Assignment for PhD Position

Domain: Field Robotics

The following document details an assignment to test general knowledge and research interest in Field Robotics. The assignment results should be described with technical details and with video results – and submitted as a PDF with video links. All sub-assignments require the candidate to work in ROS (Robot Operating System), Gazebo (simulator), and with any programming language of choice. The student is free to choose the robotic platform of their choice and interest (aerial, ground, legged).

Task 1: Design and implement a control system for your robotic platform of choice. The controller should be capable of accepting position and heading state references. Implement your control system in ROS and evaluate it on your robotic platform of choice in Gazebo. Show pose-to-pose navigation, and the robot tracking a circular trajectory.

Task 2: Select and implement a state-of-the-art navigation stack for robotic exploration of unknown environments. It is OK to use open-source software. Provide detailed technical information on how each sub-component of the exploration/navigation stack works.

Task 3: Deploy your controller and navigation stack to perform robot exploration of an unknown environment in Gazebo, with your simulated robotic platform of choice. Deploy it in a relevant Gazebo environment – or several different ones that can highlight its performance. Show video results of the algorithms performance. Discuss the systems limitations and benefits that you have discovered.

Task 4: Provide directions for future works and improvements based on your new technical knowledge of the implemented framework (Task 2), and the limitations and performance of the system that you discovered in Task 3. Provide an argument for a "first research paper" that could be written based on your suggestions for improvements and extensions.