Supervisor assessment of Master's Thesis

Student: Király Adrián, Bc.

Title: Design of Guidance, Navigation and Control for Vertical Landing of a Reusable Rocket Booster (id 23838)

Supervisor: Chudý Peter, doc. Ing., Ph.D. MBA, DCGM FIT BUT

1. **Assignment comments**
   The aim of the thesis was to design, implement and visualize a guidance, navigation and control solution for a reusable rocket booster capable of vertical lift off and landing on the Earth's surface. The non-trivial nature of the task originates from its multidisciplinary nature, spanning flight dynamics, low and high speed computational fluid dynamics, rocket propulsion and actuation system designs, optimization of flight trajectory and utilization of a balanced navigation solution providing an adequate state description capability to the control system design itself. For the author to be able to formulate the candidate guidance, navigation and control solution, he needed to gain a deeper understanding on modern optimal control approaches, aerodynamics and actuation system modeling, applicable control algorithm designs leading to state-of-the-art spacecraft control laws, and modern visualization techniques. Beyond the algorithm design and implementation effort, the author has designed an intuitive visualization which helped in understanding of the resulting rocket booster behavior during ascent and descent. Based on the previous conditions I consider the overall difficulty to be above average.
2. **Literature usage**
   The author worked with a wide range of references, which are content-wise relevant to the topic of the thesis. The author performed an individual and focused research on modern rocket booster guidance, navigation and control techniques. The author utilized published resources and along with his individual contributions designed and implemented initial iterations on control and visualization tool for rocket booster ascent and vertical landing.
3. **Assignment activity, consultation, communication**
   The author's initial positive work attitude led at the beginning to a high level of commitment in achieving excellent results. However, the emergency circumstances due to COVID-19 tested the commitment to its fullest. After a series of initial meetings, the author decided to work on his thesis autonomously. For few on-line meetings which took place, the author appeared ready and prepared. However, the communication with the author was for the most of the time delayed and lost.
4. **Assignment finalisation**
   Both, the text of the thesis and the implementation part have been finished at the last moment before the delivery, leaving zero space for adjustments, modifications or improvements.
5. **Publications, awards**
   Unknown
6. **Total assessment** **satisfactory (D)**
   The student's overall activity and motivation fluctuated throughout the work on the thesis. Achieved results introduce reusable rocket booster design and could serve as a staring point for future studies in spacecraft guidance, navigation and control. The amount of demonstrated knowledge, enthusiasm and focus needed for accomplishing the thesis was satisfactory. I recommend the thesis for a defense. Suggested grade as based on the above mentioned: **Satisfactory (D)**.

In Brno 7 June 2021

Chudý Peter, doc. Ing., Ph.D. MBA
supervisor