

# Control and Cybernetics

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## The Moving Frontier Questionnaire

response by

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### *1. What kind of problems are you currently working on ?*

The focus of my recent work is on nonlinear ill-posed inverse problems (NIIP), their formulation as optimization problems and their adequate numerical treatment. Special emphasis is given to regularization techniques. The class of NIIP which is studied most intensively is given by parameter estimation problems, which consist in the determination of parameters in partial differential equations from (partial) knowledge of the state variables. NIIP also motivate work in the area of sensitivity analysis of abstract optimization problems.

Another goal of my present work is the development of numerical techniques for constrained infinite dimensional optimization problems (SQP and augmented Lagrangian techniques), applicable to NIIP and variational inequalities, for example.

*2. What problems do you think are the most important to solve in your domain in the nearest future ?*

Problems that deserve special attention in the future include the control of nonlinear partial differential equations, especially the control of fluids and large coupled systems, control of variational inequalities, the mathematical theory of signal processing, and, in each case the simultaneous development of efficient numerical techniques, exploring the possibilities of multiscale bases, parallelism etc. In the area of NIIP it should be important to solve the real world two and three dimensional inverse problems, for example in nondestructive testing, numerical geodesy, seismic inversion and impedance computed tomography.

*3. Which of the recent applications of scientific results from your domain do you consider as most interesting ?*

Within the last two or three decades increasingly complex mathematical modelling techniques are used in different areas of the sciences, including biology, chemistry, climatology, geophysics, medicine and, of course, the engineering sciences and physics. The analysis of the resulting models, both analytically and numerically has led to a sharp increase and diversification in the interaction between nonmathematical sciences and mathematics and in some cases to new, in other cases to additional understanding of the process under investigation. Inverse problems, control theory and optimization theory provide some of the mathematical tools necessary for this process.

*4. To what extent is availability of definite computer hardware influencing your scientific work ?*

Modern computer technology provides an additional technique to obtain insight into mathematical problems and it is sometimes the only method to solve applied problems. Thus the availability of computer hard and software influences my work significantly.