



# 2D/3D MOTION ANALYSIS

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# Schedule

- Idea 😊
- Variables: distance, time, speed, angles
- Download video from internet
- Quality of video
- How to get picture from video
- How to measure: distance, time, speed
- Tools, sw

# Idea

- What to measure
  - Distance, time, speed, angles
- Get source
  - From youtube (how to download-  
<http://www.clipconverter.cc/>)
  - From web, TV, online source
  - From own camera

# Deficiencies, errors, bad source

- Quality of video –
  - resolution 720x576, 640x480, no less,
  - 25 or 30 frames per second (fps), not less
- Scene is too far
- small stature
- large movements in the frame - [http://atletictisnov.rajce.idnes.cz/2013-09-07-4.kolo\\_Uherske\\_Hradiste#MVI\\_3944.jpg](http://atletictisnov.rajce.idnes.cz/2013-09-07-4.kolo_Uherske_Hradiste#MVI_3944.jpg)

# Always...

- fixed point
- the measured distance
- angle (camera-scene) - 90 degrees
- VARIABLES are measured like the ratio between the information on the video and in fact

# Distance in 2D/3D space

## Distance between two points

The Euclidean distance between two points of the plane with Cartesian coordinates  $(x_1, y_1)$  and  $(x_2, y_2)$  is

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$

In three-dimensional space, the distance between points  $(x_1, y_1, z_1)$  and  $(x_2, y_2, z_2)$  is

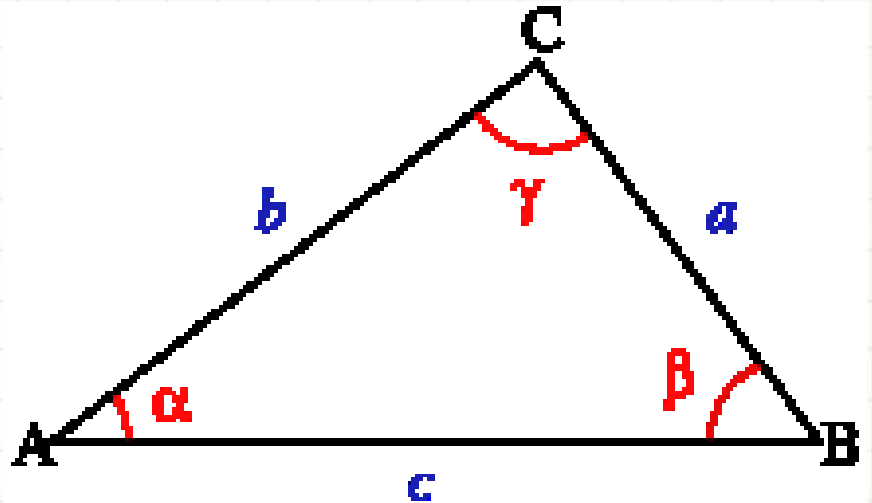
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$

# Angles

$$a^2 = b^2 + c^2 - 2bc \cos(\alpha)$$

$$b^2 = a^2 + c^2 - 2ac \cos(\beta)$$

$$c^2 = a^2 + b^2 - 2ab \cos(\gamma)$$



$$\alpha = \arccos\left(\frac{b^2 + c^2 - a^2}{2bc}\right)$$

$$\beta = \arccos\left(\frac{a^2 + c^2 - b^2}{2ac}\right)$$

$$\gamma = \arccos\left(\frac{a^2 + b^2 - c^2}{2ab}\right)$$

# Project

- Choose sport
  - Distance
  - Time
  - Speed
  - Angles