Simulation of GNSS functioning through an experimental measurement

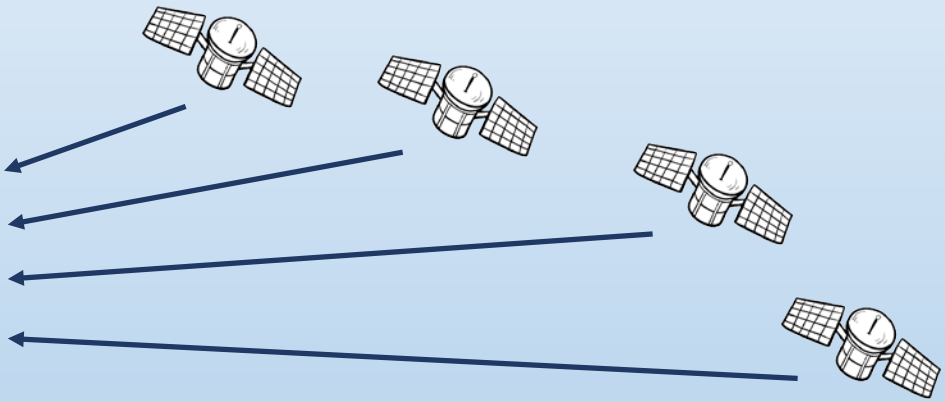
Real measurements for the positioning estimation

Scope of the excersise

Simulate the GNSS functioning through an experiment based on the measurement of the range between local representative reveiver and satellites.

How a GNSS works

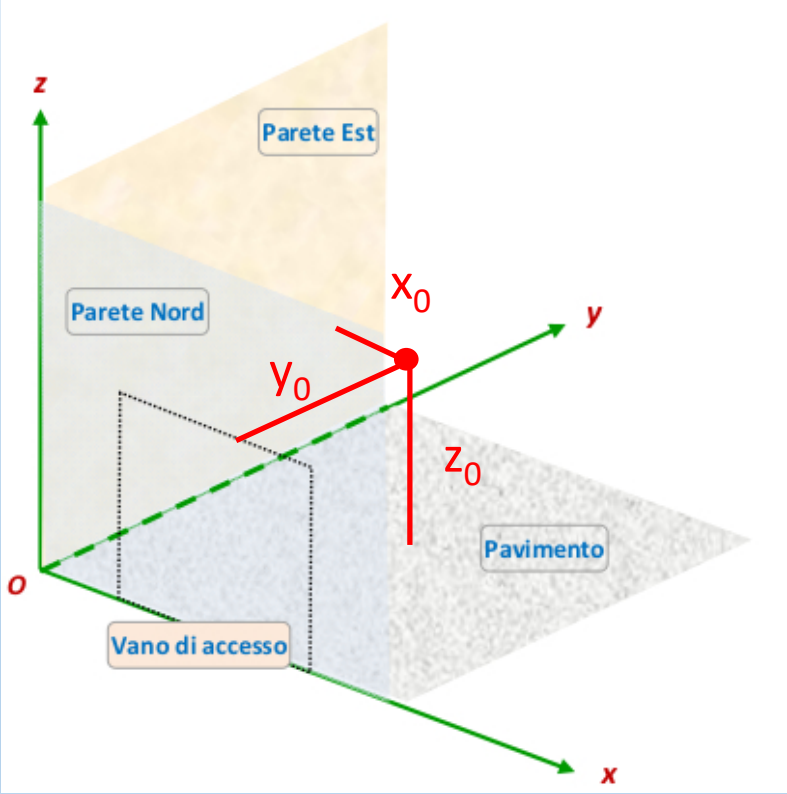
4 satellites in view
Solve 4 non-linear equations
to get position and time



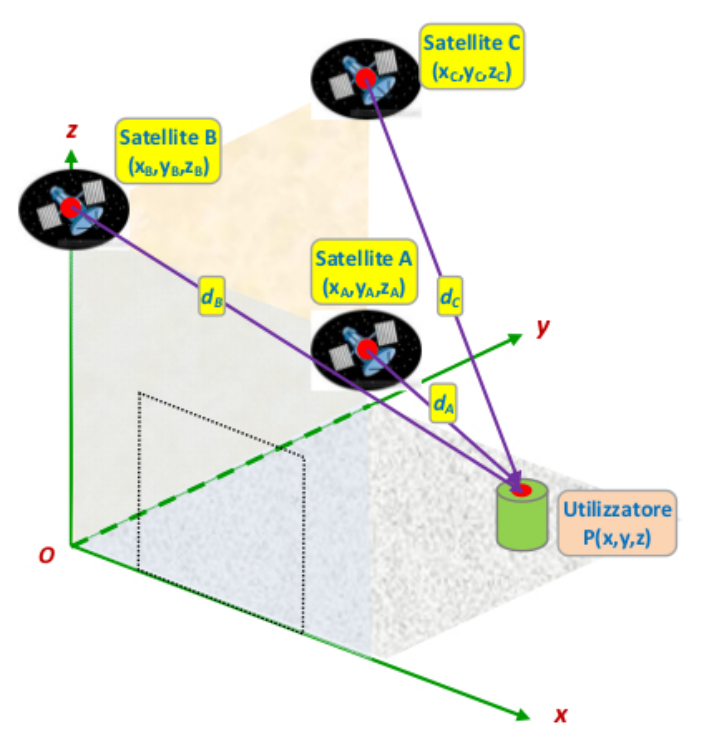
Distance measurements through the time of flight of a signal sent by a transmitter on the satellite.

How can we simulate it?

A cartesian reference system



Three «simulated satellites»



The instrument

A laser distance meter uses the time of flight of a laser to compute a distance.
In this case, since the signal is transmitted and received by the same instrument, is like the receiver and satellite clocks are synchronized → only three range measurements are required.

The range equation

$$R_A = \sqrt{(x - x_A)^2 + (y - y_A)^2 + (z - z_A)^2}$$
$$R_B = \sqrt{(x - x_B)^2 + (y - y_B)^2 + (z - z_B)^2}$$
$$R_C = \sqrt{(x - x_C)^2 + (y - y_C)^2 + (z - z_C)^2}$$

Tasks:

- Select a cartesian reference system
- Choose three «simulated satellites» and measure their position (x_A, y_A, z_A), (x_B, y_B, z_B), (x_C, y_C, z_C) with respect to the selected reference system
- Place yourself in a random point and measure the distances from the three satellites ρ_A, ρ_B, ρ_C
- Compute your position by inverting the equation of distance
- Check the results with an «actual measurement»