Software architecture for controlling an indoor hovering robot from a remote host

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SOFTWARE ARCHITECTURE FOR CONTROLLING AN INDOOR HOVERING ROBOT FROM A REMOTE HOST

A thesis submitted in partial fulfilment of the requirements for the award of the degree

Master of Computer Science – Research

from

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by

Ambika Asthana

School of Computer Science and Software Engineering

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Declaration

I, Ambika Asthana, declare that this thesis, submitted in partial fulfillment of the requirements for the award of Masters of Computer Science (Research), in the Department of Informatics, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Ambika Asthana
30 August 2007.
Abstract

To achieve stable autonomous control of an indoor flying robot is a challenging proposition in the field of robotics today. Many researchers are inspired by the echolocation of bats and vision of bees and attempt to duplicate this behaviour by using sonar sensors, cameras and onboard microprocessors. This project aims to achieve the same goal but with a different approach. We propose to build a software architecture for controlling a four-rotor helicopter, DraganFlyer, from a host computer. In order to do this, we equipped the DraganFlyer with communication devices, an Inertial Navigation Sensor (INS) and batteries.

The DraganFlyer is a four-rotor helicopter that can hover and move freely in air. Due to the near zero friction and damping at slow velocities it is marginally stable in six degrees of freedom. The aim of the overall research project is to understand the dynamics of the DraganFlyer and hence to achieve hover without drift and trajectory following without wandering. Development of software to achieve this level of control from a remote host poses a significant software design problem.

This thesis focuses on the software design problem, i.e. the design and development of real-time software for measuring the dynamics and for control of the DraganFlyer. The software runs on a host Macintosh and is divided into three main sections. One is the measurement of DraganFlyer motion with an INS. The second is the calculation of the control commands. The third is the control of the DraganFlyer via the radio control handset.

As these sections have different timing requirements, a significant part of the software design and testing time was spent examining how to decompose the system based on timing requirements and constraints. Then we had to determine how to couple these modules together to achieve overall timing goals without data loss.

Two types of experimental results are presented. The first results are to test the software, both the correctness of the calculations and their timeliness. The second are measurements of the open loop response of the DraganFlyer.
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