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Research Areas:

- Mathematics: qualitative theory of partial differential equations
- Applications of partial differential equations in mechanics of fluids

How accurate do your models and ideas reveal current changes and how much do they help us predicting upcoming future events?

Differential equations are the fundamental tool in an enormous amount of mathematical models of various processes, running in the real world. Traditional models concern physics, chemistry and engineering. However, many models can also be applied to other disciplines from biology up to humanistic sciences and to studies of the development of human society in general. The models provide not only quantitative results, without whose modern technologies would not be possible, but they also enable us to understand the nature of various phenomena and to make serious predictions for future. For example, the notions of „stable steady state" or „stable periodic process", „loss of stability", „bifurcations", „ordered or chaotic motion", and many others, have their analogues in the real world and in the behaviour of systems, studied in many other disciplines.

The question also concerns the accuracy of the models. Naturally, a better coincidence of the model with reality requires that the model involves more quantities, relations between these quantities, more information, and this all leads to a higher model complexity. Too complicated models are hardly treatable, so it is one of the important tasks of today's mathematical modelling to find an optimal balance between the the two requirements, i.e. the complexity of the model and its coincidence with the real world on one side, and the simplicity and clearness that enable us to study the model and to obtain important results and information on the other side.

Where do you need other disciplines and how can they help you to improve your strategies to face the 21st century challenges?

Theoretical mathematics is a deductive discipline, i.e. new results are obtained just by deductions, considerations and calculations, employing the human brain. An important tool are the computers, which enormously help in communication, writing and storing texts, and in various simulations that often enable one to create hypotheses which have further to be

proven or denied. Thus, other disciplines mainly act as a field where mathematical modelling (and mathematics in general) finds motivation for new ideas, for thinking in various new directions, and for creating new models.

One should also mention an important field, which extends into mathematics and into a series of other disciplines, i.e. the scientific computing. Mathematical models are often so complicated that the derivation of their qualitative properties is either very difficult or impossible. However, in spite of this, people are trying to find numerical solutions, applying modern numerical methods and computers. Then, especially in the case of absence of any qualitative results, in order to verify the used model and method of solution, one necessarily needs to compare the numerical results with the experimentally obtained data, at least in the range in which the experimental data are available. In this field, applied mathematics closely cooperates with other disciplines.