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Ultra-Wideband Localization in Multi-Robot Systems for Person Tracking

Christophe Reiners

Professor : Alcherio Martinoli

Assistant(s) : Zeynab Talebpour

This project analyses in a first step the performance of the KIO Ranging system with multiple tags in simultaneous use. In that goal, two main experiments were designed. In the first one three tags were plugged into a same laptop and were placed very close together. In the second one the tags were placed further away but in precise positions relative to each other. In both experiments the tags were carried at a persons height over a path within the region covered in line-of-sight conditions by the 4 anchors. The ground truth of that path was carefully measured.

In both of the experiments it has been found that the average error just increases slightly but that the number of outliers increases considerably. Furthermore in specific regions of the path a high biased error arises. In some cases this biased error is directional and seems to be related to the tags orientation. In some other cases we think that this biased error is due to the metallic objects of the environment, like the metallic door and shelves.

In order to get rid of the outliers three different filtering methods were tested. They were all implemented in Matlab and the data has been post-processed. First, a maximum speed filter has been tested. This filter assumes that the person cannot make huge moves in short times and suppresses in that way the outliers. Secondly a linear Kalman filter has been tested. It presupposes a human motion prediction model. In our case the person was walking with constant speed towards a constant direction. Lastly we implemented an extended Kalman filter which allowed us to adjust the direction of the speed vector of the person. The idea was to reduce the biased error.

The filters gave a small overall improvement of the measurements, but could not deliver an outstanding performance. The maximum speed filter could suppress clear outliers. The linear Kalman filter in some extend as well, but the extended Kalman filter failed to suppress the outliers. This is partly due to a small modeling error noticed afterwards and partly due to the fact that the Kalman filters are not very robust to outliers. Therefore some improvements can be made in future by correcting the modeling error of the extended Kalman filter and by cascading 2 filters; first one to suppress the outliers (maximum speed filter) and second one (extended Kalman filter) to reduce the biased error.