Supervisor's opinion on the Master Thesis
Potential of Smart City through Modeling of Single Crossing (Case Study: Olomouc)
by Tina Pourpakdelfekr

Modern civilization is based on internal combustion engines. Apart from the enormous increase in the quality of life, they have also brought a few problems. It is possible that anthropogenic emissions of carbon dioxide contribute to climate change. But it is certain that too much traffic in cities makes life in them less pleasant. Thus, it is reasonable to look into the possibilities of reducing traffic jams.

The aim of the presented Thesis is to illustrate the potential of mathematical modelling in proposing smart solutions to traffic jams. I am very glad that the demand for a mathematical modelling topic came from Tina herself – I have long advocated for the use of mathematical modelling and optimization in Foresight and I am happy to see it materialize.

The research question of the Thesis is clear – can the proposed mathematical model for the optimization of traffic lights be useful in reducing waiting time and air pollution? The Thesis brought two main outcomes – first, it demonstrated that the answer to the question is "yes", and second (and perhaps more important) it unlocked for Tina the standard tools of mathematical modelling. In my opinion, overcoming the initial barrier of problem algorithmization, procedural programming, visualisation and interpretation of the resulting numerical data, and using optimization algorithms brings a huge benefit in any future task that Tina will undertake. Thus, even if the presented algorithm may not be state-of-the-art, the learning benefit of the Thesis is substantial.

I consider the Thesis very well written. The organization of the material is clear and logical, I appreciate enough evidence, professional use of tables, charts, and references. The topic is well placed into the Foresight framework. I appreciate attempt at precise definitions of usually vague notions (smart cities, congestions, ...). I also like the optimal mix of theory and practical examples well illustrated with data. Having lived in Olomouc for the past 40 years, I must admit I learned a lot about traffic and pollution in Olomouc from the Thesis. Tina makes very good use of fresh datasets when she illustrates the real effect of traffic decrease on air pollution during the recent lockdowns. In the Methods section, I like the extensive discussion of how to measure the outcomes we want to model.

The presented algorithm for the optimization of traffic lights in a crossing is reasonable, simple, easy to understand and easy to use. There are many assumptions that simplify the problem, however, most of them can be lifted with only minor revisions of the code. The presentation of the pseudo-code and its description could be improved but I understand that Tina is not a computer science major, and I may have provided too little guidance. The figures might benefit from more precise captions, it is convenient that figures be comprehensible on their own. Naturally, it would be nice to see the presented model applied to a real crossing with real traffic data, however I understand that time is limited, and I appreciate the amount of work that Tina did. I would suggest adding a Conclusion section.

In summary, I very appreciate the courage than Tina has shown in selecting a mathematical modelling topic and coping with it. I consider the Thesis very well written, and the author's original contribution certainly sufficient. I recommend the Thesis to be defended and suggest A for the evaluation.

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Tomas Fürst
supervisor