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Simulation and Visualization of Autonomous Helicopter and Service Robots

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Abstract

To decrease the costs and the time it takes to develop and test new products, computer simulations are very helpful. Product models can be simulated, and their behavior can be examined. This applies not only to hardware, but even to software products that are composed of several components, so that their cooperative behaviour is simulated in a virtual environment. Some components of this environment can later be replaced by physical, real world devices. Some other components can be just prototypes, which are later replaced by more complex and realistic software components. In any case the idea is to construct a model and simulate both software and hardware before the actual production starts. In the WITAS project there is a need to develop a system which contains helicopters, robots and various control software and hardware. In particular there is a need to simulate the dynamic behavior of an autonomous aircraft within a virtual environment. There is a need to simulate a service environment, where robots can interact with the landed helicopter.

In this report a study of object-oriented modeling of mechanical systems using Modelica is presented with applications to autonomous helicopters and robots. Mechanical features of an autonomous helicopter have been modeled in order to verify the control system. As the result the control system has been tested and tuned. However, the flight still is not stable in the cases when flight mission directions change too often.

A robot which is able to grab, move, and release objects using automatic or manual control have been modeled. The problem of inverse geometry (and inverse kinematics) can be solved for robots using our approach. The robot models can be controlled interactively.

The geometry and dynamic structure of these systems has been designed in CAD tools and later integrated with control systems for steering these devices. The simulation has been performed in Modelica.

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