

## Review of Bachelor's Thesis

**Student:** Filo Jakub  
**Title:** Lunar Landing Simulation (id 21978)  
**Reviewer:** Prustoměský Milan, Ing., UPGM FIT VUT

- 1. Assignment complexity** **more demanding assignment**  
The thesis is focused on optimization of flight path trajectory of lunar module with respect to fuel consumption, which should be minimized. Part of the task is simulation of lunar landing and its visualization. I consider the overall difficulty as above average.
- 2. Completeness of assignment requirements** **assignment fulfilled**  
All assigned tasks of the thesis were fulfilled.
- 3. Length of technical report** **within minimum requirements**  
The thesis is written on 42 pages and fulfils the minimum conditions. The lower number of pages doesn't influence the quality of reviewed thesis.
- 4. Presentation level of technical report** **82 p. (B)**  
The thesis is very well structured and understandable for the reader. The chapters are informatively rich except the Chapter 6 Evaluation of achieved results which only compares the descent trajectory of lunar module and in my opinion should be extended. Author could compare more variables like as lunar module attitude or fuel consumption or thrust command during descent.
- 5. Formal aspects of technical report** **90 p. (A)**  
The thesis is written in English and according to my opinion at very high level. Typography of the thesis meets high standards.
- 6. Literature usage** **85 p. (B)**  
The student cites 41 books, articles and internet resources, which are relevant to the solved topic. I would recommend more balanced citing. Some chapters are richly cited and some (e.g. Chapter 3) use very low number of resources.
- 7. Implementation results** **88 p. (B)**  
The student computed optimal landing trajectory of lunar module with utilisation of BOCOP (optimal control solver) and visualised the results in 3D within his own user interface. The results were compared to real data measured during Apollo 11 mission.
- 8. Utilizability of results**  
The results of this work could be used in research of optimal flight trajectory planning and even in for solving various problems of optimisation.
- 9. Questions for defence**
  - Would it be useful (and possible) to compare lunar module optimal pitch angle or thrust command with real measured data?
  - What was the main advantage of Midpoint algorithm over e.g. Runge-Kutta 4 and why did you choose to use it.
- 10. Total assessment** **86 p. very good (B)**  
The reviewed thesis and new knowledge gained by the student has a good potential for the future utilization and development in area of optimal control and trajectory planning and I hope that the student will continue in this work even during master studies. With respect to previous findings I suggest the grade (B)

In Brno 29. May 2019

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