Review of Bachelor's Thesis

Student: Karpíšek Jakub
Title: Beresheet Lunar Landing Simulation (id 22727)
Reviewer: Vlk Jan, Ing., DCGM FIT BUT

1. **Assignment complexity** — **more demanding assignment**
   The difficulty of selected assignment is above average as it targets in my opinion challenging topics e.g. modeling and simulation, astrodynamics, numerical optimization and computer graphics.
2. **Completeness of assignment requirements** — **assignment fulfilled**
   All tasks of the assignment were fulfilled.
3. **Length of technical report** — **within minimum requirements**
   The thesis is written on 42 pages and fulfills minimal conditions for bachelor thesis. However, lower page count doesn't influence quality of the thesis. All chapters well balanced and informatively rich. Only Chapter 7 Evaluation could contain more types of results e.g. analysis of the De-orbit phase, Coast phase or Vertical descent phase.
4. **Presentation level of technical report** — **90 p. (A)**
   The logical structure of the thesis is clear and understandable for the reader. As stated above the chapters well balanced and logically connected.
5. **Formal aspects of technical report** — **95 p. (A)**
   The thesis is written in English and the student proved good writing skills. The typography of the thesis is at high level. The math notation is understandable and I appreciate that the student created his own figures where possible.
6. **Literature usage** — **93 p. (A)**
   The bibliography contains list of publications relevant to the discussed topic. The topics as orbital dynamics or numerical optimization are very well covered in the literature, but data about the Beresheet mission are not available today since the flight was performed at the beginning of 2019. I appreciate student's enthusiasm despite the lack of data. For example, the trajectory data for evaluation were extracted from the live broadcast record of Beresheet "landing".
7. **Implementation results** — **89 p. (B)**
   The student computed optimal descent trajectory of the Beresheet spacecraft using BOCOP (optimal control solver) and visualized the results in 3D within his own user interface developed using LibGDX framework. The results were compared to the data extracted from the live stream record of the Beresheet flight. The designed visualization environment is simple and intuitive.
8. **Utilizability of results**
   The results of this work and gained knowledge could be used in further research of spacecraft optimal flight trajectory design and evaluation. The growing attention to space exploration makes them extremely valuable today.
9. **Questions for defence**
   What is the reason of pitch angle and throttle command oscillations in the final phase of the optimal descent trajectory (Figure 5.10, 5.11)? Is it possible to avoid them?
10. **Total assessment** — **93 p. excellent (A)**
    The student proved considerable knowledge in the various topics mentioned above (orbital dynamics, numerical optimization, UI design) and was brave enough to face a very actual topic. With respect to previous findings I suggest the grade (A).

In Brno 24 June 2020

Vlk Jan, Ing.
reviewer