Review of Bachelor thesis

Title: Planning of swarm deployment for autonomous surveillance
Student: Matěj Petrlík

The presented thesis is concerned with path planning for a group of unmanned aerial vehicles (UAV). Starting at an initial depot the UAV group is supposed to be maneuvering through an environment while avoiding obstacles in order to reach an area of interest to be surveilled while both avoiding UAV collisions and having each UAV maintain a closer distance to at least one other UAV. For the planning process, the UAVs are moved by a discretized control input based on a car-like dynamic/motion model. Several sampling-based algorithms are discussed, most notably RRT and its variations, as well as a PSO-based method. The experimental part focusses on comparing the PSO-based method with basic RRT as well as RRT-path which uses A* to guide the RRT's random sampling process. This is done for both reaching the areas of interest as well as covering them upon arrival.

All in all, the submitted thesis is a very decent piece of work. It is well organized, follows a clear, easy-to-follow line of logic and the methods used are well described using fluent language accompanied by depicted graphs. Assumptions and simplifications, as well as proposed (heuristic) improvements of methods used in the thesis are reasonable, including the simplification of the full quadrotor model, and all-in-all the choices seem well balanced between both trying to maintain universality and generating fast plans for the specific UAV deployment problem. However, some formulations and discussions on runtime complexity tend to be sloppy and should have been made with more care despite the clear emphasis on (simulated) experiments and implementation.

Questions:

- Which improvements can be made to avoid the RRT-path planner getting stuck next to obstacles based on the proposed objective/cost function? Which are the downsides of these changes?
- Can the RRT-path approach be generalized to a gradually refined planning for a complicated (e.g. full quadrotor) motion model to generate close to low-level control inputs? That means, e.g.: 1) Find Paths using A*, 2) Use RRT-path with the car-like motion model, 3) Generate trajectories using a method similar to RRT-path with a guidance-path from step (2) together with the full quadrotor model.
- Can the RRT-path algorithm be parallelized and decentralized by introducing some coordination mechanism or communication between the UAVs?

Given the overall impression of the work, I recommend grade A.

Karlsruhe, June 3rd 2015

____

Dipl.-Math. Dipl.-Inform. David Oertel
Karlsruhe Institute of Technology
Institute for Anthropomatics and Robotis (IAR)
– Intelligent Process control and robotics (IPR)
Engler-Bunte-Ring 8, 76131 Karlsruhe
Email: david.oertel@kit.edu