Analysis of the header in football
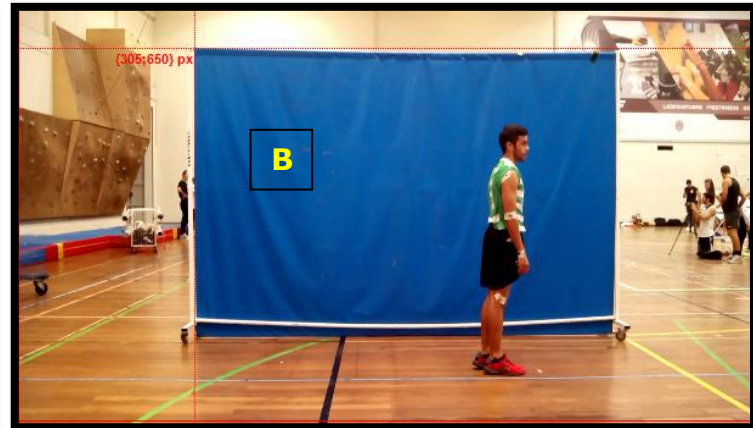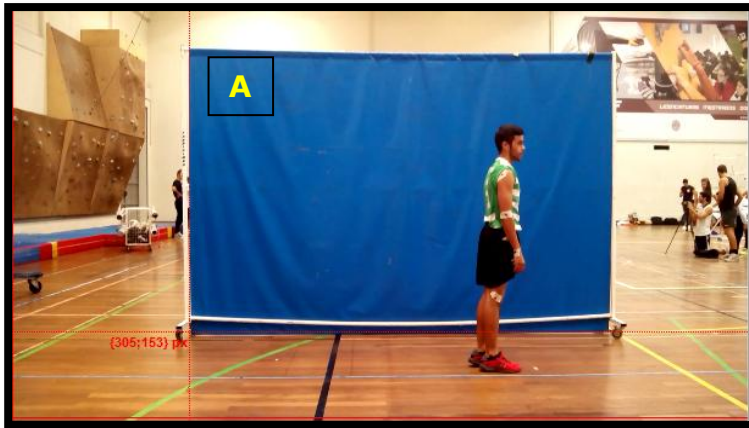
(2D and 3D Motion analysis)

Teacher: Mgr. Martin Sebera, Ph.D.

Student: Francisco Luz

Calibration

Calibration was performed by determining the coordinates of two points (A and B), whose distance between them is 2,70m in real scale, corresponding to the height of the blue panel in the back.
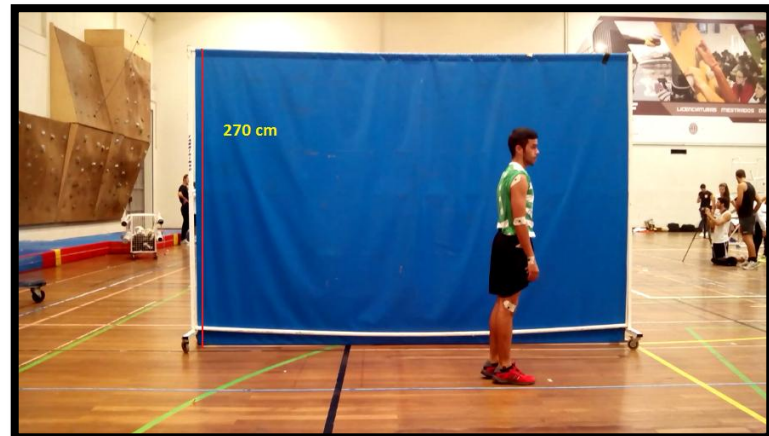

Calculations:

$$AB=\sqrt{(305-305)^2+(650-153)^2}$$

AB= 497

Pixels	cm
497	270
1	X

X= 0.54326 cm

We can conclude that in the video/pictures, 497 pixels correspond to 270cm and that 1 pixel corresponds to 0.54326cm.

calibration		
	x	y
Point1	305	153
Point2	305	650
d=	497,0 pixlu	270 cm

Distance

To calculate the distance was chosen as reference the point of the knee, respectively point A (624; 200) and B (717; 336) as showed in the pictures.
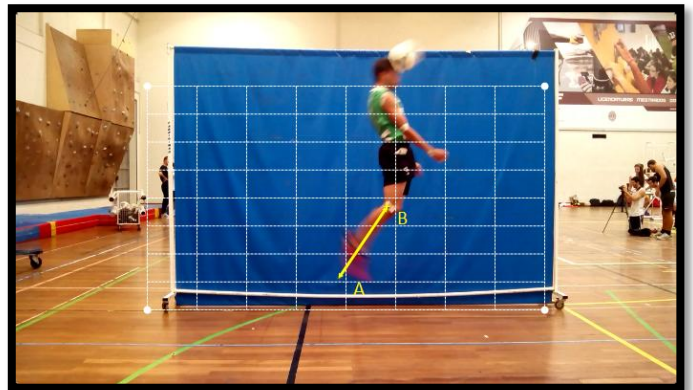

Calculations:

A (624; 200) B (717;336)

$$\overline{AB}=\sqrt{(717-624)^2+(336-200)^2}$$

$$\overline{AB}=\sqrt{27145}$$

$$\overline{AB}= 164{,}757$$

Pixels		cm
1	——	0.54326
164,757	——	X

X= 94.49 cm

We can conclude that in the video/pictures, the distance between point A and B it's about 164,757 pixels, corresponding to 94.49 cm.

	distance x	y
Point1	988	598
Point2	889	741

d=		173,9 pixel	94,49 cm
	1 pixel	0,54326 cm	

Velocity/speed

To determine the velocity the distance between point C (658; 592) and D (711; 618) was used as reference. This will calculate the speed of the head since the movement of "header" starts till the contact with the ball.

Calculations:

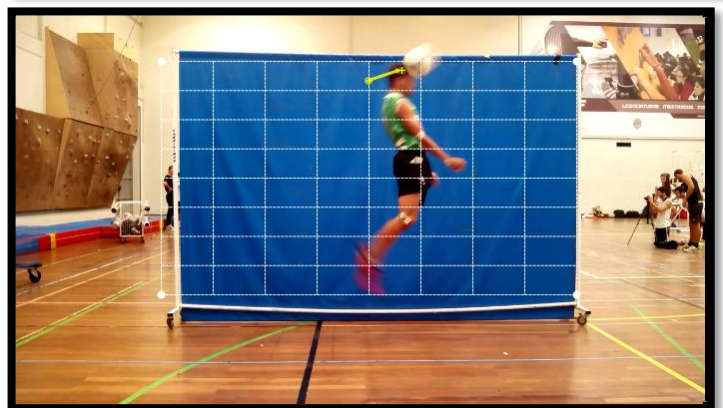$$CB=\sqrt{(711-658)^2+(618-592)^2}$$

Distance – 59 pixels

59x0.54326= 32,1 cm

$$V=\frac{d}{\triangle t}$$

Time – 0.14s

$$V=\frac{0.321m}{0.13s}$$

Velocity= 2,5 m/s

Angles

The 2 angles chosen were the angle of the knee and the angle made by the opening between the trunk and the arm.

Angle of the knee;

1st Picture

1 (575; 274)
2 (624; 200)
3 (592; 104)

Point 1		Point 3		Point 1	
x1	575	x1	592	x1	575
y1	274	y1	104	y1	274
Point 2		Point 2		Point 3	
x2	624	x2	624	x2	592
y2	200	y2	200	y2	104
size	88,7524648	size	101,192885	size	170,84789
cos 2 =	-0,616	cos 1 =	0,885	cos 3 =	0,913
2 =	128,05	1 =	27,80	3 =	24,15
control					
180,00					

2nd Picture
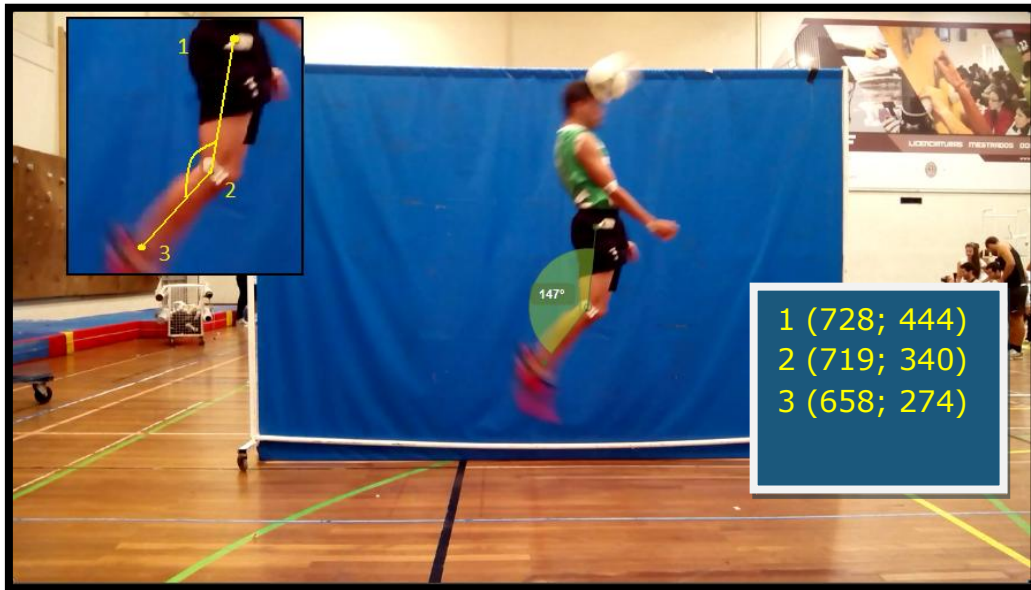
Point 1		Point 3		Point 1	
x1	728	x1	658	x1	728
y1	444	y1	274	y1	444
Point 2		Point 2		Point 3	
x2	719	x2	719	x2	658
y2	340	y2	340	y2	274
size	104,388697	size	89,8721314	size	183,84776
cos 2 =	-0,790	cos 1 =	0,954	cos 3 =	0,937
2 =	142,20	1 =	17,43	3 =	20,37
control					
180,00					

Observation:
There was an opening of the angle of the knee from the first to the second position of 14º.

Angle of the trunk/arm;

1st Picture

Point 1			Point 3			Point 1		
x1	580		x1	607		x1	580	
y1	282		y1	291		y1	282	
Point 2			Point 2			Point 3		
x2	650		x2	650		x2	607	
y2	346		y2	346		y2	291	
size	94,8472456		size	69,8140387		size	28,460499	
cos 2 =	0,986		cos 1 =	0,914		cos 3 =	-0,833	
2 =	9,54		1 =	24,00		3 =	146,45	
control								
180,00								

2nd Picture

1 (713; 429)
2 (687; 529)
3 (736; 484)
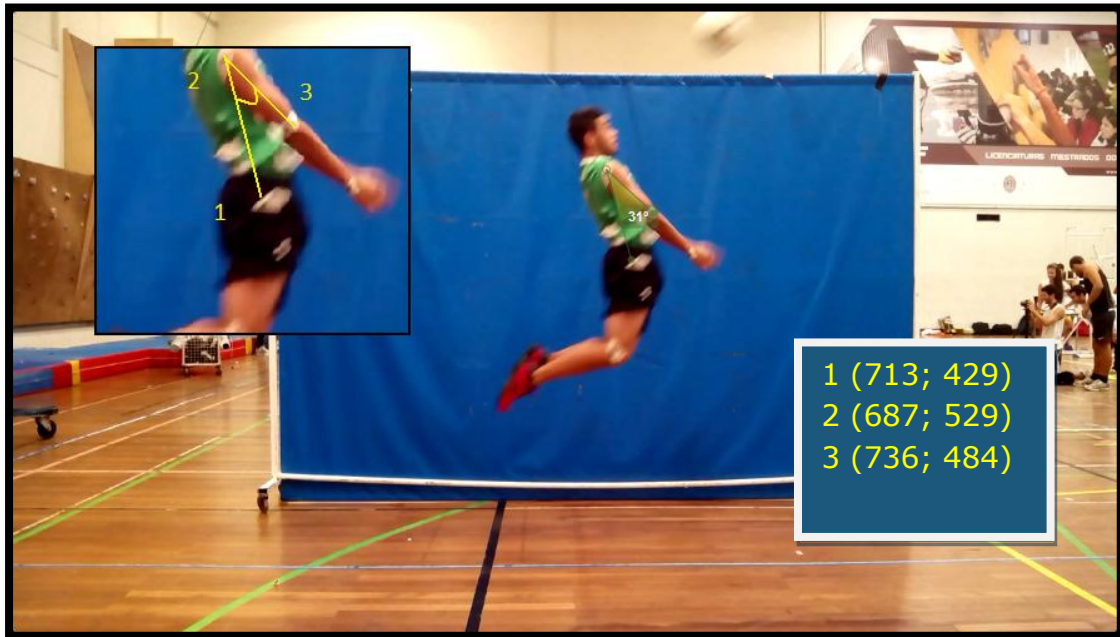
Point 1			Point 3			Point 1		
x1		713	x1		736	x1		713
y1		429	y1		484	y1		429
Point 2			Point 2			Point 3		
x2		687	x2		687	x2		736
y2		529	y2		529	y2		484
size	103,324731		size	66,5281895		size	59,615434	
cos 2 =	0,840		cos 1 =	0,796		cos 3 =	-0,340	
2 =	32,86		1 =	37,27		3 =	109,87	
control								
180,00								

Observation:

There was a opening of the angle from the first to the second picture of 22º.