magnet has been positioned, (e.g. disposal of used packaging material), return of reusable pallets to Erlangen (e.g. the pallet for the filter plate)

Installation requirements are given in the Planning Guide.

For jobs not covered by the installation lump-sum please refer to Info **M 9-050-2**, „**INSTALLATION**“, Chapter „**MAGNETOM Installation**“.

11 Separator 60kW 14418489

The SEP (Separation cabinet) has to be used if a central hospital chilled water supply is available or if a chiller of any brand/type is already available.

The SEP is the interface between the on-site water chiller (of any brand or type) or the interface to the central hospital cooling water supply.

For the above-mentioned cases the SEP is mandatory!

In these cases, the primary water specifications must fulfill the requirements (i.e. 63 kW heat dissipation; 100+-10l/min flow; 6 to 12°C water temperature; pH value 6 to 8, max. working pressure 6 bar).

Dimensions: 1950mm x 650mm x 650mm (height x width x depth)

Weight: approx. 340kg

Function:

- Interface between the on-site water chiller (of any brand/type) or
- Interface to the central hospital chilled water supply.

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Delivery volume:

- Separator
- Two 3.0 m hoses (forward and return) for connecting the SEP to the local cooling water supply system
- Separation cabinet
- With the SEP configuration, the helium compressor is built into the SEP cabinet and connected internal
- Regional specific adapter for connection to the hospital installation

RF cabins MAGNETOM systems and Biograph mMR

- 12 RF-Cabin, Steel #3T
14413606

Steel full-room RF cabin, module method of building, for MAGNETOM Trio a Tim System, Verio and Prisma.

Standard cabin outside dimensions:

L x W x H = 7.590 x 4.590 x 3.000 mm

Screen damping value:

90 dB (Co-Siting 100 dB) at 15 until 130 MHz.

The following elements are included in the standard scope of supply:

- floor, side and ceiling panels including contact material
- floor panels with standard floor (without floor covering)
- sound protection door [>44 dB(A)] with door handle and lock, 1,200 x 2,100 mm
- filter panel with 1 pc. frame for the filter plate, including 3 pcs. tube leads (d=50 mm) for medical gases
- observation window (W x H = 1,200 x 800 mm) in the side panel
- tube lead d=150 mm with 2 pcs. flanges for quench tube
- 2 pcs. honeycombs 514 x 289 mm for the air conditioning
- insulated ring bolts for ceiling panel suspension
- 1 pc. plastic foil for insulated cabin installation

- 13 RF-Cabin Installation, EUR #3T
14401488

Installation of an RF cabin in modular construction from Albatross Projects GmbH.

Cabin size: L x W x H = 7600 x 4600 x 3000 mm.

Scope of supply:

- Floor, wall and ceiling setup
- Fitting of door, observation window and RF feed-throughs
- Fitting of honeycomb window inserts and mounting of fixing brackets for internal completion
- RF test measurements and documentation thereof

- 14 DTI Package #P
14436656

The DTI Package is a bundle of:

- Diffusion Tensor Imaging
- DTI Evaluation and
- DTI Tractography syngo

The bundle comprehends all acquisition and postprocessing tools for comprehensive DTI exams.

Diffusion Tensor Imaging

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Diffusion Tensor Imaging allows for a complete description of the diffusion properties of the brain within the scope of the tensor diffusion model, both for anisotropic and isotropic diffusion. Efficient diffusion direction schemes are pre-defined to allow for optimal diffusion directional resolution. Schemes with up to 256 directions can be selected.

Inline technology enables automatic and immediate calculation of the diffusion tensor, including grey-scale and colored "fractional anisotropy" (FA) map derived from it.

With the addition of DSI, it is possible to acquire diffusion data in up to 514 different directions each with independent b-values.

Details:

- Measurements with up to 256 different directions and with up to 16 different b-values
- Inline calculation of tensor, grey-scale and colored FA map, ADC map and trace-weighted image
- Support of parallel imaging (iPAT)
- Clinical protocols with full head coverage, incl. inline calculation of tensor, FA, ADC and trace-weighted images in 4 minutes.

DTI Tractography *syngo*

syngo DTI Tractography is optimized for the clinical use by providing advanced 3D visualization of white matter tracts in the context of 2D or 3D anatomical datasets and DTI datasets. DTI data sets can be explored fast and intuitively using the interactive QuickTracking. QuickTracking instantaneously displays the tract originating from the mouse pointer position while moving over the DTI data set. This also allows identifying qualified regions to place seeding ROIs. Seed points can be set to assess connectivity by tracking with single ROI and with multiple ROIs. Furthermore they can be placed in fused views displaying the anatomical reference and e.g. the colored FA map simultaneously.

Texture Diffusion, a highly versatile in-plane visualization of white matter tracts, allows to display and read DTI Tractography results on PACS reading stations and in the OR.

At the same time the package provides the scientific user with the flexibility to configure the tracking algorithm and to change display settings for the tracts. Tract and seeding ROI statistics are included to support publications (e.g. mean/max FA value, min/mean/max ADC value). All views can be exported as DICOM images or bitmaps. Tract and seeding ROI statistics can be exported as html files.

DTI Evaluation

Clinical applications are supported by a dedicated DTI evaluation mode to support diagnostics of white matter diseases (e.g. multiple sclerosis and brain maturation disorders). Based on the tensor, in addition to the already inline-calculated parameter maps, further maps characterizing the anisotropy of diffusion properties can be calculated and stored. Multiple diffusion parameter maps (e.g. Fractional Anisotropy, ADC, b=0) and an anatomical image are displayed next to each other in the same slice position for comparison. The images can be evaluated together based on ROIs and the results can be documented in a table. The display options include 2D and 3D tensor graphics, colour-coded images and overlay images on the anatomical images.

In addition, the package offers the scientific user full flexibility of 2- and 3-dimensional visualization of the diffusion tensor with measures of isotropic and anisotropic (fractional and relative) diffusion, Eigen vectors (E1, E2, E3) of the diffusion tensor and shape-descriptive measures of the diffusion tensor (linear, planar, spherical).

15 Inline BOLD Imaging #Tim 07820090

The BOLD imaging package is based on blood oxygen level dependent (BOLD) contrast-sensitive single-shot EPI sequences.

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Inline technology enables the automatic real-time calculation and display of statistical (t-value) images during the measurement of BOLD paradigms (including 3D motion correction and spatial filtration). The mosaic image format is supported. Clinical protocols are prepared. With Inline BOLD Imaging, functional brain mapping can be optimally integrated into clinical routine, e.g. prior to neurosurgical interventions.

The BOLD imaging package allows the user to define protocols which, apart from the measurement, configure automatic evaluation of the measured data during the scan. With Inline Technology it is thus possible to generate statistical images (t-value) based on 3D motion corrected and spatially filtered data automatically in real time without any further user interaction. The Inline display of activation cards allows the user to decide during the scan whether enough statistical power has built up for his brain mapping task or if the examination is corrupted by motion. As a result examinations will be shorter with a higher success rate. Functional brain mapping can be easily integrated into the clinical routine e.g. prior to neurosurgical interventions.

Additional Features:

- Inline retrospective 3D motion detection and correction in 3 rotational and 3 translational directions
- Inline t-statistics calculation for variable paradigms and display of t-value images
- Statistical evaluation by means of "General Linear Model (GLM)"
- Paradigms can be configured
- Transitions between passive and active states can be modeled by the hemodynamic response function
- Correction of low-frequency trends
- Allows for time delays due to the BOLD-EPI slice order during a measurement
- Display of GLM design matrix
- Display of a continuously updated t-value card during measurement
- Display of colored activation cards continuously updated during measurement, overlaid over the respective BOLD images using Inline technology
- MOSAIC image mode for accelerating display, processing and storage of images

16 3D PACE syngo #Tim 14405330

3D PACE (Prospective Acquisition CorrEction) enhances Inline BOLD imaging with motion correction during the acquisition of a BOLD exam. In contrast to a retrospective motion correction that corrects previously acquired data, the unique 3D PACE tracks the head of the patient, correcting for motion in real time during the acquisition.

By tracking the patients head 3D PACE reduces motion resulting in increased data quality beyond what can be achieved with a retrospective motion correction. As a result the sensitivity and specificity of BOLD experiments are increased.

Features:

- Real time prospective motion correction: Highest accuracy real time motion detection algorithm feeding a real time feed back loop to the acquisition system with updated positioning information
- 3D motion correction for 6 degrees of freedom (3 translation and 3 rotation)
- Motion related artifacts are avoided in first place instead of correcting for them retrospectively
- Significant reduction of motion-related artifacts in statistical evaluations
- Increased sensitivity and specificity of BOLD experiments

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17 fMRI Trigger Converter
14405316

An optical trigger signal is available to trigger external stimulation devices in fMRI experiments. With the "fMRI Trigger Converter" this signal can be converted to an electrical signal (TTL/BNC and RS 232 interface for PC; modes: toggle or impulse).

Znalecký posudek – Alard Roebroek

vypracovaný za účelem pořízení technologie

„Dodávka experimentálních lidských celotělových 3T MR tomografů pro CEITEC MU“

v rámci projektu „CEITEC – Středoevropský technologický institut“,
registrační číslo projektu CZ.1.05/1.1.00/02.0068.

Objednatel

Jméno:	Masarykova univerzita, CEITEC MU
se sídlem:	Žerotínovo nám. 9, 601 77 Brno,
IČ:	00216224,
DIČ:	CZ00216224,
Zástupce:	prof. RNDr. Jaroslav Koča, DrSc.,
Kontaktní osoba:	JUDr. Pavel Vacek,
Tel./Fax:	549 493 669,
E-mail:	pavel.vacek@ceitec.muni.cz

Znalec

Jméno:	Dr. Alard Roebroek
Adresa:	Oxfordlaan 55, Maastricht, Nizozemsko

Soudní znalec: Dr. Alard Roebroek, znalec předkládající tento posudek, je odborným asistentem na Oddělení kognitivní neurovědy Maastrichtské univerzity a vedoucím laboratoře MR ve středisku Scannexus B.V. v Nizozemsku. Intenzivně se věnuje specifikacím MR systémů, porovnáváním prodejců MR systémů a nákupu MR systémů pro novou výzkumnou laboratoř MRI „Brains Unlimited“, kterou v rámci Maastrichtské univerzity provozuje středisko Scannexus. Zmíněná laboratoř v současné době používá přístroje Siemens Prisma Fit, Siemens Magnetom 7T a Siemens Magnetom 9.4T. Ústav dr. Roebroeka má uzavřenu vzorovou dohodu o výzkumu se společností Siemens Healthcare; se společností Siemens Healthcare také v rámci Nizozemska a Německa aktivně spolupracuje.

V Maastrichtu dne 18. listopadu 2013

/podpsán alroebroek/
podpis, otisk znalecké pečeti

Na základě písemné žádosti objednatele ze dne 29. října 2013 byl vypracován následující posudek pro potřeby realizace projektu „**CEITEC – Středoevropský technologický institut**“, reg. č. CZ.1.05/1.1.00/02.0068, jehož cílem a předmětem je posouzení unikátnosti technologie „**Dodávka experimentálních lidských celotělových 3T MR tomografů pro CEITEC MU**“ a cenová adekvátnost stávající nabídky.

Technická specifikace

Základní požadavky	
<p>Dva nové celotělové MR tomografy s indukci magnetického pole o velikosti 3T, se supravodivým, aktivně stíněným magnetem a širými vyšších řádů, které budou určeny pro celotělovou diagnostiku a výzkum u lidí. Rozsah diagnostických vyšetření musí zahrnovat nejmodernější experimentální i klinická neurologická/neurovědní vyšetření (např. funkční MRI, mnohasměrové difuzní měření s možností mapování tenzorů difúze, 3D traktografie, protonová lokalizovaná spektroskopie a spektroskopické zobrazování s možností rozšíření na multinukleární spektroskopii, anatomické zobrazování T1, T2 a PD vážené ve velmi vysokém rozlišení), nativní a kontrastní angiografie, zobrazování páteře a míchy. Rovněž musí být dodány odpovídající hardware, včetně vysoce výkonných gradientů a vysoce citlivých RF cívek. Požadavkem je kompatibilita s místem instalace.</p> <p>Systém A: funkční MRI vč. BOLD efektu a ASL perfúze, kontrastně obohacená perfúze, spektroskopie, SWI</p> <p>Systém B: funkční MRI vč. BOLD efektu a ASL perfúze, traktografie založená na difúzi</p> <p>Pracoviště: společné využití pro systémy A i B vybavené pro potřeby analýzy dat a rozvoje metod</p>	
Požadované technické a funkční vlastnosti	Požadovaná hodnota
(Nabídky musí splňovat všechny níže uvedené parametry. Hodnota porovnávaných parametrů se musí nacházet v rozmezí označeném jako „požadovaná hodnota“; hodnoty přesahující „hodnotový práh“ budou považovány za prahové hodnoty.)	
Magnet	
Magnet s polem 2,8-3,0 T a aktivním stíněním	ano
Bezodparový systém – spotřeba kapalného helia v litrech během prvních 5 let provozu	
Max. vzdálenost od izocentra s magnetickým polem přesahujícím 0,5 mT	na osách x, y max. 2,7 m, na ose z max. 3,7 m
Min. výška místnosti	max. 3,0 m
Hmotnost	max. 15000 kg
Průměr patientského otvoru v nejužším bodě	min. 60 cm
Rozsah snímání, zorné pole v jednotlivých osách (x, y, z)	min. 45 cm v každé ose
Časová stabilita pole	≤ 0,1 ppm/h
Homogenita statického Vrms (střední kvadratická odchylka na kulové ploše stanovená na základě alespoň 24 měření v 24 paralelních rovinách), DSV 100 cm	≤ 0,03 ppm
Homogenita statického pole Vrms (střední kvadratická odchylka na kulové ploše stanovená na základě alespoň 24 měření v 24 paralelních rovinách), DSV 20 cm	≤ 0,07 ppm
Homogenita statického pole Vrms (střední kvadratická odchylka na kulové ploše stanovená na základě alespoň 24 měření v 24 paralelních rovinách), DSV 30 cm	≤ 0,50 ppm

Homogenita statického pole Vrms (střední kvadratická odchylka na kulové ploše stanovená na základě alespoň 24 měření v 24 paralelních rovinách), DSV 40 cm	≤ 1,40 ppm
Max. obsah železa v podlaze	min. 80 kg/m ²
Chlazení místním okruhem chladicí vody?	ano
Gradientní systém	
Max. amplituda gradientního pole v každém směru	min. 75 mT/m
Max. rychlost přeběhu pro amplitudu 75 mT/m ve všech směrech	min. 200 T/m/s
Max. pracovní cyklus (zatížitelnost) gradientů	100 %
Aktivně stíněný?	ano
Chlazení místním okruhem chladicí vody?	ano
Radiofrekvenční systém	
Digitální s vysokou přesností	ano
Počet kanálů přijímače	min. 32, možnost rozšíření
Počet nezávislých vysílacích kanálů	min. 2
Šířka pásma každého nezávislého RF přijímacího kanálu	min. 1 MHz
Max. výkon vysílače	min. 35 kW
Možnost multinukleární spektroskopie (31P, 23Na, 19F, 13C)	ano
Pacientský stůl	
Určený pro celotělovou diagnostiku	ano
Max. zatížení	min. 200 kg
RF cívky odpovídající požadovanému rozsahu vyšetření	
Vícekanálová cívka pro diagnostiku hlavy, šimování RF pole, počet kanálů	min. 32 kanálů
Cívka pro vyšetření hlavy T/R (vysílací/přijímací)	ano
Celopátevní cívka	ano
Elektronické spínání cívky	ano
Automatické rozpoznání cívky	ano
Akviziční systém	
Barevný LCD monitor	úhlopříčka min. 19"
Moderní CPU (min. 2,4 GHz), hardwarová akcelerace (GPU)	ano
RAM	min. 4 GB
HD	min. 400 GB
Síťové rozhraní	1 Gbit/s
Rekonstrukce obrazu	min. 5000 obrazů/s pro obrazovou matici 256x256
Možnost kopírování parametrů vyšetření do nových akvizicí	ano
Možnost opakování studií při zachování předchozích parametrů	ano
Archivace dat na DVD/CD	ano
Synchronizace s ECG	ano
Synchronizace s respirací	ano
Velikost akviziční matrice nejméně 64x64 až 1024x1024	ano
Obrazový formát a protokol DICOM, vč. pracovního seznamu	ano
Požadovaná vyšetření, sekvence	

Standardní sekvence, jako jsou 2D, 3D akvizice T1, T2 (FSE, SE), PD, GRE pro MR angiografii nativní a kontrastní, SSFSE, TOF, DWI, EPI, SWI	ano
Angiografie (nativní a kontrastní) cév mozku a krku	ano
Vodní difúze v mozku (jeden záběr / více záběrů s vysokým rozlišením, zobrazování tenzorů difúze) a výpočty (ADC, DTI mapy)	ano
Vyšetření oblastí mozku, páteře, MR myelografie ve vysokém prostorovém rozlišení	ano
Sekvence pro funkční MR měření (BOLD, ASL)	ano
MR spektroskopie jednovoxelová, multivoxelová, 2D, 3D; stimulované echo, založená na spinovém echu, příprava magnetizace (voda, tuk, potlačení vnějšího objemu)	ano
Kontrastní perfúzní zobrazování (DCE, DSC) – měření a výpočty hemodynamických map	ano
Možnost vytváření uživatelských pulzních sekvencí a protokolů	ano
Dostupnost dat ve formátu RAW	ano
Min. tloušťka řezu 2D	max. 0,5 mm
Min. tloušťka řezu 3D	max. 0,1 mm
Software pro nezávislé pracoviště	
Software (prohlížení dat a analýza) pro nezávislé pracoviště	ano
Požadavky na specifikaci připojení do PACS	
Rozhraní Ethernet dle normy IEE 802.3	min. rychlost 100 Mb/s konektor RJ45 nebo metalické rozhraní (100BASE-TX, 1000BASE-T) Optické rozhraní MultiMode s konektory ST, SC, MTRJ, LC, E2000 (100BASE-FX, 100BASE-SX, 1000BASE-SX)
Komunikace přes protokol TCP/IP verze 4	ano
Komunikace s protokolem DICOM verze 3.0 nebo novějším	ano
Podpora těchto DICOM vlastností	Služba DICOM Verification Ukládání DICOM objektů na vzdálený DICOM systém Vázání uložených DICOM objektů na vzdáleném DICOM systému Dotaz na data na vzdáleném DICOM systému Vyvolání DICOM objektů ze vzdáleného DICOM systému Basic Worklist Management
Certifikace „DICOM Conformance Statement“ (Prohlášení o shodě)	ano
Ostatní požadavky	
Rozvaděč pro připojení k elektrickému rozvodu	ano
RF stínící kabina vč. pozorovacího okna, dveří a nezbytného vnitřního vybavení (podhled, obložení stěn, osvětlení, podlaha)	ano
Odvod helia – odtahové potrubí	ano

Kamera umístěná v prostoru vyšetřovny pro sledování vyšetřované osoby, možnost nahrávání (např. na externí digitální zařízení)	ano
Průchodky s demontovatelnými nebo odklápěcími krytkami mezi RF kabinou a ovladnou	2 průchodky, průměr každé alespoň 5 cm
Průchodky s demontovatelnými nebo odklápěcími krytkami mezi RF kabinou a technickou místností	2 průchodky, průměr každé alespoň 5 cm
Průchodka s demontovatelnými krytkami určená pro promítání obrazu do vyšetřovny (optická stimulace pro fMRI)	ano

Konfigurace vybavení (shrnutí nabídky firmy Siemens)

Systém A	Systém B	Pracoviště A
<p>MAGNETOM Prisma – systém</p> <ul style="list-style-type: none"> - 3T magnet (celotělový, supravodivý, aktivně stíněný, bezodparový pro helium, 50 cm FOV) - gradientní systém XR 80/200 (aktivně stíněný, vodou chlazený, kompenzace síly) - šimy 1. a 2. řádu - TimTX TrueShape+syngo ZOOMit + ZOOMit EPI + ZOOMit SPACE - Tim 4G [204x64] + Dot - RF systém vysílání/přijem (technologie DirectRF™) - Cívky Tim 4G RFs technologií Dual-Density Signal Transfer (hlava/krk 20 DirectConnect, páteř 32 DirectConnect, tělo 18, Flex Large 4, FLex Small 4) - Tim Table (vyšetřovací stůl) - Dot Engine (nástroj pro denní optimalizaci výkonu) - střediska Dot Display a Dot Control - technologie Dot - Brain Dot Engine - Výkonný počítač pro rekonstrukci obrazu využívající technologii GPU - Tim Application Suite 	<p>MAGNETOM Prisma – systém</p> <ul style="list-style-type: none"> - 3T magnet (celotělový, supravodivý, aktivně stíněný, bezodparový pro helium, 50 cm FOV) - gradientní systém XR 80/200 (aktivně stíněný, vodou chlazený, kompenzace síly) - šimy 1. a 2. řádu - TimTX TrueShape+syngo ZOOMit + ZOOMit EPI + ZOOMit SPACE - Tim 4G [204x64] + Dot - RF systém vysílání/přijem (technologie DirectRF™) - Cívky Tim 4G RFs technologií Dual-Density Signal Transfer (hlava/krk 20 DirectConnect, páteř 32 DirectConnect, tělo 18, Flex Large 4, FLex Small 4) - Tim Table (vyšetřovací stůl) - Dot Engine (nástroj pro denní optimalizaci výkonu) - střediska Dot Display a Dot Control - technologie Dot - Brain Dot Engine - Výkonný počítač pro rekonstrukci obrazu využívající technologii GPU - Tim Application Suite 	<p>Pracoviště syngo MR #T+D</p>

(syngo TimCT FastView, Neuro Suite, Angio Suite, Cardiac Suite, Body Suite, Onco Suite, Breast Suite, Ortho Suite, Pediatric Suite, Scientific Suite, Whole Body Suite) - software syngo MR - Sekvence - Komunikace s pacientem - Počítačový systém - Instalace	(syngo TimCT FastView, Neuro Suite, Angio Suite, Cardiac Suite, Body Suite, Onco Suite, Breast Suite, Ortho Suite, Pediatric Suite, Scientific Suite, Whole Body Suite) - software syngo MR - Sekvence - Komunikace s pacientem - Počítačový systém Instalace	
Tim [204x64] XR Gradienty #P	Tim [204x64] XR Gradienty #P	
PC klávesnice s US angličtinou #Tim	PC klávesnice s US angličtinou #Tim	PC klávesnice s US angličtinou
Tim Table #P 1	Tim Table #P 1	
Kvantifikace průtoku #Tim	Kvantifikace průtoku #Tim	Argus Flow MRWP
Neuro Perfusion Package (Neuroperfúzní sada) #T+D		Neuroperfúzní evaluace MRWP#T+D
RESOLVE #T+D	RESOLVE #T+D	
Arterial Spin Labeling (Klasifikace arteriálního spínu) 3D #T+D	Arterial Spin Labeling (Klasifikace arteriálního spínu) 3D #T+D	
Arterial Spin Labeling (Klasifikace arteriálního spínu) 2D	Arterial Spin Labeling (Klasifikace arteriálního spínu) 2D	
SWI #Tim		
Spectroscopy Package (Spektroskopická sada) #T+D		syngo MRWP pro spektroskopickou evaluaci
Multinukleární podpora #Sk		
Multinukleární spektroskopie #Sk		
Podpora SpectroShim #P		
	Hlavová cívka vysílání/příjem	
Hlava/krk 64 #P, Sk	Hlava/krk 64 #P, Sk]	
MAGNETOM Prisma Install. EUR	MAGNETOM Prisma Install. EUR	
Odlučovač 60 kW	Odlučovač 60 kW	
RF kabina, ocel #3T	RF kabina, ocel #3T	
Instalace RF kabiny, EUR #3T	Instalace RF kabiny, EUR #3T	
Inline BOLD zobrazování #Tim	Inline BOLD zobrazování #Tim	BOLD 3D Evaluation syngo MRWP #T+D
3D PACE syngo #Tim	3D PACE syngo #Tim	
Zobrazování tenzoru difúze #P		DTI Evaluation MRWP #Tim
	DTI sada #P - Zobrazování tenzoru difúze - DTI Tractography syngo - DTI Evaluace	DTI Tractography syngo MRWP #Tim
fMRI Trigger Converter (měnič spínače RF impulzů)	fMRI Trigger Converter (měnič spínače RF impulzů)	
Záruka tři roky	Záruka tři roky	Záruka tři roky

IDEA Development Licence	IDEA Development Licence	IDEA Development Licence
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Uvedená cena (dle nabídky firmy Siemens)

104 miliónů Kč bez DPH

Na základě podrobného zkoumání, osobních poznatků a průzkumu trhu je uvedeno následující stanovisko:

1) Zdůvodnění unikátnosti technologie, zařízení, respektive práv, a vysvětlení tvrzení, že na trhu je skutečně pouze jediný dodavatel schopný takové zboží dodat

Ze „SPECIFIKACE MR SYSTÉMŮ A VÝZKUMNÝCH TÉMAT PRO SDÍLENOU LABORATOŘ MAFIL“ vyplývá, že funkční MR (fMRI) a difúzní MRI (dMRI) aplikované na lidský mozek jsou ústředními metodami výzkumných cílů CEITECu, tudíž pořizované přístroje musí v zájmu těchto technik podávat prvotřídní výkon. Mimořádně kvalitní výkon v rámci *obou* těchto metod je pro účely špičkového výzkumu zcela závislý na současné dostupnosti následujících parametrů: vysoká gradientní amplituda, vysoká gradientní rychlost přeběhu, vysoká dlouhotrvající gradientní stabilita a specializované cívky pro hlavu, resp. hlavu/krk, s velkým počtem radiofrekvenčních (RF) příjmových kanálů. Termín „vysoká“ vyžaduje bližší vysvětlení, nicméně v podobných případech jako je tento platí, že vyšší je téměř vždy lepší. Všechny špičkové 3T RMI systémy, které prodejci velkých RMI systémů nabízejí, nabízejí různou úroveň výkonu pro jednotlivé hardwarové parametry uvedené výše, přičemž všechny jsou schopné přispět k některé z forem fMRI a dMRI měření. Dle mého nejlepšího vědomí je Siemens Prisma v současné době jediným systémem na trhu, který dokáže *simultánně* poskytovat nejvyšší klinicky možnou gradientní amplitudu (80 mT/m), gradientní rychlost přeběhu (200 T/m/s) a počet RF příjmových kanálů pro hlavu (32), resp. hlavu/krk (64), a který má vynikající dlouhodobou gradientní stabilitu. Díky tomu má i nejvyšší krátko- a dlouhodobý potenciál pro nejvyšší úroveň výkonu fMRI a dMRI v kontextu výzkumu. Vše je ještě významnější vzhledem ke skutečnosti, že každá modernizace zmíněných hardwarových parametrů v rámci systému (je-li vůbec možná) vyžaduje vysoké dodatečné investice vynakládané až v době po úvodní instalaci, předání a převzetí MRI systémů (na rozdíl od softwarových aktualizací, které bývají poměrně levné).

Z odpovědí na mé konkrétní dotazy ohledně výzkumných plánů a požadavků střediska CEITEC/MAFIL jsem zároveň pochopil, že (budoucí) zaměstnanci laboratoře CEITEC/MAFIL mají velkou zkušenost s provozem systémů Siemens MR a navíc, což je velice důležité, odborné znalosti související s prostředím specifického vývoje MR pulzních sekvencí firmy Siemens. Zejména v oblasti vysoce specifikované odbornosti spojené s MR vývojem pulzních sekvencí trvá dlouhou dobu, než se podaří vyškolit nebo přeškolit odborného technika či vědce tak, aby byl schopen takto specifickou platformu využívat. Pro CEITEC/MAFIL by proto bylo velice rozumné využít stávající odbornosti svých pracovníků namísto reinvestic do jejich přeškolení, což trvá nějaký čas a vyžaduje další (nepřímé) náklady. Jde o významnou skutečnost, neboť v kontextu výzkumu je místní rozvoj MR pulzních sekvencí, a díky němu i přístup k nejnovějším, komerčně

nedostupným výzkumným sekvencím jiných MR výzkumných středisek (tj. třetích stran), *klíčem* k dosažení nejvyšší úrovně excelentních výsledků v prostředí mezinárodní konkurence. Významným ukázkovým příkladem je rozvoj MR pulzních sekvencí probíhající v rámci programu NIH Human Connectome Project, který vytváří supermoderní fMRI a dMRI sekvence dostupné pro všechna pracoviště Siemens. Tyto sekvence s sebou přinášejí možnost využití vícepásmové technologie (resp. technologie více řezů), díky čemuž se výkon v oblasti fMRI a dMRI výzkumu v porovnání se sekvencemi od jiných výrobců zvyšuje.

2) Důvody potvrzující nemožnost využití jiných, podobných a přijatelných zařízení či technologií

Nikdy není zcela nemožné používat MRI systémy od jiných výrobců. Zároveň lze ale s jistotou tvrdit, že dlouhodobého potenciálu nejvyšší úrovně excelence fMRI a dMRI v kontextu výzkumu (o jaký CEITEC/MAFIL usiluje) lze dosáhnout pouze tehdy, pokud na základní, výše popsané hardwarové parametry navazuje nebo je dokonce překonává (v rámci stejného provozního MR protokolu současně, nikoliv odděleně v jiném hardwarovém nastavení pro různé protokoly) jiný zvažovaný MR systém. Dle mého nejlepšího přesvědčení tyto požadavky nesplňuje ani jeden z produktů konkurujících systému Siemens Prisma.

3) Ocenění pořizované položky či práva

Přezkoumal jsem specifikaci i cenovou nabídku obou systémů Siemens Prisma. Pro cíle, jaké CEITEC má, jsou dané specifikace adekvátní. Cenu je vždy třeba posuzovat v kontextu širší nabídky prodejce a stávajících okolností, a proto mohu učinit pouze kvalitativní úsudek. Dle mých znalostí a zkušeností s cenovými nabídkami se zdá být opodstatněná.

SEZNAM PŘÍLOH:

1. Specifikace MR systémů a výzkumných témat pro centrální laboratoř MAFIL
2. Nabídka č. 061-13P0095 (ocenění dodávky firmy Siemens)
3. MAGNETOM Prisma-1-A8WMI1-2-A (Podrobná technická specifikace systému MR A)
4. MAGNETOM Prisma-1-A8WMI1-4-B (Podrobná technická specifikace systému MR B)

Prohlášení znalce:

Potenciálu pro nejvyšší míru excelence fMRI a dMRI v kontextu výzkumu (z hlediska cílů centra CEITEC/MAFIL nesmírně významného) lze na současném trhu dosáhnout jedinečnou kombinací hardwarových parametrů, kterou popisovaná zařízení umožňují. Nezanedbatelnou výhodou je také možnost stavět na předchozích odborných znalostech a školeních, a to zejména pokud jde o programování MR pulzních sekvencí. Cenová nabídka se pohybuje v očekávaném rozsahu pro danou kombinaci systémů a specifikací.

V Maastrichtu dne 18. listopadu 2013

/podpsán alroebroek/

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podpis, otisk znalecké pečeti

SPECIFIKACE MR SYSTÉMŮ A VÝZKUMNÝCH TÉMAT PRO SDÍLENOU LABORATOŘ MAFIL

OBEČNÁ CHARAKTERISTIKA PŘÍSTROJŮ

Celotělové 3T MR systémy se supravodivými, aktivně stíněnými magnety, certifikované pro klinické využití, vybavené pro potřeby pokročilého výzkumu v oblasti neurověd a zároveň podporující výzkum v oblasti kardiologie a ortopedie, včetně instalace na místo určení, funkčních zkoušek a proškolení obsluhy. Dodávka obsahuje vysokofrekvenčně stíněné kabiny, ovládací panel pro zpracování sdílených dat, software s odpovídajícími licencemi pro vizualizaci, analýzu a uchovávání dat, respektive pro plánování pokusů a vývoj metod na obou systémech i ovládacím panelu, dále metody měření a protokoly pro diagnostiku a výzkum, přístrojové vybavení pro funkční zobrazování kompatibilní s MR. Oba tomografy musí zaručovat zejména vysoce kvalitní morfologické zobrazování, pokročilé měření parametrů difúze, funkční zobrazování vycházející z BOLD efektu, dynamické měření pro zobrazování perfuze, protonovou stereoskopii a stereoskopické zobrazování.

Oba tomografy musí využívat totožný software, umožňovat sdílení měřících protokolů a vysokofrekvenčních cívek, podporovat synchronizaci pomocí externích signálů. Požadavkem je dodávka tomografu A vybaveného pro potřeby citlivého zobrazování, zobrazování rychlých protonů a neprotonového zobrazování, dále pro spektroskopii a spektroskopické zobrazování hlavy a oblasti krku. Tomograf B bude rovněž vybaven s ohledem na hlavu a oblast krku, včetně rozšířené podpory zobrazování míchy, trupu a kloubů. Požadavkem je, aby oba systémy zaručovaly vysokou homogenitu statického pole (podporovanou RT šimy alespoň druhého řádu) a dosahovaly vynikajících parametrů gradientních a vysokofrekvenčních subsystémů.

Ke každému přístroji a softwarové jednotce je třeba dodat podrobný uživatelský manuál obsahující informace týkající se správné obsluhy a údržby, stejně jako servisní příručku, příručku pro programování protokolu a pulzní sekvence a podrobný popis dodávaných přístrojů, a to včetně dodávaných měřících metod a protokolů. Zmíněné dokumenty je třeba doručit elektronicky (ve formátu PDF umožňujícím alespoň kopírování, připojování komentářů a tisk). Veškerá technická dokumentace musí být dodána v anglickém jazyce, uživatelské příručky rovněž v českém jazyce.

ODHADOVANÁ CENA

100-105 miliónů Kč + DPH (1 EUR = 25 Kč)

PLÁNOVANÉ VYUŽITÍ

Oba systémy se stanou základními prostředky zobrazování ve sdílené (centrální) laboratoři MAFIL (Laboratoře multimodálního a funkčního zobrazování¹) institutu CEITEC. Hlavním využitím obou snímacích zařízení používaných ve výzkumném programu CEITEC Výzkum mozku a lidské mysli² je neurologický výzkum. Jako součást sdílené laboratoře však oba tomografy podpoří také výzkum dalších programů CEITECu v rámci Masarykovy univerzity, respektive jeho výzkumných partnerů. Sdílená laboratoř se rovněž zapojí do translačního výzkumu využívajícího specializované tomografie zvířat (např. 9,4T MR) a různá zařízení používaná u zvířat (umístěná v Ústavu přístrojové techniky – ÚPT). Společným záměrem sdílené laboratoře CEITECu a ÚPT je poskytovat část snímací kapacity MRI externím uživatelům z pozice národního uzlu projektu EuroBioImaging.

Očekává se, že se oba systémy brzy stanou přístrojovým základem špičkového neurovědního výzkumu a zároveň podpoří ostatní výzkum v rámci CEITECu, který by mohl těžit z multiparametrického, vysoce kvalitního MR zobrazování lidského těla. Svě postavení by si měly udržet alespoň 8-12 let, což je v současné době běžná morální životnost srovnatelných systémů. Nedávná historie MR prokázala úzké spojení mezi kvalitou a rychlostí získávání dat a vývojem v oblasti MR technologie, které bylo zpravidla výsledkem vývoje metod na výzkumných ústavech. Z tohoto důvodu není požadavkem pouze vybavení systému měřícími protokoly aktuálními v době nákupu, ale také umožnění rychlé aplikace novějších prací uskutečněných na jiných výzkumných ústavech v době po koupi a poskytnutí týmu MAFIL možnosti vlastního rozvoje metod. Tato skutečnost by měla být výhodou pro celý CEITEC i pro budoucí výzkumné partnery a zároveň by se mohla stát předmětem spolupráce s výrobcem celého systému. Zapojení CEITECu do globálního rozvoje MR povede nejenom k dosažení nejvyšších metodologických úrovní, ale i k posílení jeho vnímání v zahraničí. Aby CEITEC těchto očekávání dostal, musí dosáhnout plné programovatelnosti metod v rámci systémů, jak ji poskytuje licence IDEA pro systémy firmy Siemens. Je známo, že vydání takovéto licence se zakládá na úspěšném školení zaměstnanců v programování MR systémů, jež Siemens pořádá. Zmíněný model udělování licencí, pro Siemens jedinečný, má více než desetiletou tradici a je podporovaný internetovým fórem, které zajišťuje sdílení technických znalostí důležitých pro vývoj metod mezi vývojáři celého světa. Skupina MAFIL má již dva členy (P. Latta, Z. Starčuk), kteří podobným kurzem prošli a mají již dřívější zkušenosti s programováním těchto systémů, což do značné míry zvyšuje šance CEITECu na rychlý start v této oblasti; je to tedy další důvod pro výběr systému.

CÍLE PROGRAMU MOZKU A LIDSKÉ MYSLI

Podporovat společnou teoretickou, experimentální a klinickou studii mozku od molekulární pro behaviorální a kognitivní úroveň. Rovněž proběhne rozsáhlý výzkum buněčných, molekulárních a klinických aspektů poškození a nápravy nervové tkáně. Bude dokončený mezioborový výzkum v oblastech neurobiologie, neuropsychofarmakologie, funkční neuroanatomie, neurofyziologie, neurozobrazování, neuropsychologie, neurologie, psychiatrie a výpočetní neurovědy. Pokročilé metody biomedicínského zobrazování dnes začínají překračovat dříve nedosažitelnou hranici na mikroskopické a molekulární úrovni. Jejich aplikace mohou výrazně přispívat k lepšímu pochopení fyziologických a patologických změn v nervovém systému, víceúrovňové studii chování zvířat a lidí,

¹ <http://www.ceitec.eu/headquarters/multimodal-and-functional-imaging-laboratory/z10>

² <http://www.ceitec.eu/ceitec-mu/brain-and-mind-research/v8>

a konečně i k translačnímu výzkumu se silným dopadem na léčbu neuropsychiatrických onemocnění. Program se zaměřuje na dosažení excelence ve výzkumu a vzdělávání v oblasti mozku a lidské mysli.

SOUČASNÁ TÉMATA

- **Téma 1: Multimodální studie strukturální a funkční konektivity ve fyziologických, hraničních a patologických podmínkách v kontextu behaviorální a sociální neurovědy.**

Cílem této oblasti je dosáhnout partnerství s psychology a sociology, respektive zahájit společné projekty v sociální a behaviorální neurovědě zabývající se různými aspekty sociální kognice a mozkové konektivity zdravých jedinců i neuropsychiatrických pacientů. Specifika výzkumu empatie, motivace a rozhodování; iracionální aspekty funkce lidského mozku; neuroekonomika a vývoj aplikační možností v tomto oboru.

Pokusná část: funkční MRI (BOLD+ASL), simultánní snímání v sociální interakci, zobrazování tenzorů difuze (neboli DSI), anatomická versus funkční konektivita v mozku, spojující změny ve funkci (fMRI) a struktury (morfometrické studie, strukturální konektivita).

- **Téma 2: Aplikace neurověd, včetně vývoje multimodálních protokolů MRI vytvořených k identifikaci biomarkerů neuropsychiatrických onemocnění (neurodegenerace Parkinsonovy choroby a schizofrenie), které souvisí s nemocí, a neuropatické bolesti.**

Současným cílem je stanovení spolehlivých biomarkerů raného stadia Parkinsonovy choroby (PD), studium strukturálních a funkčních změn v mozkových sítích při schizofrenii a založení laboratoře pro výzkum bolesti. Výzkum lidských jedinců bude následovat po translačním výzkumu na zvířecích modelech (s transgenickými nebo toxickými modely myši) v oblasti mechanismů na molekulární a buněčné úrovni. Metoda multimodálního MRI umožňuje rozlišit symptomatické a chorobu modifikující účinky léčebných zásahů a rychle i objektivně stanovit jejich účinnost. Každou z těchto modalit se získá jedinečná doplňující informace o celkové atrofii, mikrostruktury, funkci a chemickém složení; metoda multimodálního MRI by tak měla vytvořit komplexní obraz progresivních změn a účinků léčby na patologii

Pokusná část: Korelace elektrofyziologických měření s behaviorálním a kognitivním testováním, funkční zobrazovací metody (zájem je zejména o klidový stav fMRI), metody tenzorů difuze pro kvantitativní vyhodnocení parametrů difuze a traktografie a dalších, spíše doplňkových měření MR (ASL perfuze, MR spektroskopie, morfometrické studie, strukturální konektivita).

- **Téma 3: Komplexní kortiko-subkortikální interakce ve zdraví a nemoci.**

Výzkum procesů pozornosti, paměti, rozhodování, inhibice habituálních reakcí, kognitivních funkcí. Zaměření na především kortikální (epilepsie) a především subkortikální (PD) choroby. Lepší pochopení kortiko-subkortikálních interakcí se odrazí na přesnějších neuromodulačních technikách (optimální indikace, minimalizace vedlejších účinků).

Pokusná část: Intrakraniální záznamy, fMRI, multiparametrické metody mapování mozku, funkční MR spektroskopie, ASL perfuze.

- **Téma 4: Vývoj v technologii MR, pokročilé zpracování dat a metody pro multimodální/multiparametrickou integraci dat**

Zaměření na maximální využití prostorového, spektrálního a temporálního rozlišení dosaženého při specifických expozicích vysokého magnetického pole (např. limitace vysokofrekvenčního pole a B1 šimování, změna kontrastu ve vysokém poli, plné využití paralelní detekce) pro potřeby strukturálního a funkčního zobrazování in vivo a ex vivo subjektů. Zvláštní pozornost bude věnována účinným technikám robustního a rychlého MR spektroskopického zobrazování, zobrazování metod následného zpracování dat využívaných pro charakterizaci mozkové konektivity, a kvantitativní MRI.

Pokusná část: Elektrofyziologická data, všechny techniky MRI/MRS včetně výpočetní neuroanatomie a modelování/simulací dynamických změn v mozku (funkční a efektivní konektivita).

- **Téma 5: Pokročilé techniky zobrazování páteře a svalů**

Hlavním cílem je využití několika pokročilých zobrazovacích technik pro zobrazování míchy za účelem studia ultrastrukturálních změn a patofyziologických procesů míchy in vivo při různých patologických podmínkách. Hlavní důraz bude spočívat na zkoumání patopsychologie a přirozeného průběhu cervikální spondylotické myelopatie, ostatní typy myelopatie budou zkoumány kvůli správné klasifikaci a zlepšení diagnostické přesnosti.

Dále budou zkoumány různé patologie muskuloskeletálních svalů, a to pomocí difuze a zobrazování difuzních tenzorů, což jsou slibné techniky pro detekci ultrastrukturálních abnormalit svalů.

- Pokusná část: Zobrazování difuzních tenzorů, zobrazování perfuze a spektroskopie; parametry pro zobrazování budou přizpůsobeny konkrétním anatomickým oblastem a dojde k vývoji nových postupů ve zpracování dat.

DALŠÍ VÝZKUMNÉ PROGRAMY

Cílové léky a kontrastní látky: testování prospěšnosti látek testovaných v preklinickém systému ultra vysokého pole při klinickém nastavení.

Umělé materiály v těle: např. chrupavka při klinické intenzitě pole.

ZAMÝŠLENÁ KONFIGURACE MR TOMOGRAFŮ

MAGNETOM PRISMA – SYSTÉM A / B

Systém A	Systém B
MAGNETOM Prisma Systém <ul style="list-style-type: none"> - 3T magnet - XR Gradienty - TimTX TrueShape + syngo ZOOMit + ZOOMit EPI + ZOOMit SPACE - Tim 4G+Dot - DirectRF - RF vysílací/přijímací systém - Tim 4G cívky (krk/hlava 20, tělo 18, páteř 32, Flex velká 4/ Flex malá 4) - Tim Table (vyšetřovací stůl) - Dot Engine (nástroj pro denní optimalizaci výkonu) - Dot kontrolní střediska a Dot Display - Dot technologie - Brain Dot Engine (nástroj pro mozek) - soustava Tim Application Suite (syngo TimCT FastView, Neuro Suite, Angio Suite, Cardiac Suite, Body Suite, Onco Suite, Breast Suite, Ortho Suite, Pediatric Suite, Scientific Suite, Whole Body Suite) - Sekvence - Komunikace s pacientem - Počítačový systém - Instalace 	MAGNETOM Prisma Systém <ul style="list-style-type: none"> - 3T magnet - XR Gradienty - TimTX TrueShape + syngo ZOOMit + ZOOMit EPI + ZOOMit SPACE - Tim 4G+Dot - DirectRF - RF vysílací/přijímací systém - Tim 4G cívky (hlava/krk 20, tělo 18, páteř 32, Flex velká 4/ Flex malá 4) - Tim Table (vyšetřovací stůl) - Dot Engine (nástroj pro denní optimalizaci výkonu) - Dot kontrolní střediska a Dot Display - Dot technologie - Brain Dot Engine (nástroj pro mozek) - soustava Tim Application Suite (syngo TimCT FastView, Neuro Suite, Angio Suite, Cardiac Suite, Body Suite, Onco Suite, Breast Suite, Ortho Suite, Pediatric Suite, Scientific Suite, Whole Body Suite) - Sekvence - Komunikace s pacientem - Počítačový systém - Instalace
Tim [204x64] XR Gradienty #P [14432224]	Tim [204x64] XR Gradienty #P [14432224]
PC klávesnice s US angličtinou #Tim [08464872]	PC klávesnice s US angličtinou #Tim [08464872]
Tim Table #P 1 [14432226]	Tim Table #P [14432226]
Průtoková kvantifikace #Tim [08464740]	
Argus Flow [07365419]	
Neuro Perfusion Package (Neuroperfuzní sada) #T+D [14416946]	
Neuro Perfusion Evaluation (Neuroperfuzní evaluace) #T+D [14426290]	

DTI Sada #P [14436656]	Diffusion Tensor Imaging (Zobrazování difuzních tenzorů)#P
Neuro fMRI Sada #T+D [14416943]	Inline BOLD Imaging #Tim 3D PACE syngo #Tim fMRI Trigger Converter
RESOLVE #T+D [14430391]	RESOLVE #T+D [14430391]
Arterial Spin Labeling (Značení arteriálního spinu) 3D #T+D [14416965]	Arterial Spin Labeling (Klasifikace arteriálního spinu) 3D #T+D [14416965]
Arterial Spin Labeling (Klasifikace arteriálního spinu) 2D [14409110]	Arterial Spin Labeling (Klasifikace arteriálního spinu) 2D [14409110]
SWI #Tim [14402527]	
Spectroscopy Package (Spektroskopická sada) #T+D [14416941]	
Multinuclear Support (Multinukleární podpora)#Sk [14430398]	
Multinuclear Spectroscopy (Multinukleární spektroskopie) #Sk [14430399]	
SpectroShim Support (Podpora spektrošimů) #P [14432229]	
Hlava/krk 64 #P,Sk [14432234]	Hlava/krk 64 #P,Sk [14432234]
MAGNETOM Prisma Install., EUR [14436659]	MAGNETOM Prisma Install., EUR [14436659]
Separator (odlučovač) 60kW [14418489]	Separator (odlučovač) 60kW [14418489]
RF-Cabin, Steel (RF-kabina, ocel) #3T [14413606]	RF-Cabin, Steel (RF-kabina, ocel) #3T [14413606]
RF-Cabin Installation (Instalace kabiny), EUR #3T [14401488]	RF-Cabin Installation (Instalace kabiny), EUR #3T [14401488]
syngo MR Pracoviště #T+D	
vysílací/přijímací hlavice cívky	
záruka 3 roky	záruka 3 roky

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Žerotínovo náměstí 617/9

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Datum 25.10.2013

Nabídka č. 061-13P0095

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Sektor Healthcare
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Tel.: +420 23303 3303
Fax: +420 23303 1112



Adresa:
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Sektor Healthcare
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155 00 Praha 13

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S přátelským pozdravem,
Siemens, s.r.o.



Ing. Vratislav Švorčík
ředitel Sektoru Healthcare



Ing. Karel Kopejtko
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Siemens s.r.o.
Sektor Healthcare
www.siemens.cz
Tel.: +420 23303 3303
Fax: +420 23303 1112

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Adresa:
Siemens, s.r.o.
Sektor Healthcare
Siemensova 1
155 00 Praha 13

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Jako tlumočnick jazyka anglického jmenovaný rozhodnutím Krajského soudu v Brně ze dne 13. ledna 2012, č. j. Spr. 371/2009-32 stvrzuji, že překlad souhlasí doslovně s textem připojené listiny.

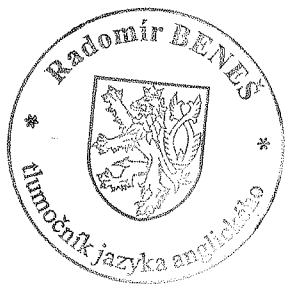
Tlumočnický úkon je zapsán pod pořadovým číslem 24-10-2013 tlumočnického deníku.

Interpreter's Statement

As an interpreter of the English language, appointed by the decree of the Regional Court in Brno from 13th January 2012, ref. No. Spr. 371/2009-32, I hereby certify that the translation corresponds with the text of the document attached.

The translation is recorded under No. 24-10-2013 in the Register of Translations.

Otisk kulaté pečeti / Round Seal



Jméno a příjmení / Name and Surname

Radomír Beneš

Místo / Place

Veverská Bítýška,

Česká republika / the Czech Republic

Datum / Date

28. 11. 2013 / 28th November 2013

Podpis / Signature

