UvA Drone Team
Team Description Paper
IMAV 2011, Parrot AR.Drone competition

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November 23, 2010

1 The Team

The Intelligent System Laboratory Amsterdam is a research group active in enhancing the autonomy of robotic systems. The students of our Artificial Intelligence program are skilled in both perception and decision making. The UvA team consists of two honours students of the University of Amsterdam, who will finalize their Bachelor AI with a thesis related to the IMAV competition.

Both students are already experienced with programming a quadrotor; they designed and tested an algorithm for autonomous flight for an AirRobot[1] equipped with six sonar sensors. This autonomous exploration behaviour was tested in the UsarSim environment of the RoboCup Rescue Simulation League. They are eager to extend their experience to the control of a real quadrotor.

Other relevant experience is based on the courses Probabilistic Robotics, Geometric Algebra, Electrical Engineering and a stereovision project for rebuilding 3d-maps of the environment. Their scientific advisor has both experience with automated ground and air vehicles, mostly related with the RoboCup Rescue League (both real and simulated).

[1] `http://www.airrobot.com`

2 The Challenge

The ultimate goal is to perform both indoor challenges fully autonomous with the Parrot Drone using only its internal sensors. Each indoor challenge will function as a central research question of a Bachelor thesis. The challenge will be to find a scientific method to train the AR.Drone to accomplish (a part of) the mission fully autonomous. The Parrot AR.Drone is an interesting robot for testing machine learning approaches due to the extent of its internal sensors and its low amount of range sensors. The lack of full range sensory equipment means we will rely mostly on its frontal camera for the Pylon challenge and a combination of both cameras for the Exploration challenge.

3 The Method

For autonomous flights in nontrivial environments as the Exploration challenge it is necessary to have some form of internal map. We would like to implement an algorithm for the Parrot AR.Drone, which creates and uses a simple visual map of the environment. The basis for this algorithm will be an Optical Flow algorithm, which could be used for fast and reliable background detection. Objects in the foreground can be tracked and registered as landmarks in a map of the environment. Simultaneously, an estimation of the robot's movement is maintained by combining the visual clues with data from the accelero- and gyrometers. For the Pylon challenge we intend to use reinforcement learning to optimize the speed of this task.

The localization and mapping functionality will be used in a behaviour layer, which implements the specific behaviours for each task inside the Exploration challenge. The architecture of these behaviours shall be made as general as possible, making it easy to port the code to other tasks or environments.

It is our plan to try and get OpenCV to work on the image stream. Yet, it is not clear if the images can be processed onboard before being broadcasted. Otherwise, the processing has to be done remotely. Another plan is to extend the AR.Drone with an extra camera in order to test the combination of stereovision with optical flow.