Title: *An Advanced Software Framework for Real-time Multi-Robot SLAM*

This project aims to develop a unified framework for effective Simultaneous Localization And Mapping (SLAM) to be implemented on our Nao Bipedal Robots on the Nomadz Robocup Team at ETH Zürich (https://robocup.ethz.ch/).

Keywords: SLAM, particle filter, estimation and detection, multi-robot coordination

Labels: Semester Project, Nomadz Robocup Team, Automatic Control Laboratory (ETHZ)

Description:

In the field of robot navigation, S**imultaneous Localization And Mapping** (**SLAM**) is the critical task of constructing and continuously updating a map of an initially unknown environment while keeping track of a robot's location within it simultaneously. In robotics, there is often the case that a map is required for the successful operation of a robotic task. These tasks normally involve traversing environments and sometimes require operation in highly dynamic environments, e.g autonomous driving, delivery and assistive robots.

The ability of a robot to learn an environment from scratch by utilizing a form of map representation increases its autonomy and enables it to adapt to changes in the environment. This comes with the cost of dealing with challenging problems such as 1) High dimensionality in the space of all possible maps and observations, 2) Uncertainty in the robot's position and observations, 3) Map size and resolution and 4) Perceptual aliasing.

Goal:

The main goal of this project is the development of an advanced software framework for effective multi-robot localization and mapping within a soccer playing field, with the further aim of implementing it on our team of Nao bipedal robots, the core of our Nomadz Robocup Team at ETH Zürich (https://robocup.ethz.ch/).

The starting point for this project is a prior semester thesis work, where a particle filter based sensor fusion method is used to improve self-localization of the robots by combining odometer and vision-based measurements. First, we will extend this approach to cope with single and multi-robot SLAM problems in which the initial pose of the robots is known (e.g. all robots start from the same location). Then, we will introduce techniques to solve the generalized problem in which the initial pose of robots is not known a priori (e.g. the bipeds start from widely separated locations). The latter can be accomplished by 1) calculating their relative pose for the initialization of a particle filter and 2) Utilizing the subsequent observations from all bipeds, so that a common global map can be constructed. We will finally demonstrate the performance and accuracy of the developed framework by implementing and testing it on the real bipeds.

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