3 questions to...

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on human and organisational factors

A postdoc at the Institute of Information Theory and Automation of the Czech Academy of Sciences, Radek Hofman specialises in mathematical modelling of environmental processes, Bayesian filtering and software development for decision support. He received the Czech Nuclear Society's award for his doctoral thesis titled *Application of Advanced Data Assimilation Methods in Off-site Consequence Assessment.*

What is the basic principle of data assimilation methods?

Also known as 'statistical inference', data assimilation (DA) refers to a group of methods used to estimate the state of a dynamic system by combining multiple information sources. Typically, the numerical model of a system under investigation thus is corrected with observational data. In case of an accident with off-site consequences, DA can be applied to estimate the true scale of the accident with a view to improving the reliability of decision-making and countermeasure planning. One of the most challenging tasks is the prediction of the spatial and temporal distribution of radionuclides during the early phase of an accident where they propagate in the form of a radioactive plume. This can be simulated using an atmospheric dispersion model. However, partial ignorance of meteorological conditions and source term together with inherent model errors due to the wrong conceptualisation of atmospheric phenomena hinder us from obtaining accurate results. In such circumstances, DA allows us correcting the model using sparse measurements from a stationary radiation-monitoring network (RMN) and mobile groups. This problem has been already addressed using different methods based on point-wise estimates and filters for parameterised densities, and we attempt to solve it using sequential Monte Carlo. The resulting method, based on simultaneous propagation of multiple dispersion models, can answer the questions asked by decision makers – e.g. "What is the probability of exceeding a given threshold of deposition in a particular location?" *– in a more informative probabilistic manner. The associated disadvantage, a high computational complexity, is becoming a minor issue with the development of increasingly powerful computers.*

Was DA implemented to the Fukushima Daiichi situation?

DA has been already applied to the retrospective analysis of the Chernobyl disaster and some other accidents and tracer experiments. In the case of Fukushima Daiichi, a wide array of radiological measurements is accessible on the web site of the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT). These data, together with available meteorological data, were already used in several studies focused on the estimation of the source term.

Can data assimilation be applied to any kind of accidental situation?

DA can be applied whenever it is beneficial or necessary to combine data from different sources. The generic character of the methods allows their modification for non-radioactive pollutants and accidents, e.g. releases of chlorine from industrial facilities or spreading of a toxic agent in urban areas. Moreover, we do not have to restrict just to the data collected from a RMN or mobile groups. Currently, we are developing an algorithm for the navigation of unmanned aerial vehicles – called 'drones' – equipped with measuring devices as an alternative source of observations. As the drones can be deployed on demand and autonomously navigated in order to maximise information gain, their application seems to be a promising way how to obtain data from areas not covered by a stationary RMN. ✖