PROJECT 2

- ID, name, surname of all the members:

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- Small description of the files inside the archive:

Inside the archive there are 3 folders:

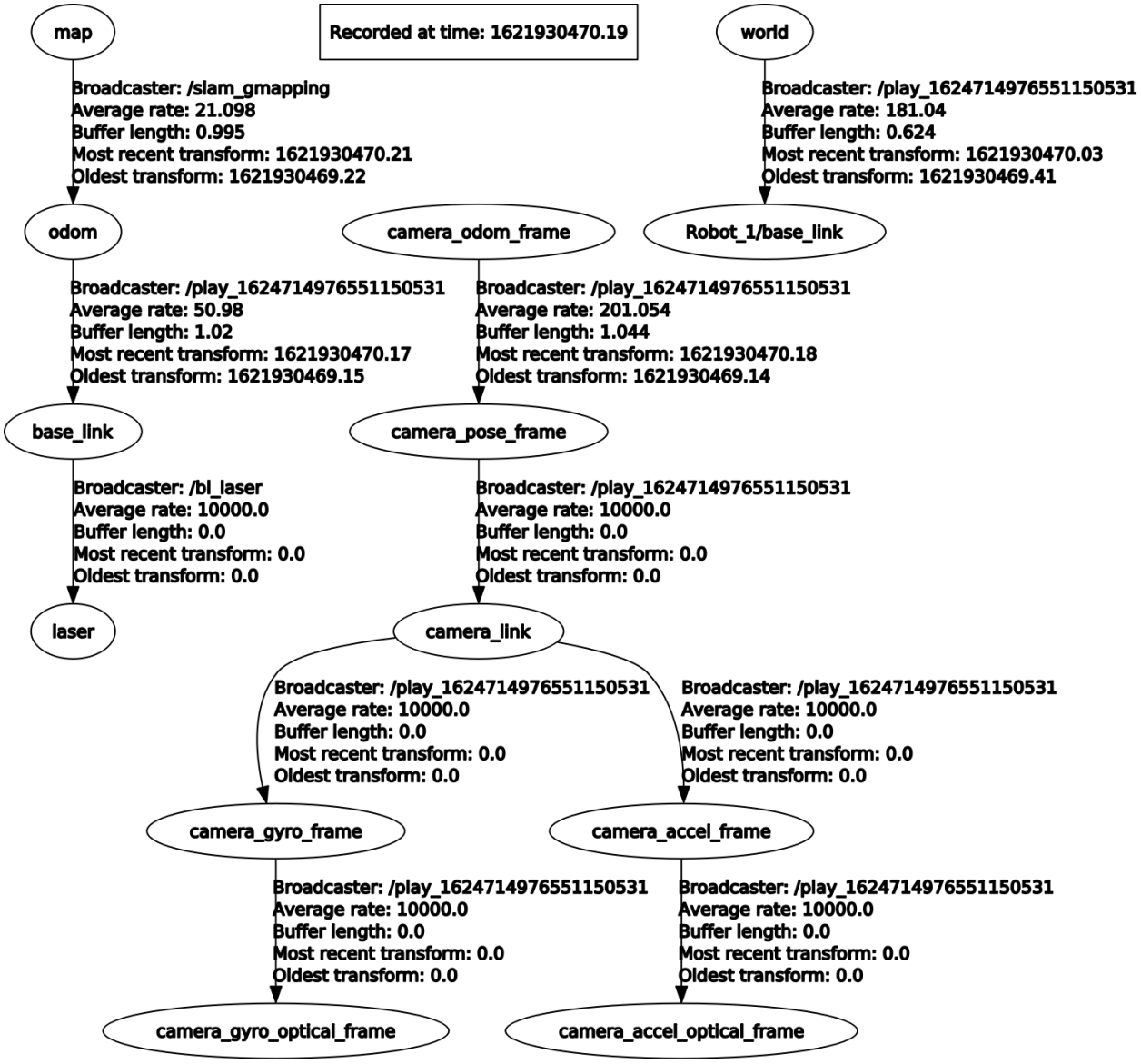
- A “launch” folder containing:
  - a launch file for localization called “*localization.launch”*
  which starts rviz and shows on it the saved map and the robot moving on it with all the particles from the particle filter.
  - a launch file for mapping called “*mapping.launch”*
  which starts rviz and shows on it the robot moving according to its odometry (the one saved in the topic */odom*) and simultaneously building the map.
  - an xml file for gmapping called “*gmapping.launch.xml”*
  contains all the necessary parameters to perform mapping using gmapping.
  - an xml file for amcl called “*amcl.launch.xml”*
  contains all the necessary parameters to perform localization using amcl.

- A “maps” folder containing:
  - a map file in pgm format called “*map.pgm”*
  which contains only an image of the map.
  - a map file in yaml format called “*map.yaml”*
  which contains some other data regarding the map.

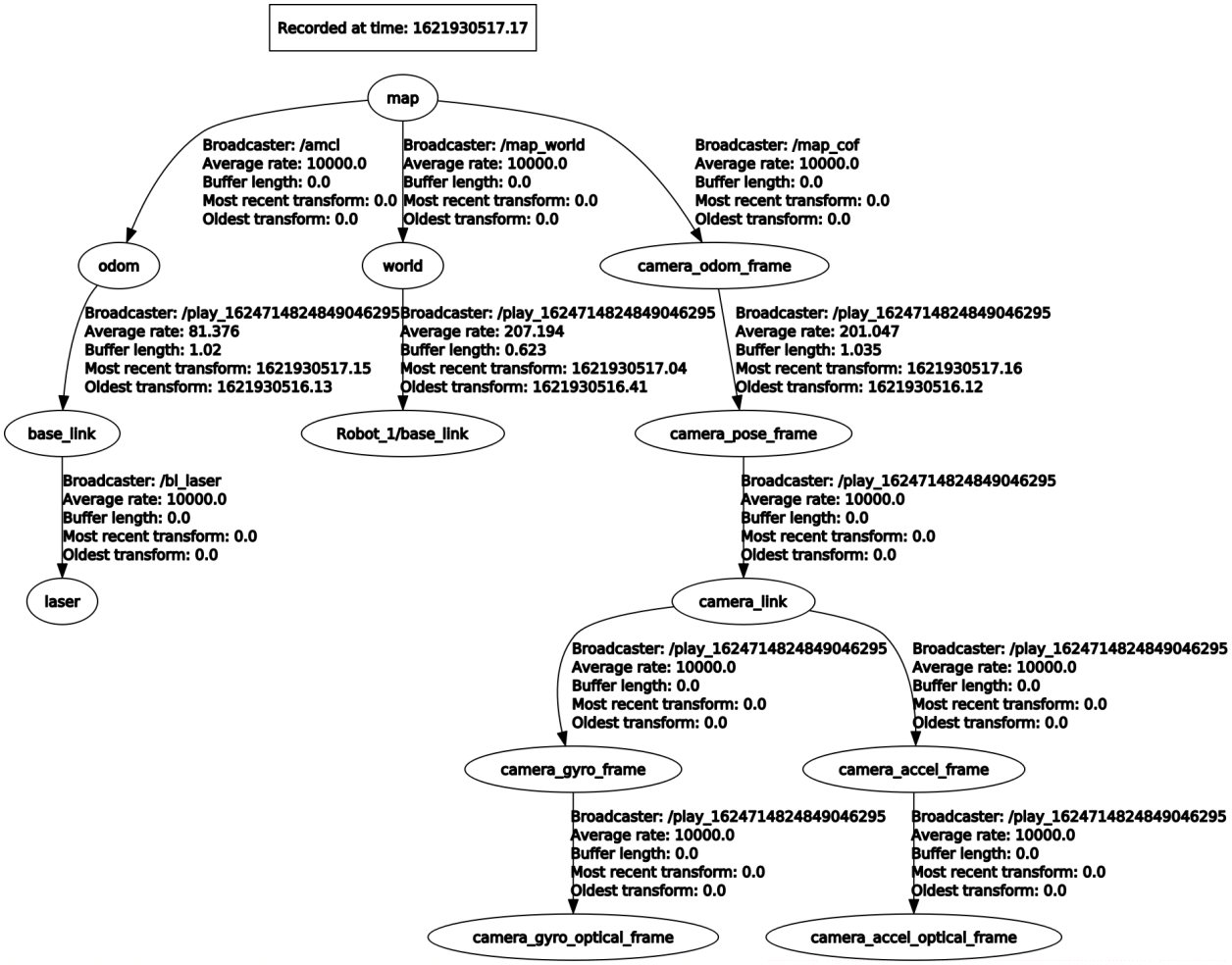
- A config folder containing:
  - a configuration file for the rviz needed for mapping called “*configMAPPING.rviz”*
  which is used to set rviz with everything needed so that it is not necessary to add things manually.
  - a configuration file for the rviz needed for localization “*configLOCALIZATION.rviz”*
  which is used to set rviz with everything needed so that it is not necessary to add things manually.

- Structure of the tf tree:

TF tree of the mapping procedure (we have used only the scan of the SICK LMS100, for that reason we have ignore the other components, i.e. not connected to base_linik):



TF tree of the localization procedure:
(here we linked every frame so that we could test multiple configurations)



- Name of the bag used to create the map and bags to test:

bag used for calibration:	calib.bag,
bag used to compute the map:	1.bag,
bags used for test:	2.bag, 3.bag

- Description of how to start/use the nodes:

the iter needed to run the files is:
- run the mapping launcher: roslaunch project *mapping.launch*
- run the bag with the command: *rosbag play --clock 1.bag*
- save the map in the map_server: *rosrun map_server map_saver -f map*
- run the localization launcher: roslaunch project *localization.launch*
- run the other bags (*2.bag* or *3.bag*) *rosbag play --clock 2.bag*

NOTE: when you save the map, you have to be sure that the path is the one specified in the launch file localization.launch. Similarly, you need to have the correct paths for the other files (configuration files for rviz, .xml).

- Small report to explain the sensors choice :

In the localization launcher we used three sensors:
- the odometry from the robot *“odom0” (Agilex Scout)*
- the odometry from the camera *“odom1” (Intel T265)*
- the imu *“imu0” (pixhawk mini)*

In particular we used two sources of odometry, plus an imu sensor hoping to improve the localization.
In order to select which parameters of the config matrix of the sensors set to true, we looked with plotjuggler which data were published for each sensor, then we tried some possible configurations and, based on the outcome seen on rviz, we came to the following conclusion.
For the first odom sensor (*odom0*), we set the x, y and theta_z parameters (corresponding to the first, second and sixth elements) inside the configuration matrix to “*true”*. This has been done because we decided to let the first odometry (*odom0*), the one from the topic “/odom”, manage the pose, while the second source of odometry (*odom1*) was decided to manage the velocities. This was based on the idea that the two odometry sources would compensate each other. Consistently with this choice, we set *"odom1_differential" param* to true, and also *"odom0_relative"* and *"odom1_relative"*. Moreover we set the seventh, eighth and twelfth elements (corresponding to vx, vy, wz) of the odom1 configuration matrix to true.
For the imu configuration we set the linear accelerations ax and ay (thirteenth, fourteenth elements) and again wz to true. This again was done because the imu takes the linear accelerations from the accelerometers (az was not considered because we were assuming to be in 2D) and takes the wz from the gyroscope (assuming to have only yaw movement not negligible).

- Info you think are important/interesting

The calibration of the laser was done taking a tf between the *baselink* reference frame and the *laser* reference frame and trying to map the environment using data from calib.bag. Because the only unknown parameter was the angular offset between the two reference frames, we used a trial and error strategy at the end of which we came to the conclusion that an angle of approximately 90 degrees was the best one. This strategy consisted in changing the value of the angle and generating the map. The best map was obtained for this value of the angle.