High level motion planning for a multi-agent system
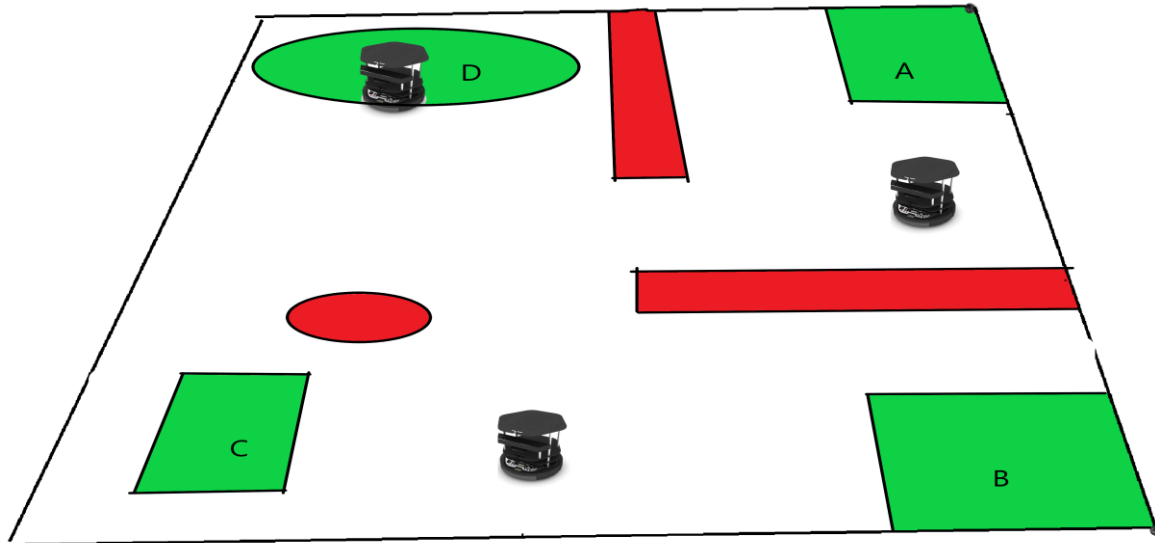

Figure 1: The robots needs to avoid the red areas, and meet up at the green areas. The order in which they visit the green areas is determined by the system to optimize the completion time.

Controlling the motion of a robot can be done in multiple ways. One option, which would work well for implementations where non-technically trained people are involved, is control synthesis for high level tasks. High level tasks refers to more abstract tasks (e.g. visiting every room in the building) compared to low level tasks which are more specific (e.g. going to point x with speed v). Control synthesis refers to automatically finding a plan based on information of environment and a given task.

When multiple robots are considered (i.e. a multi-agent system) the planning becomes more complicated since we have to consider how they affect each other.

  In this project we want you to suggest a framework for multi-agent control synthesis (i.e. finding controllers for each robot). Your framework should be able to plan for high level tasks considering obstacles and target regions where the robots should meet up. One possible approach is to use Linear Temporal Logic (LTL) to express these tasks but you are free to use other solutions.

The project should address the following:
- Make a mathematical model of the environment the robots are moving in and the dynamics of the robots.
- Suggest a framework which returns a plan that satisfies given tasks of the form 'avoid area X' and 'meet up at area Y'. The framework should be optimal in some sense with respect to time, meaning you have to take the transition times and potential waiting times into consideration when planning. This may affect which trajectories the robots follow as well as in which order the target regions are visited.
- Illustrate that the suggested framework works with simulations and theoretical descriptions.
- Discuss the advantages and disadvantages of this approach. What limitations does the solution have? What assumptions do you need to make?
- Reflect on the future of mobile robots in society and in settings where the operator has no technical background.