Review of Master's Thesis: "Mission planning for cooperative construction by a team of unmanned aerial vehicles"

Author of thesis: Jasna Petrić
Reviewer: Ing. Daniel Fišer

The thesis is targeted at solving a very specific problem from MBZIRC 2020 competition, namely building a wall from colored bricks using UAVs. In the first part of the thesis, an algorithm for selecting an order in which the bricks will be placed in the wall is proposed. And the second part describes a simulation and real-world experiments with the proposed algorithm.

Although the simulation and real-world experiments seems to be satisfactory, the work on the scheduling algorithm has serious deficiencies.

The chapter on related work is rather short, it is filled with inaccurate or confusing statements, and cited literature sometimes seems to be chosen at random. For example in 2.2.1, a paragraph starts with "Graph based solution usually suffers [...] from computation complexity." and follows with "One of the ways to avoid the dimensionality problem is to use a sequence of graphs." which is the first time the "dimensionality problem" is mentioned. It is not clear why (or which) graph-based approaches suffer from computational complexity, what are "sequences of graphs", what is meant by dimensionality problem and so on. As another example in the same section, the fifth paragraph starts with defining a tree as a directed connected graph without cycles, for which three sources are cited, two relating to UAVs and LaValle's book Planning Algorithms. And immediately after that, a tree is defined again, this time as "a structure of hierarchically linked nodes where each node represents a particular state". I don't understand why these three source are cited for a standard definition of a tree and why is a tree re-defined immediately after that. It is, probably, an attempt to define a state space as a tree structure, but it is utterly confusing.

The worst part of the thesis is the third chapter. The fact that the title of the chapter reads "Cooperative wall building", but there is nothing "cooperative" in the described algorithm, is the smallest of all problems. As far as I can tell from the description of the problem, the goal was to find a sequence of bricks that will be placed in the wall so that as many bricks as

possible is placed in the wall even in a case UAVs fail to deliver the assigned brick to the right place. Before I get to the proposed solution, I should mention that the thesis does not describe what is a valid sequence of bricks. I can only guess that that was the purpose of the section 3.2 named "Tree build", because otherwise this whole section doesn't make sense to me.

On several places in the thesis, it is said that the goal is to minimize the cost (of delivering bricks to the right places) and maximize the reward (the number of correctly placed bricks). However, it is never described how exactly are these two criteria used for selecting the optimal solution or even what is the optimal solution. (I should also mention that on several occasions, the thesis mentions "less optimal" and "more optimal" solutions, which adds to the confusion.)

The cost of a brick is defined in equation (3.2) to be independent of the order in which the brick is placed in the wall. Assuming that the reward is also independent of the order, maximizing reward would, obviously, mean to place all bricks in the wall in any valid order, because the cost of all solutions would be constant. Minimizing the cost would then result in an empty wall. Since the thesis does not describe how these two opposing criteria are combined, it is impossible to assess the proposed solutions. The only thing I can say is that the method named "brute force" just generates all possible sequences and selects the best one (but again, it is unclear what that is). The "greedy" and "improved greedy" methods seem to be just weirdly described best-first search methods.

Overall, I don't think the work meets the requirements for a Master's Thesis and I grade the work with **F (failed)**.

Prague, June 3, 2019

Daniel Fišer