

Opponent Review of Doctoral Dissertation

Applicant: Mgr. Ing. Pavel Šeda

Title of Dissertation: OPTIMIZATION OF WIRELESS NETWORKS INFRASTRUCTURE USING ARTIFICIAL INTELLIGENCE METHODS

Opponent: Prof. Giuseppe Araniti

Opponent's Department: DIIES Department, University Mediterranea of Reggio Calabria (Italy)

In accordance with the Study and Examination Rules of BUT, in his/her review the opponent will mainly comment on:

- a) the topicality of the dissertation,*
- b) whether the dissertation achieved its given objective,*
- c) the problem-solving procedure and the results of the dissertation along with the concrete contribution of the doctoral student,*
- d) the significance for practical application or the progress in the field,*
- e) formal and language qualities of the dissertation,*
- f) whether the dissertation fulfils the conditions of Section 47 (4) of the Act,*
- g) whether the student proved his/her creative abilities in the given research field and whether the work does or does not comply with the standard requirements placed on the dissertations in the given field. The review is not valid without this conclusion.*

It is necessary to add a concise commentary to each of the points below.

Ad a) Topicality of the dissertation

The topic of the dissertation is very topical.

Comment: The candidate has addressed a very hot and timely research topic by introducing relevant contributions to the state of the art. Indeed, in this dissertation, an optimization model and algorithms are designed by using artificial intelligence methods for a suitable base station deployment in 5G and beyond networks, where the demand for services, such as High Definition (HD) video streaming services on mobile, Augmented Reality (AR), and Virtual Reality (VR), is continuously increasing.

Ad b) Objective of the dissertation

The objective of the dissertation was achieved.

Comment: The dissertation achieves the following objectives:

- 1) reviews the main challenges of the 5G and beyond technology and the existing covering models that find the optimal base station deployment;
- 2) classifies the implementation approaches and reviews the optimization algorithms for location covering problems;

- 3) proposes a novel location covering model to find optimal locations for base station deployment by first considering the basic requirement of coverage distance and then, improving the model by taking into account the advanced requirements of capacity and interference in 5G and beyond networks.
- 4) computes the computational complexity of the proposed model;
- 5) proposes algorithms that implement the proposed location covering model;
- 6) verifies the validity of the proposed solutions through the analysis of numerical simulation results obtained for real use-cases.

Ad c) Problem-solving procedure and the results of the dissertation and the concrete contribution of the doctoral student

The problem-solving procedure and the results of the dissertation are excellent.

Comment: Starting from a careful study of the literature, the candidate has been able to identify one of the major challenges of the 5G+ (i.e., the location covering optimization problem) and has designed a model for the optimal base station location, which exploits artificial intelligence and considers the requirements of interference and capacity of 5G+ networks, characterized by a continuous and growing demand for HD and AR/VR services on mobile devices. Furthermore, the validity of the proposed optimization model has been demonstrated through the analysis of numerical simulations results obtained for real use-cases. Therefore, the problem-solving procedure and results of dissertation can be considered novel and complete.

Ad d) Significance for practical application or progress in the field

The significance for practical application or progress in the field is excellent.

Comment: The dissertation has notable significance for practical applications that has been demonstrated and analyzed through the modelling of real deployment use-cases. Furthermore, the candidate has illustrated other aspects, which pave the way for future research directions.

Ad e) Formal and language qualities of the dissertation

Formal and language qualities of the dissertation are excellent.

Comment: The dissertation is in general well-written, and contents are clear.

Ad f) The dissertation fulfils the conditions of Section 47 (4) of the Act

The dissertation fulfils the conditions of Section 47 (4)*) Act No. 111/1998 Sb. Higher Education Act: YES

*(*4) Studies are duly finished with a doctoral state exam and dissertation defence, which prove the ability and readiness to work independently in the field of research or development, or in theoretical and creative arts. The dissertation must comprise original and published results or results accepted for publication.*

Ad g) Creative abilities of the student in the given research field. Compliance with the standard requirements placed on the dissertations in the given field.

The doctoral student did prove his/her creative abilities in the given research field and the work does comply with the standard requirements placed on the dissertations in the given field.
Comment: The dissertation meets the requirements of originality, completeness, and accuracy in addressing a cutting-edge topic in the research field of the pursued PhD.

Overall evaluation: The candidate has addressed a very hot and timely research topic by writing a PhD thesis that is original, complete, and clear. In general, the dissertation is well-structured, well-written, and supported by a rich bibliography and a good number of publications. It is recommended proceeding with the defence of dissertation.

Opponent's questions: Before the final publication, the following minor modifications are recommended:

- 1) add the year of publication in table 2.2 on page 22;
- 2) be consistent with the font style (capital or small letters) of the authors in the list of publication on pages 67-68;
- 3) improve minor English expressions.

I recommend do not recommend the dissertation for the defence.

Date: 18.06.2022

Signature:
