REVIEWER'S OPINION OF FINAL THESIS

I. IDENTIFICATION DATA

Thesis name:	**Robust Plan Execution in Multi-Agent Systems**
Author's name:	**Josef Weis**
Type of thesis :	bachelor
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Cybernetics
Thesis reviewer:	Anton Andreychuk
Reviewer's department:	-

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment	challenging

Evaluation of thesis difficulty of assignment.

The thesis considers a challenging problem of multi-agent pathfinding. It considers an extended problem statement that takes into account possible delays of actions during the execution that is even more challenging than the original classical MAPF problem.

Satisfaction of assignment	fulfilled

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.

The thesis meets the assignments described in the guidelines.

Method of conception	correct

Assess that student has chosen correct approach or solution methods.

The student has chosen an appropriate approach to solve the problem. It uses a commit cut algorithm that is based on the combination of SoTA suboptimal MAPF planner, i.e., ECBS, and ADG. A modified version with replanning mechanism was proposed that allows to increase the quality of the found solutions.

Technical level	B - very good.

Assess level of thesis specialty, use of knowledge gained by study and by expert literature, use of sources and data gained by experience.

The technical level of the thesis is very good. It contains a rich section of experimental evaluation. Supplementary materials contain the sources of the methods, dataset, i.e., maps and instances, that were used for the experiments.

Formal and language level, scope of thesis	B - very good.

Assess correctness of usage of formal notation. Assess typographical and language arrangement of thesis.

The original MAPF problem is formulated really good. However, the extension to the MAPF problem, i.e., delays of actions, robust execution, were not formally described in the problem statement.

Selection of sources, citation correctness	C - good.

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.

The student has performed a good work collecting the relevant sources about the approaches of solving MAPF problems. However, there are a lot of missing works related to the MAPF with delays, robust execution, etc.
Just a few examples: Atzmon, D., Stern, R., Felner, A., Wagner, G., Barták, R., & Zhou, N. F. (2020). Robust multi-agent path finding and executing. Journal of Artificial Intelligence Research, 67, 549-579.
Shahar, T., Shekhar, S., Atzmon, D., Saffidine, A., Juba, B., & Stern, R. (2021). Safe Multi-Agent Pathfinding with Time Uncertainty. Journal of Artificial Intelligence Research, 70, 923-954.

Ma, H., Kumar, T. S., & Koenig, S. (2017, February). Multi-agent path finding with delay probabilities. In Proceedings of the AAAI Conference on Artificial Intelligence (Vol. 31, No. 1).

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.

Please insert your commentary (voluntary evaluation).

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 considers a variation of multi-agent pathfinding problem. Additionally to the regular challenges of MAPF problems related to the requirement to find a set collision-free trajectories, it also considers the problem of possible delays during the execution of the plan. To deal with it, an approach based on combination of ECBS algorithm, Action Dependency Graph and repeated replanning is considered. To verify the functionality of this approach, there was developed a simulation tool that allows to simulate execution of the plans and to add delays to some of the actions. An extensive experimental evaluation was performed that considers different ways of using ADG and replanning mechanism.

Overall impression of the thesis is positive. However, there are some parts that definitely might be improved.

1) The problem statement is mainly focused only on classical MAPF problem with only one paragraph that says that the problem under consideration is different and actually takes into account the presence of delays during the execution.

2) Some major papers related to the work are missing. The exact examples are given in section "Selection of sources, citation correctness".

3) Some important details in the experimental evaluation are missing. It is not clear how many agents contains each of the instances. It is also never mentioned the planning time of the approach. Does it have any timelimit? Was it always possible to find a solution?

I evaluate handed thesis with classification grade **B - very good.**

Date: **31.5.2022**   Signature: