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SPACE SYSTEMS SYMPOSIUM (D1)
Space Systems Architectures (4)

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MULTI-AGENT TESTBED FOR DISTRIBUTED SPACE SYSTEMS

Abstract

A Multi-Agent Testbed for Distributed Space Systems (MATDSS) is currently under development at Delft University of Technology. This testbed is needed to simulate real-world challenges associated with autonomous coordination of distributed space systems, like communication interruption, computation delays, critical failures on individual spacecraft or modules, and sensor noise. The purpose of this testbed is to support the development, testing, and validation of robust autonomous formation flying algorithms. In these algorithms the control authority can be assigned to a central leader, or distributed amongst the agents. Some of the distributed control algorithms require data sharing between peers. This paper will provide an overview of existing multi-agent testbeds in the world, and describe MATDSS in detail. Presently, numerous multi-agent testbeds exist in industry, at government organizations, and at universities. An investigation of multi-agent testbeds all over the world has resulted in a number of design options. Many of these testbeds consist of Commercial-Off-The-Shelf (COTS) vehicles, e.g. fixed and rotary wing aircraft, R/C cars, hobby robots, and unmanned underwater vehicles. Other testbeds consist of home-built vehicles, such as blimps, microgravity vehicles, and planar air bearing vehicles. Some institutes have build testbeds that consist of a heterogeneous set of vehicles. Another fundamental difference between the testbeds are their attitude and position determination sub-systems, a variety of design options are used, e.g. (omnidirectional) onboard cameras, overhead cameras, motion capture systems, inertial measurement units, pressure sensors, and various ranging techniques using either electromagnetic waves or sound waves. All design options were evaluated in a quantitative trade-off to find which design is best suitable for this project. The result is a testbed with vehicles that move on omnidirectional-caster-bearings which gives them second order dynamics, and three degrees of freedom. The attitude determination is to be performed by a gyroscope and the position determination by ultrasonic rangers. Details of this testbed, including architecture and control strategy, will be provided, followed by a discussion on its applicability for distributed space systems.