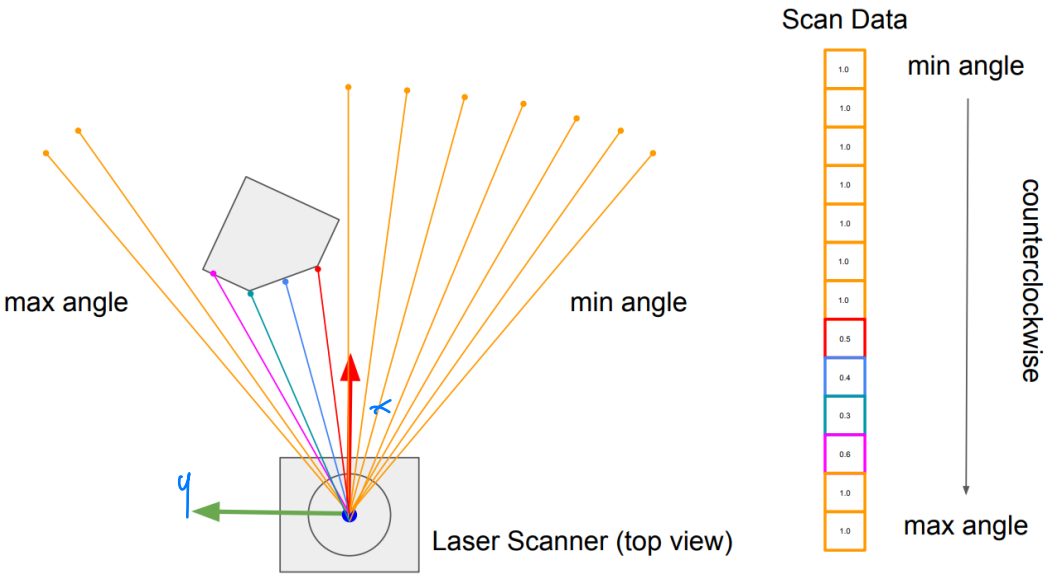
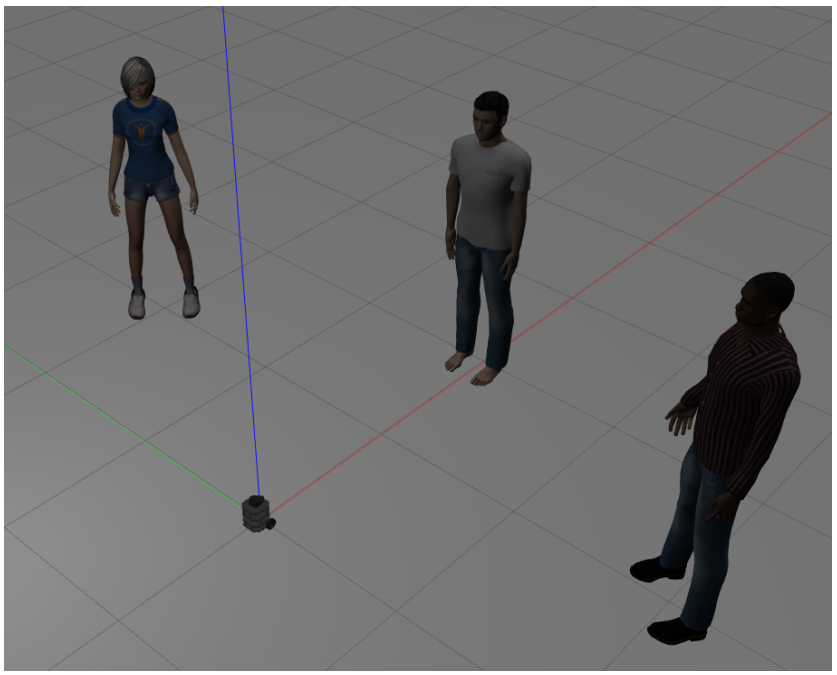
Exercise 5: LaserScan

In this exercise, we ask you to perform a simple processing of data gathered with a laser range laser finder (LRF), a very common sensor in mobile robotics. This sensor provides range information on the surroundings of the robot. In particular, given a single scan, for each element of the data vector, you will find the distance of the closest obstacle viewed by the laser in that specific line of sight. This family of sensors uses the so-called *polar coordinates* format. An example is given below:



In this exercise, the laser range finder is mounted on a mobile robot that is facing three people, like in the picture below:



Exercise

The assignment of this exercise is to **compute the location of the three people** w.r.t. the robot's reference frame (i.e., equal to the sensor reference frame). Each person's position should be given in X and Y coordinates, in meters. We assume that the position of a person is the point in the middle of the two legs.

1. Download the ROS Bag file

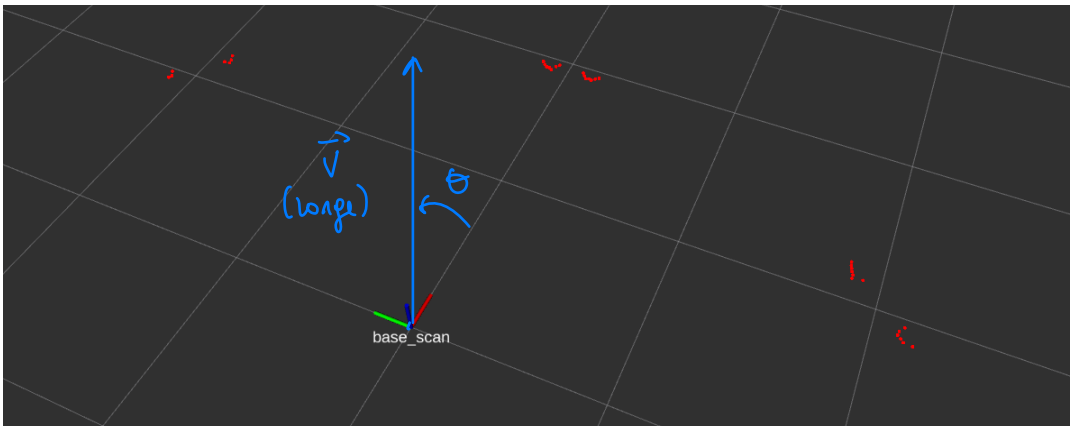
Link to file: bag_es_5.bag

Suggestions:

- You can download the ROS Bag file anywhere in your system
- Remember that *roscore* should be already running before you run the bag
- Remember to run the bag using the *rosbag play* command, *-l* argument keeps the bag running in a loop
- The data should always be running *before* you execute your code or run RViz for visualisation. **Hint:** If nothing happens, stop and restart the bag file.

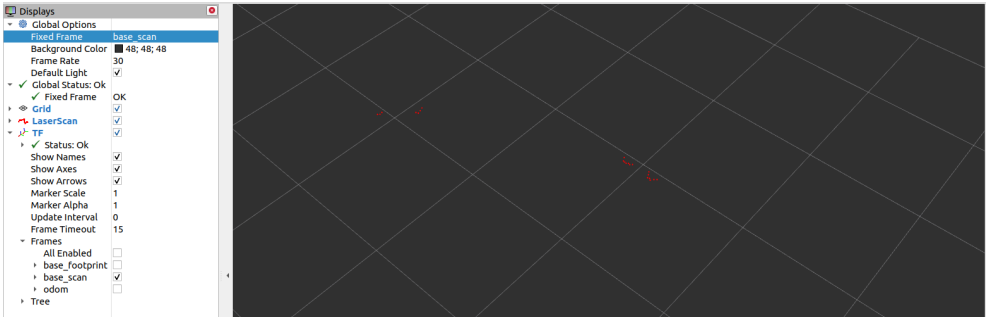
2. Visualize the data inside the ROS Bag file using RViz

You should see in RViz something like the screenshot below:



Suggestions:

- RViz is a potent tool. You can visualize all the data running in your ROS Bag.
- Add *LaserScan* and *TF* in the *Display* window if you want to see the laser.
- If you see errors regarding missing frames, maybe you set the wrong *Fixed Frame* in the *Display* window on the left in RViz. For this exercise, the correct frame should be *base_scan*:



3. Create a ROS node to compute the position of the people

Subscribe to the */scan* topic and write the code to process laser data.

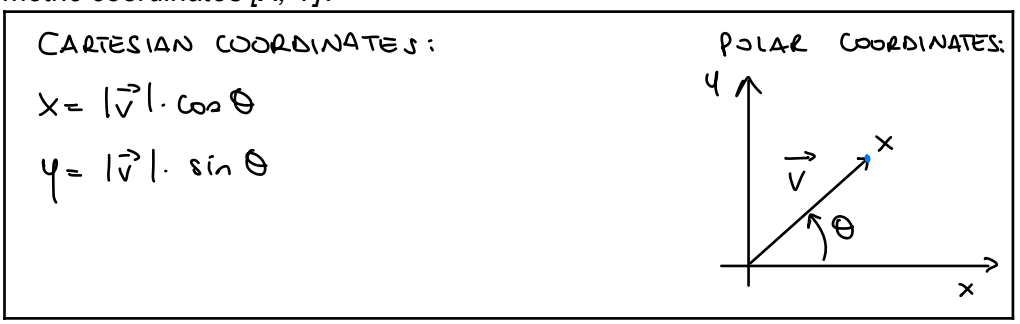
Suggestions:

- The Laser Scan contained in the ROS Bag file has the following features:
  - angle_min: 0.0 (radians)
  - angle_max: 6.28 (radians)
  - angle_increment: 0.0087 (radians)
  - range_min: 0.12 (m)
  - range_max: 3.5 (m)

  Try the command *rostopic echo /scan*

- Can you say in advance the size of the vector of data coming from the laser scan? Yes, the site is: $\frac{(angle\_max) - (angle\_min)}{angle\_increment}$
  - ☐ 360
  - ☒ 720
  - ☐ 1440

- Do you know how to convert *polar coordinates [angle, distance]* into *2D metric coordinates [X, Y]?*



Write here the formula to obtain X and Y.

- Convert each readout of the laser range finder into [x, y] coordinates in the reference frame of the robot.

- Compute the position of each person as the point in the middle of the two legs.

4. Generalize the ROS node to compute the position of any number of people.

(i.e. remove the assumption that you have three people)