



Team Number #15

Report #1

Rev 1.2

Mission Statement

Our project is to program a simulated autonomous helicopter that will have the ability to navigate through a simulated urban environment.

Key Business Goals:

- Product will be completed by May 2010.
- Helicopter will be able to fly through simulated space at a speed faster than 10m/s.
- The software will be modular.
- The project will have no fiscal cost.

Market:

Primary: Dr. Sebastian Magierowski

Secondary: Research

Assumptions:

- We are writing the code based on a published study. We are assuming the source code used in the study will not be made available.
- Our finished product will be passed on to future engineering students, or a research team.
- Our code will help further research in robots, specifically robotic helicopters.

Stakeholders:

1. University Professors
2. Research Staff

Product Specifications

Assumptions:

- The software will run on the Player/Stage simulation platform, using the Gazebo 3D simulator.
- The “urban environment” simulated in Gazebo will be an open field filled with crude 3D boxes representing buildings, power lines, and other obstacles. It can be either modeled in advance or randomly generated using a script.
- The simulated helicopter in Gazebo will possess a laser range finder, allowing it to determine the distance between itself and the objects in its environment. This laser range finder will be based on a Fibertek laser scanner, which has a field of view of 30 x 40 degrees, a frame rate of 1.3, a blind distance of 14 m, a maximum 6 mm black wire detection range of 58 m, an angular resolution of 2 mrad, and a range resolution of less than 2 m.
- The global and local path planners and the speed controller will be based on those described in “Flying Fast and Low Among Obstacles: Methodology and Experiments,” S. Scherer, S. Singh, L. Chamberlain, M. Elgersma, *The International Journal of Robotics Research*, vol. 27, pp. 549-574, May 2008.

Features:

- The software will be modular such that Dr. Magierowski and his research team can alter the 3D environment navigated by the helicopter, as well as the helicopter’s physics, sensors, and control algorithms.
- The simulated helicopter in Gazebo will have a rotor span of 3.1 m, a length of 3.6 m and a height of 1.1 m.
- The simulated helicopter will be able to fly above the environment and use its laser range finder to create an occupancy grid of the area. This occupancy grid will represent the likelihood that a particular cell contains an obstacle.
- The simulated helicopter will be able to use an occupancy grid and a user-specified destination to calculate a vector field of potentials that points away from obstacles and towards the destination. This is referred to as the global path planner. By following the calculated vector field, the helicopter will be able to navigate a coarse path towards its destination.
- The global path planner will be capable of running in real-time, while the helicopter is in flight.
- A local path planning algorithm will allow real-time corrections to be made to the global path plan based on newly discovered obstacles in the flight path of the helicopter.
- The simulated helicopter will implement a speed controller that will maintain a minimum stopping distance from all obstacles, guaranteeing that the helicopter will not collide with any object in the 3D environment.

Performance Specifications

The performance specifications are based on a simulation run on an AMD Athlon 64 3700+ "San Diego" processor with 2GB of RAM.

- The simulated helicopter will be able to fly at an average speed exceeding 10m/s, at elevations 5–11m above ground level.
- The global path planner will be able to update the global path faster than once per 2 seconds.