THESIS SUPERVISOR'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Robust control for the two-wheeled-legged robot Sk8o.**
Author's name:	**Petr Kuchař**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Control Engineering
Thesis supervisor:	doc. Ing. Zdeněk Hurák, Ph.D.
Supervisor's department:	Department of Control Engineering

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **challenging**

How demanding was the assigned project?

In principle, this is a standard control engineering project: a real physical system is provided to the student who should improve the performance of the existing controller. And this is what makes the project challenging. The student had to

- get familiar with a new technology (not always perfectly documented),
- build a mathematical model (by modifying some existing one and translating to another modeling framework),
- understand the existing implementation of a simple controller and analyze its deficiencies,
- apply some advanced control design methods presented in the course, but with which he did not have hands-on experience so far,
- and finally get his hands dirty by implementing the controller in the robot hardware, run the experiments and analyze the results.

Apparently, it is the breadth of this realistic engineering problem that makes it rather challenging.

Fulfilment of assignment **fulfilled**

How well does the thesis fulfil the assigned task? Have the primary goals been achieved? Which assigned tasks have been incompletely covered, and which parts of the thesis are overextended? Justify your answer.

I am happy to conclude that that the assignments have all been fulfilled.

Activity and independence when creating final thesis **A - excellent.**

Assess whether the student had a positive approach, whether the time limits were met, whether the conception was regularly consulted and whether the student was well prepared for the consultations. Assess the student's ability to work independently.

I gladly confirm that the student worked independently and with initiative. He used to consult his progress regularly. Although he was open to advice, he did not follow it blindly, but subjected it to critical consideration.

Technical level **A - excellent.**

Is the thesis technically sound? How well did the student employ expertise in his/her field of study? Does the student explain clearly what he/she has done?

First, I am really impressed by the fact that the student indeed succeeded in improving the existing control system. The reality here "proved" the correctness of the student's work. What I particularly like about this thesis is that it offered an opportunity to the student to apply some advanced computational control design techniques that he had learned in courses.

Just for archival purpose I will note here that in the current form I view the two controllers (the fixed one and the gain-scheduled one) as based on rather different control design frameworks (Hinf-optimization based vs LQR combined with the eigenstructure assignment), which is not particularly convenient. Techniques seem to be available for formulating the gain-scheduling control design using the Hinf framework too. For example, instead of eigenstructure assignment with all its numerical caveats, some Hinf-based model matching could be perhaps used. The capacity of this thesis was, however, filled completely and the proposed can thus serve as a suggestion for a future student.

Formal level and language level, scope of thesis	**B - very good.**
Are formalisms and notations used properly? Is the thesis organized in a logical way? Is the thesis sufficiently extensive? Is the thesis well-presented? Is the language clear and understandable? Is the English satisfactory?	
The English of the thesis is just fine, although maybe a bit clumsy in places.	

Selection of sources, citation correctness	**C - good.**
Does the thesis make adequate reference to earlier work on the topic? Was the selection of sources adequate? Is the student's original work clearly distinguished from earlier work in the field? Do the bibliographic citations meet the standards?	

The selection of the resources (papers, books, …) is just fine. After all, the control design methods that were considered/proposed to be used in the project are now commonly taught at graduate course on advanced (optimal/robust, …) control. Where the standard is not fully met is the way these resources are cited. References such as [10], [11], [12], [22], … , well, in fact most of them if not all of them, are far from fully specified. Just the name of the author, the title of work and the publication year. This is, however, not sufficient to fully identify the resource and does not obey the common citation styles, not to speak of standards.

A few minor issues:

- Links to documentation for Matlab products and functions do not necessarily have to be included in the bibliography. They may be included in the text as footnotes instead. I would perhaps keep only materials such as paper, reports, and books in the bibliography.
- It is possible to tweek the typesetting of the bibliography so that abbreviations such as LMI are not typeset as Lmi.

Additional commentary and evaluation (optional)

Comment on the overall quality of the thesis, its novelty and its impact on the field, its strengths and weaknesses, the utility of the solution that is presented, the theoretical/formal level, the student's skillfulness, etc.

n/a

III. OVERALL EVALUATION, QUESTIONS FOR THE PRESENTATION AND DEFENSE OF THE THESIS, SUGGESTED GRADE

Summarize your opinion on the thesis and explain your final grading.

This was a complex engineering project containing all the steps such as mathematical modeling, numerical simulation, optimization-based control design, implementation in real hardware, experimentation with a real robot. I gladly acknowledge that the results the student delivered were functional and they performed better than what was available (to us) previously.

Although the text of the thesis suffers from a few minor imperfections, I regard the work done by the student very high.

The grade that I award for the thesis is **A - excellent.**

Date: **17.6.2024** Signature: