Ph.D. Thesis Opponent Review

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Application of Advanced |Data Assimilation Methods in off-site Consequence Assessment

The topic of the presented doctoral thesis is a very up to date especially in the view of the relatively recent Fukushima nuclear power plant accident in Japan. It is right that the Czech Republic is not located in the seismic active costal area but industrial accidents are not limited only to such areas and are not connected only with the seismic risks. Each developed state that is responsible for the welfare of its inhabitants and using the nuclear energy has to have prepared some crisis plan in case of unthought accident. This doctoral thesis is a good example of a such approach. From this point of view I suggest to accept this thesis as an example of a very topical one.

The presented Ph.D. thesis deals with the problem of data assimilation methods that can give us the relatively correct information about spatial distribution of the dangerous species – in this case the radioactive substance. This information is divided from the temporal point of view into two stages – Early Phase and Late Phase and the differences in both these phases heve been explained.

The thesis is written on the 114 pages including the relatively extensive list of bibliography and the index. Text is accompanied with figures that well document and illustrate the substantiality of the thesis. Including Introduction and Conclusion the whole text is divided into eight main chapters. The individual or sub-chapters also contain algorithms for the described methods used.

Chapter one – Introduction contains the motivation of the submitted dissertation, information about assimilation techniques that can be used in the radiation protection and the state of the art of these techniques. Also mentions the specific features of the Early Phase assimilation and the Late Phase assimilation.

Physical background of the presented problem is a subject of the second chapter. In this chapter the topic of dispersion modelling is mentioned together with the links to the radiological problems.

The third chapter deals with the general problem of data assimilation techniques. Emphasis is given to the filtering approach but this is not the only method used in the data assimilation problems.

Marginalized Particle Filter (MPF) method and its modification, its more detailed description is a subject of the fourth chapter together with the simulation studies results when artificial input data were used.

The fifth and sixth chapters deal with the problems of assimilation in the Early Phase (the fifth chapter) and the Late Phase (the sixth chapter). In both these chapters results of the numerical experiments are presented.

Software developed in the framework of this dissertation is described in the seventh chapter and the eighth chapter contains conclusion and the future research outlook.

Some details dealing with the used methods are mentioned in the appendices A and B.

The dissertation thesis is written in English. In the text some typing errors and mistakes can be found but they do not decrease the level of understanding the presented text. Sometimes the author is too concise and for non-expert in used methods it is relatively difficult to read the text. There are also some inaccuracies (for example, see the fig.5.4.1 and following text). But these mistakes and inaccuracies are only formal and have no impact on the investigated problem and results obtained.

The results of the suggested methods seem very promising and I strongly suggest to continue in this research especially when some model giving the flow field with as high resolution as possible would be available as it is necessary to have in mind that terrain irregularities or other obstacles mounted on the earth surface (urban areas) could induce deformations in the flow field and thus they also complicate the pattern of the spatial distribution of the radioactive material. And it is a question whether the grid of monitors would be able to describe such a complicated pattern due to their density and spatial resolution. And, of course, it is a question how the grid of monitors would look like in the case of a real accident when neither the place nor time is not known in advance nor the surrounding (meteorological) conditions. In connection with this problem I would like to ask the following question: How complicated would be the presented method if the premise given at the page 69 at the beginning of the paragraph 3 in the subchapter 5.3.1 would not be fulfilled (settled (urban) areas, for example)? And how much time is the suggested method consuming?

I suppose that this thesis fulfil all criteria and that it can be judged as a doctoral (Ph.D.) dissertation and that Ing. Radek Hofman very clearly demonstrated his ability for scientific work. I suggest accept this thesis and after successful defence of this dissertation he should be designated as Ph.D.

In Prague 2 June 2011

doc. RNDr. Josef Brechler, CSc.