ELEC 5660 Project 3: Phase 2

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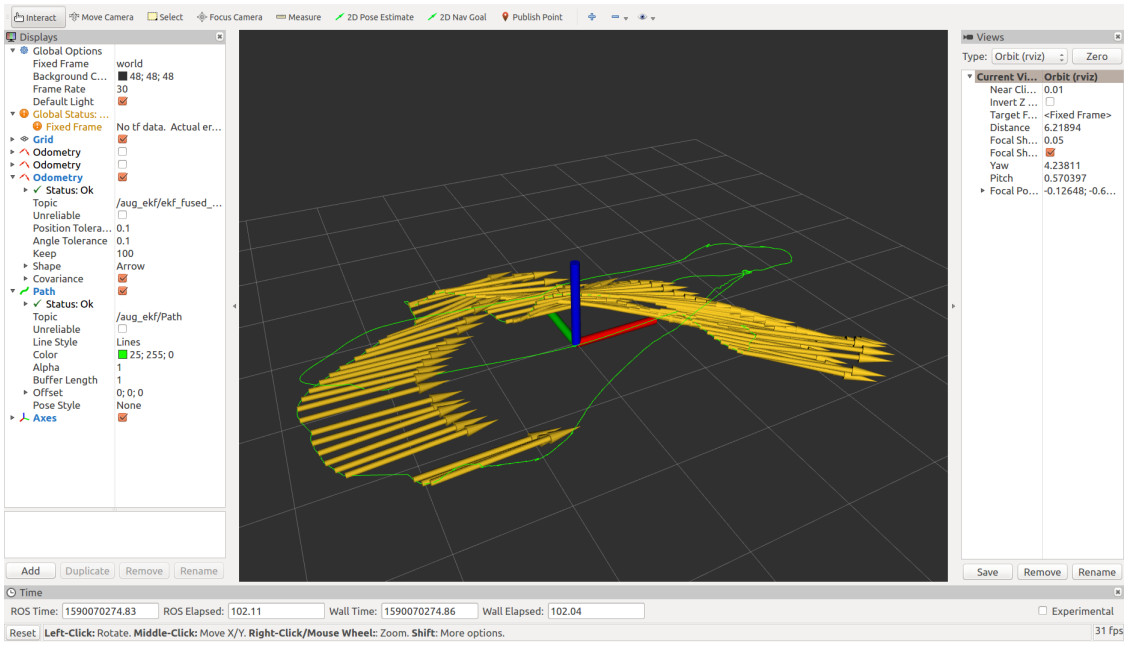
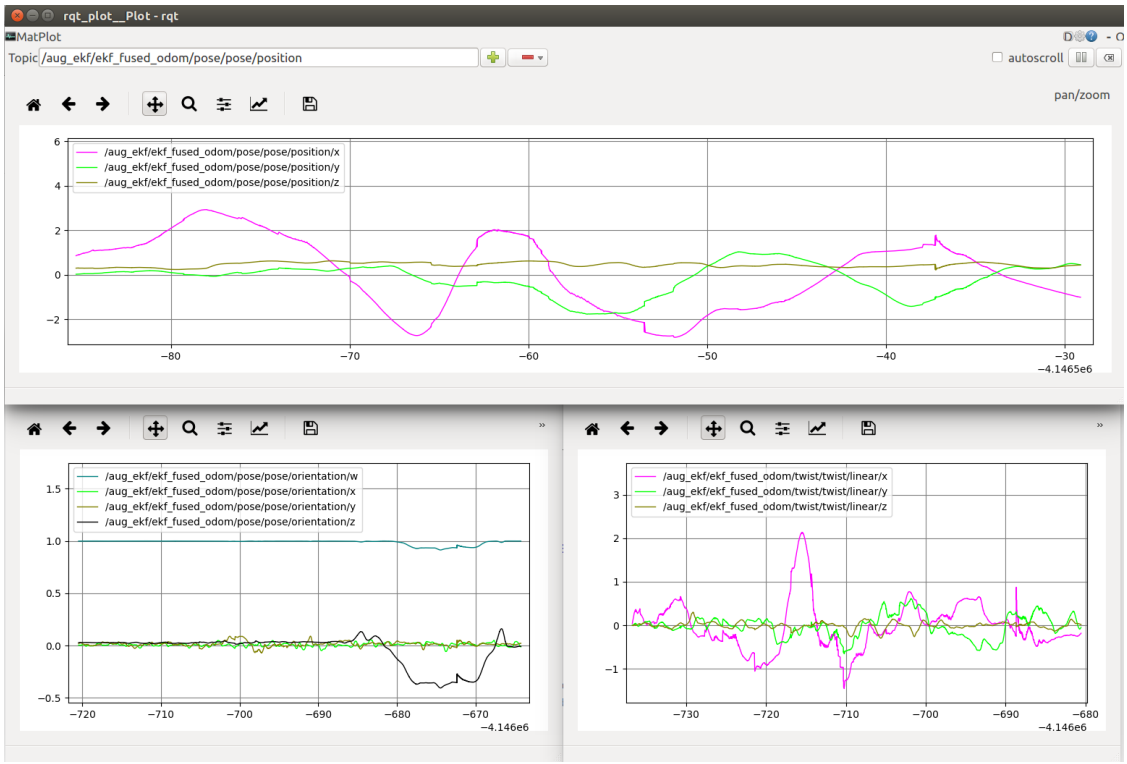
Figures

The fused result of path and odometry.



Position, orientation and velocity



Description

The fusion of 3 sensors

The VO, imu and tag_detector are fused using AS EKF. VO only provides relative measurement, and it requires to maintain a copy of keyframe state in its own state vector.

When formulating the measurement model, the analytic derivative of the following, especially the measurement of orientation (from Euler angle to Matrix and back to Euler angle), is extremely long to write in the program, and the amount of intermediate calculation is huge. To get a faster approximation, numeric derivative is used.

$$\mathbf{z}_{t|t_i} = \begin{bmatrix} \mathbf{R}(\mathbf{q}_\mathrm{K})^T (\mathbf{p} - \mathbf{p}_\mathrm{K}) \\ \mathrm{euler}\Big(\mathbf{R}(\mathbf{q}_\mathrm{K})^T \mathbf{R}(\mathbf{q})\Big) \end{bmatrix} + \boldsymbol{v}_{t|t_i}$$

The problem of sensor data arriving order

Some assumptions are made and verified before implementation. The verification is done by solely reading out data in each callback and output to a log file.

- [x] pnp and vo can be later than imu.
- [x] imu has much more frequent data rate.
- [x] vo keyframe always comes earlier and has smaller time_stamp
  - [x] verified by log
- [x] same type of data is always in order.
  - [x] verified by log
- [x] except the first KF, all the KFs are vos.
  - [x] verified by log

The implementation can run smoothly with the above assumptions.

Thread safety

I don't if it is a good practice to modify, especially insert and erase a queue in 3 callbacks in ROS, but no fatal errors seem to occur at least in my experiments.