Local Planning for Unmanned Ground Vehicles using Imitation Learning

Johan Henningsson

Modern path-planning algorithms display problems when introduced to novel environments and might need to be adapted to the new environment, which is a very time-consuming endeavour. Neural networks provide a possible solution to this problem, being more generalized and having no need to be adapted.

Mobile robotics is a booming field worldwide with applications in many sectors such as logistics, health care, agriculture and military. This development gives rise to the need for navigational systems that can traverse various environments. How can your robot vacuum cleaner traverse your house without getting stuck or bumping into obstacles all the time? Using clever path-planning algorithms of course. Instead of a robot vacuum cleaner the mobile platform in this thesis is an Unmanned Ground Vehicle (UGV), specifically the Husky platform from Clearpath Robotics, displayed in Fig. 1. Current path planning algorithms used at the Swedish Defence Research Agency, FOI, tend to be very inflexible when introduced to new environments. This provides an issue if the UGV is to be introduced for military purposes, where the UGV needs to work in numerous environments. It would not be acceptable if the UGV got stuck in a narrow corridor just because some setting was a bit off, thereby not being able to solve its task, which in the worst case could lead to a failed mission and possibly military personnel getting injured or killed.

The results from the thesis show that there is a possibility to use a neural network as a replacement for the path-planning algorithms while keeping the same level of performance and in some settings the neural network outperformed the planning algorithms. The neural network needs further work to be a definitive replacement for the planning algorithms and to be more robust. My work can be used as a baseline for further development, by introducing dynamic obstacles to the environment and by implementing other machine learning components on top of the neural network.

Figure 1. The UGV used in the thesis, the Husky platform from Clearpath Robotics.