ATTITUDE AND POSITION CONTROL OF A QUADCOPTER IN A NETWORKED DISTRIBUTED SYSTEM

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Introduction Quadcopters are becoming increasingly interesting due to the great variety of usage [1]. They constitute a control challenge due to their inherent instability and coupled behavior. This paper examines the performance achievable with a linear control system, which handles the attitude and the position of the quadcopter. Furthermore, the effects of the attitude controller's bandwidth on the translational controllers are considered along with the effect of remote sensing.

Model The control design is based on a model derived by first principles. It describes the thrust forces and drag torques applied by the propellers, the attitude behavior and the translational behavior. The model is linearized using the Taylor approximation.

Network Two main network effects are considered when designing the controller, which are the delay and the controller not using the newest received data, defined as missed packets. By considering these, the stability of the designed controllers is not affected. This is done by simulating the model, the controllers and the network together. To include the network effects, the simulator TrueTime is utilized [2].

Control The control system is divided into attitude and translational subsystems. The attitude controller is designed with a state space approach. It is constituted by a state feedback with integral control. These terms are designed using LQR. A reduced order observer is also introduced to estimate non measured states. The translational controllers are designed with classical control methods, organized in a cascaded structure. The inner loops control the translational velocities with PI controllers, and the outer loops control the position of the quadcopter with P controllers. [3]

Results The results presented in this paper show the behavior of the implemented attitude controller and the simulated translational controller when tracking a given reference.

Discussion The obtained results show that the control design for both the attitude and the translational behavior is able to control the quadcopter in simulation. Moreover, the implementation and tests of the attitude controller have been carried out on the quadcopter successfully. It has been discovered, that the use of an external motion tracking system limits the bandwidth of the control solution, which affects the response of the controlled system, making it slower.

References

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