Dissertation thesis review

Author of the dissertation thesis: **Ing. Dan Martinec**

Title of the dissertation thesis: **Travelling Waves in Distributed Control**

The thesis focuses on a novel approach for the analysis and control of a linear multi-agent system. The author introduces travelling-wave approach utilizing decomposition of the outputs of the agents into two independent waves travelling through the system in opposite directions. The author critically analyzes the interactions between agents and features of the waves in several configurations of the multi-agent system. One of the main achievement of such approach is the usage of irrational transfer functions approximation for modeling the behavior of the system. The problem addressed in the thesis is **challenging and very actual**.

The thesis is well written and forms easy to follow story from the motivation and fundamental basics, to authors achievements and results. Each part of the thesis states the mathematical model extensions and carefully discus its new properties. The changes in transfer functions, wave behavior or absorbers design for corresponding multi-agent system configuration are well described and analyzed. The results are validated on the simulation. The thesis analyses the properties of the system and provides the research results starting from simple linear configuration and ending with non-homogenous and non-linear agents' configurations. In all parts the problem analysis, methods and validation are **appropriate for research work**.

The results of the thesis have been already published in several journals and conferences. The references in the presented work are well balanced between author's own achievements and state-of-the-art publications in the field. Author claim the main contributions of the thesis in

- Wave transfer function generalization and its approximation, together with wave-absorbing controllers design for string stability ensuring,
- Hard and soft boundary concepts introduction to model wave reflections,
- General-graph generalization of the approach.

The thesis document well the claimed contribution and gives a clear evidence of the quality of the author's scientific work. It can be stated the **goal** of the thesis **has been achieved**. The results provide significant scientific contribution in the field of distributed control of multi-agent systems.

For the defense I would like to rise following questions:

- The presented control is based on limited communication. In case of communication between vehicles, is it possible to model communication delays using waves similarly to presented approach? How much different are communicated information propagation and distance observation approaches?
- Is the homogenous platoon case achievable in reality? How big is the influence of noise, tolerance or small dissimilarities of the real trucks?

Based on the above, I can conclude that the thesis of Ing. Dan Martinec fulfils conditions of a standalone creative research work and contains original research results published (or submitted for publication) by author of this thesis. I **do recommend** this dissertation thesis for defense.

In Prague, 1.7.2016

doc. Ing. Jiří Vokřínek, Ph.D.