Albert-Ludwigs-Universität Freiburg
Institut für Informatik
Lecture: Introduction to Mobile Robotics
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Sheet 9

Topic: Simultaneous Localization and Mapping

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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 EKFs 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?