Opponent Review of Doctoral Thesis

Title: Intra- and Out-of-Vehicle Channel Measurements and Modeling

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Evaluated dissertation work of Pavel Kukolev clearly belongs to the field of his study. The work is divided into two main chapters, state of the art, objectives of the work and the conclusion. Load-bearing part of the work is represented in chapters 4 and 5. The work contains a list of figures, tables, abbreviations. The references of 106 titles and a list of 11 author’s publications are included at the end of work. A short version of doctoral thesis was also included.

Answers to questions from the request to evaluate the thesis are as follows:
1. The theme belongs to the field of knowledge and is very actual because of the extensive development of C2C communication.
2. The work is original with author’s own scientific contributions, to which I consider following:
   a. The proposal to use IEEE 802.11p standard for vehicle communication based on simulation model created in Matlab.
   b. The proposal to use specific models describing the signal propagation in-car and out-car environments (double exponential decay model, average channel model, UWB model).
   c. The assessment of proposed models’ parameters through analysis of measured power delay profile.
   d. The proposal of 2-D localization method based on TOA method.
3. The main part of doctoral thesis was published at the requested level: 6 international conferences (Radioelektronika 2013 indexed in WoS), 5 articles in scientific journals (2 of them submitted) – the most valuable IEEE Transactions on Vehicular technology (IF 2015 = 2.2). All published articles belong to the field of dissertation. I found 2 citations of author’s article on WoS.
4. The candidate clearly demonstrated that he belongs to scientific workmen and is able to work in such a complicated field of science as the propagation of radio waves is.

Remarks to the work:
- In the first part of the work the author analyses the performance of two WiFi standards – IEEE 802.11a and IEEE 802.11p in Rayleigh channel. To my opinion standard 802.11a is almost unusable in channel model E (it is not able to reach better BER as 10exp-3 for arbitrary large Eb/N0 ratio), whereas the author declares only slightly greater BER.
- The performance of 802.11p standard over ITU-R channel model was carried out. The author’s analysis of BER performance over vehicular channel B is overestimated (Fig.4.10, 4.11, 4.12). It is obvious that the system is not able to reach better BER as ~10exp-1 even at low (30 kmph) velocity.
- There are missing some partial conclusions at ch.4.1 – which technology will be preferred for C2C communication and which channel model will be used next.
- To evaluate the performance of two term exponential model, the comparison between model and power delay profile was used and the difference was presented in the form of MSE.
There is no conclusion about this comparison, whether in table or in graphical form. Question: Is the computed value of MSE=6.95x10exp-5 low enough? If yes, how was this level defined?

- To find the proper distribution for describing SSV variations, the author applied 3 theoretical distributions to approximate CDF of measured SSV. It is hard to declare which one is the best from Fig.4.20. How do you come to conclusion about the best candidates for this operation – the logistic and GEV?

**Conclusion**

The evaluated dissertation work of Pavel Kukolev satisfies the conditions laid down for the level of dissertations and corresponds to the generally accepted requirements for granting an academic degree so therefore I

**Recommend**

after the successful defense of work to award Pavel Kukolev the scientific and academic rank Ph.D.

In Žilina, 13.7.2016

Prof. Ing. Vladimír Wieser, PhD.