

I. IDENTIFICATION DATA

Thesis name:	Navigation System for Autonomous Student Formula
Author's name:	Tomáš Roun
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Dept. of Computer Science
Thesis reviewer:	Radim Tyleček
Reviewer's department:	University of Edinburgh, School of Informatics

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging
<i>Evaluation of thesis difficulty of assignment.</i>	
Optimization of a complex method for real-time application requires both detailed understanding of the algorithm and development skills for the targeted GPU architecture. While the chosen existing algorithm is well known, it still required tuning on the target domain (race track) where sparsity of landmarks and their similar appearance poses additional challenges.	

Satisfaction of assignment	fulfilled
<i>Assess that handed thesis meets assignment. Present points of assignment that fell short or were extended. Try to assess importance, impact or cause of each shortcoming.</i>	
Presented simulations demonstrate that a practical system for landmark-based navigation has been developed. Real-world experiments with the formula would be desirable, but this was not possible due to external factors.	

Method of conception	outstanding
<i>Assess that student has chosen correct approach or solution methods.</i>	
The approach appears to be initially driven by the need to speed up PythonRobotics package's implementation of SLAM. The choice of GPU architecture for parallelization follows current trends in the area and is appropriate for the chosen algorithm.	

Technical level	A - excellent.
<i>Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.</i>	
Theoretical chapters in the thesis demonstrate in-depth knowledge of the problem and present it clearly. Implementation was carried based on suitably chosen packages and the result is close to open-source standard.	

Formal and language level, scope of thesis	A - excellent.
<i>Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.</i>	
The work is well structured, readable and contains all expected sections. English language level is high but could be improved (typos). The theoretical part has even educational qualities.	

Selection of sources, citation correctness	B - very good.
<i>Present your opinion to student's activity when obtaining and using study materials for thesis creation. Characterize selection of sources. Assess that student used all relevant sources. Verify that all used elements are correctly distinguished from own results and thoughts. Assess that citation ethics has not been breached and that all bibliographic citations are complete and in accordance with citation convention and standards.</i>	
The work focuses on Lidar-based SLAM algorithms and particularly in the implemented area of filters the bibliography is complete. While the formula has also video cameras mounted, I would expect a broader introduction that also considers	

visual-inertial methods based on image sensors, including existing packages like popular ORB-SLAM or modern Kimera.

Additional commentary and evaluation

Present your opinion to achieved primary goals of thesis, e.g. level of theoretical results, level and functionality of technical or software conception, publication performance, experimental dexterity etc.

Code publication in an online repository is encouraged as a contribution to the community, accompanying excerpts from the thesis could turn it into a useful resource for students.

III. OVERALL EVALUATION, QUESTIONS FOR DEFENSE, CLASSIFICATION SUGGESTION

Summarize thesis aspects that swayed your final evaluation. Please present apt questions which student should answer during defense.

The thesis shows that the author has successfully researched, conceived, implemented and presented a solution to a real-world problem, which can benefit the author's Student Formula team as well as the autonomous driving community.

I evaluate handed thesis with classification grade A - excellent.

Question for the student:

- 1) In the context of Student Formula competition, what are the advantages of using Lidar sensors compared to image sensors?
- 2) Would it be possible to simulate the path planning and vehicle control based on the input from the proposed real-time implementation, e.g. in FSDS?

Date: **23/06/2021**

Signature: Radim Tylecek