

## Sheet 10

### Topic: Simultaneous Localization and Mapping

Due date: 29.06.2018

#### Exercise 1: Bearing-only SLAM

Bearing-only SLAM refers to the SLAM problem when the sensors can only measure the bearing of a landmark but not its range. One problem in bearing only SLAM with EKF's concerns the initialization of landmark location estimates, even if the correspondences are known. Discuss why, and devise a technique for initializing the landmark location estimates (means and covariances) that can be applied in bearing only SLAM.

#### Exercise 2: Data Association

Features extracted from an observation can be interpreted as either matches with existing features in a map, previously unobserved features, or false alarms (noise). Consider two features  $z_t^1$  and  $z_t^2$  extracted from an observation  $z_t$ , and a map  $m_t = \{l_1, l_2\}$  with two landmarks. Each observed feature  $z_t^i$  is either assigned to an existing or a new landmark, or it is marked as a false alarm.

- (a) Write down all possible assignments for the two observed features  $z_t^1$  and  $z_t^2$ . Note that each feature can be associated to at most one landmark and vice versa.
- (b) Now consider an update of the map to obtain  $m_{t+1}$ . Here, every new feature is added to the map as a new landmark, and every existing landmark without a match is removed. Suppose no false alarm is detected. How many solutions for the assignments remain? Are there any two solutions that will result in the same map?
- (c) How many new assignments can be generated from this set of maps in total if at time  $t+1$  a single feature  $z_{t+1}^1$  is observed?