Supervisor's Review of Diploma Thesis

Name of student: **Timizar Mehdi Badreddine**
Title: **Noisy non-linear dynamics analysis and control design for the ball levitation set-up**

Student Timizar Mehdi Badreddine followed the guidelines given in the thesis in satisfactory manner. At the beginning, the state of the art focused on non-linear dynamics analysis of levitation phenomena is briefly presented with the emphasis on the dimensional analysis fluid dynamics. Then, the water levitation task is described by means of hardware and software including position sensor calibration. Next, a mathematical model of the water levitation process is formulated by physical experiments involving all the variables of the water flow dynamics. In the Chapter 4 measurements and identification of the levitation process continues with operating point disseminations when around the middle of the actuator range nearly linear steady-state characteristics is revealed. Based on a singular values analysis the model order and parameters are identified in the vicinity of the actuator mid-range. Finally a comparative study of the PID and IMC control are provided. This comparative study demonstrates the effect of the tuning rules on the control of the levitation task and also the noise filtration effect.

The thesis starts with appropriate state of the art in the area of non-linear dynamics analysis. The Chapter 2 is unnecessarily long and it should be sufficient to refer to the virtual laboratory of Automatic control (http://vlab.fs.cvut.cz) only for describing the water levitation task. On contrary the Chapter 3 and 4 altogether should be longer in the text than they are because the physical and identification experiments deserve some comments to justify the fluids dynamics modelling. Also the Chapter 5 would require much better explanations of control loop responses shown. Particularly the noise affecting the control responses is resolved only mildly. I have to admit the master thesis is typed fast with many grammatical misuses which deteriorate the text understanding.

At the end, from the viewpoint of control theory the thesis is abundant enough in presented problems but as regards own solutions of the control problems the thesis is moderate only. Nevertheless the thesis meets sufficiently the given assignments with the grade

D = satisfactory =

Praha, 27 June, 2016

Ing. Jaromír Fišer, Ph.D.
supervisor