

Final Project Proposal

Emergency Hexacopter Landing Under Uncertainty

Zakariya Laouar

11/20/2020

In this project, I aim to find optimal trajectories for a hexacopter to land in an emergency situation in a stochastic environment. The emergency planning will be triggered by the failure of a motor. The following subproblems are defined:

- 1) Implement a single tree goal biased RRT planner for a hexacopter with a failed motor. Successful implementation of the RRT planner will validate dynamics model.
 - a. Determine the nonlinear equations of motion for a hexacopter with a failed motor. Linearize the equations w.r.t. nominal flight conditions.
 - b. Develop goal biased RRT with kinodynamic planner constrained by the linear dynamics in (a). The map will be a continuous space version of the environment provided in (2a).
- 2) Upon successful validation of linear dynamics, an MDP will be used to formulate the problem and a simple Value Iteration algorithm will be used to compute an optimal policy.
 - a. **Environment/Rewards/Actions:** Setup the environment as a discretized 3D space (each state will occupy a cube in this space). The discrete set of actions will be defined by motion along the inertial axes (X,-X,Y,-Y,Z,-Z). There will be one cube in the map which will have a large positive reward (this represents the goal landing location). There will be several pole-like obstacles represented by stacked cubes spanning the Z axis. These will have some negative reward.
 - b. **Transition Probabilities:** In this implementation all actions will be stochastic. The chosen action will have a probability of 0.8 while the four actions normal to the commanded action will each have a probability of 0.05. The action opposite the commanded action will have a probability of 0.
 - c. **Solution:** A simple value iteration algorithm will be implemented to find the expected rewards for each action in each state. Then, the optimal policy will be evaluated by maximizing the value function in each state.