THESIS SUPERVISOR'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Hyperbolic positioning in UWB networks with non-transmitting tag**
Author's name:	**Bc. Josef Krška**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Control Engineering (k13135)
Thesis reviewer:	Ing. Václav Navrátil Ph.D.
Reviewer's department:	Dept. of Radio Engineering (k13137)

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **challenging**

How demanding was the assigned project?

The student had to acquire in-depth understanding of both hardware and software of the UWB transceivers (IEEE 802.15). He had to develop and implement a UWB indoor localization system with receiving-only tag and deal with the inherent problems caused by drifting clock of the tag.
Moreover, the student was ought to find a suitable method for determination of the anchor network topology based on the distances between anchors obtained via two-way ranging. He had to familiarize himself with distributed solutions of non-linear problems and use them accordingly.

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.

The student presented the localization system with receiving-only tag, where the clock drift is estimated and its effect mitigated by means of extended Kalman Filter. Its performance has been experimentally verified by a series of well-designed tests. The results are similar to the variant with transmitting-only tag, in terms of accuracy.
The work in distributed solutions of the anchor positions reached even beyond the assignment, since the student not only applied the algorithms, but also improved several of them.

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.

The student provided regular updates on the state of work on the thesis and followed the plan that we agreed on. The student worked independently, however, consulted the key points. He was actively searching for additional sources and did not hesitate to ask when necessary, resulting in several fruitful discussions.

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?

The technical level of the thesis exceeds the ordinary level expected from master thesis. The student not only applied his knowledge of control systems (e.g. EKF) and optimization methods, but had to become acquainted with the radio wave propagation and signal processing. Student's contribution is clearly identified and distinguished from the previous works.

Formal level and language level, scope of thesis **A - excellent.**

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 structure of the thesis follows a logical outline and explains the relevant topics thoroughly and understandably. I consider the use of English language satisfactory. The use of mathematical notation and abbreviations is consistent throughout the thesis; even though it adheres to standard notation, it is well described. The typography of the thesis is on exceptional level.

Selection of sources, citation correctness	**A - excellent.**
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 thesis cites relevant work in the field, including student's own work. The chosen approach is compared with the latest articles about the development of similar systems. Student's original work is clearly distinguished and the citations meet the standards.	

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.
The UWB position approach that was developed and implemented performs alike or better than the approaches presented in recent articles, in terms of accuracy. Moreover, the described approach is superior in terms of air-time utilization and ease of implementation. On the grounds of possible impact to the field, it is recommended to publish the results in a relevant research journal.

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

The thesis is on excellent level both technically and formally. The presented methods and results may have a considerable impact in the field of UWB indoor navigation. Therefore I have chosen the highest grade possible.

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

Date: **28.5.2021** Signature:

THESIS REVIEWER'S REPORT

I. IDENTIFICATION DATA

Thesis title:	**Hyperbolic positioning in UWB networks with non-transmitting tag**
Author's name:	**Josef Krška**
Type of thesis :	master
Faculty/Institute:	Faculty of Electrical Engineering (FEE)
Department:	Department of Control Engineering
Thesis reviewer:	Prof. Ing. Jan Holub, Ph.D.
Reviewer's department:	Department of Measurement

II. EVALUATION OF INDIVIDUAL CRITERIA

Assignment **challenging**

How demanding was the assigned project?

The assigned topic is definitely challenging and up-to-date.

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.

The assigned tasks have been solved in full.

Methodology **outstanding**

Comment on the correctness of the approach and/or the solution methods.

The selected approaches and methods are appropriate.

Technical level **A - excellent.**

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

The thesis is definitely technically sound and well explained, including clear indication of the student contribution.

Formal and language level, scope of thesis **A - excellent.**

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 thesis is organized in a logical way and written in excellent English.

Selection of sources, citation correctness **A - excellent.**

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?

Sources are properly identified and cited appropriately.

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.

The student's work is novel with potentially strong impact on the field. I recommend to publish the results in a suitable research journal.

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

The thesis submitted by Bc. Krška exceeds the usual amount of work and presentation quality. I definitely suggest the highest possible grade. I propose the following questions for the discussion:

-Why do "Anchor to Tag" mean errors deviate from the actual position in an opposite direction than "Tag to Anchor" in Fig 3.5 (page 47)? Identical positions are measured using the same hardware.
-What are the computational requirements for the methods proposed in Chapter 4.4 ? Considering those requirements, discuss their applicability for low-power devices/nodes.

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

Date: **25.5.2021**

Signature: