

Review of Bachelor Thesis

Name of student: JoonHong Min

Title: Control design of a quadcopter with suspended load

Student JoonHong Min followed the guidelines given in the thesis in satisfactory manner. First, the state of the art on unmanned aerial vehicles (UAV) is provided where special attention is paid to quadcopters. Particularly the measurement devices, namely gyroscope, magnetometer and barometer, are emphasized as ubiquitous requisites of the UAV. Later on various control algorithms are surveyed that have been used for UAV control. These algorithms are PID, LQ, gain scheduling, backstepping method, feedback linearization and fuzzy-neural network.

Beginning the fifth chapter the model of a quadcopter is introduced, linearized in equilibrium state which assumes initial hovering condition. This model is adopted from the supervisor, Ing. Matěj Kuře, and subsequently in the sixth chapter the PID cascade control scheme is applied to controlling the quadcopter model. This scheme is an extension of that cascade scheme developed by the supervisor earlier. The extension consists in controlling the quadcopter hovering by adding PID controller for setting the thrust. The simulations to the quadcopter model itself are made and subsequently the cascade control loop responses are obtained after PID controllers tuning. These controllers are two PIDs, for the pitch and thrust, and PD for the torque control. The tuning is run from the inner loop to the outer loop by trial and error method. Due to the model linearization the inner loop is equipped by the saturation of the pitch. Finally the PID cascade scheme is compared with the state feedback and it results from this comparison that the state feedback much better endure the noise. While the PID cascade scheme maintains the pitch within the saturation limits much closer to the equilibrium state than the state feedback.

Chief objection of the bachelor work is that the comparison study is made under condition of availability of all the state variables. Then, of course, the state feedback action surpasses the PID cascade control as also pointed out in the conclusions. Next objection concerns the PID controllers tuning because more sophisticated tuning method than the trial and error method should bring better performance of the PID cascade control. Unfortunately, the terminology used is very unconventional throughout the work, namely "*stability of D controller*", "*non-time variant system*" and "*stabled variable*". The "*bias constant*" is the initial control in fact. As regards the English the bachelor work is barely publishable elsewhere. Finally, from technical point of view the following question is given

- Could you explain what does it mean physically that all the PID gains for controlling the pitch (variable theta) are negative?

Although the thesis assignments are satisfied I have to admit that the way of meeting them is scary. Hence the bachelor work is graded by

D = satisfactory =

Praha, 31 August, 2018


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reviewer