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# The Moving Frontier Questionnaire

response by

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

Phenomena appearing in nature and in the technical sphere are subject to some laws. But not all of the laws are known to us and thus we can speak about random events and apply probabilistic models. Hence, the probabilistic approach can be thought of as raising one's hands towards the true degree of complexity of natural phenomena. On the other hand the probabilistic approach, for instance in conventional stochastic optimal control problems, makes it possible to consider the cases of incomplete information. In these problems, the plant outputs in the past are known from measurements and can be treated as deterministic variables, and the values of the same outputs in the future are not known and must be treated as random variables. The characteristic thing is the two–fold treatment of the same variables which change their role as time goes. This approach makes it possible to consider the cases of different controller information which, in particular, was summarized by myself in [1]. I have also

transferred this idea to two–level structure with many controllers having different information [2,3,4,5]. In this case the two–fold treatment of some variables also at the time of synthesis of the control stucture makes it possible to perform the local and global optimization realized by the local controllers and a coordinator, respectively, as well as to obtain a partially decentralized control. Actually, using similar approach I try to obtain price coordinantion for resource allocation realized in a two-level control structure with different information of controllers . Other considerations concern the singular problems of state estimation and linear–quadratic control for discrete–time and continuous–time case [6]. The two–fold treatment of some variables has an essential meaning also for some of these problems.

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

The significant growth of computer system facilities in the last decade creates a new possibility of applications. It is possible now, in particular, to accumulate and process large amounts of information, as well as to realize quite complex control algorithms. In connection with this it seems that in the not so distant future a significant role will be played by the different kinds of effective learning algorithms making it possible to accumulate information about controlled processes, as well as to improve the realized control. The different kinds of learning systems (also in the form of neural network) will create the possibility of effective realization control also for the so called "difficult" and "complex" plants, changing their characteristics, containing nonlinearities and having uncertainty.

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

I was recently impressed by the degree of complexity of the applied control system described by Benveniste [8]. He writes "... the overall approach of Siemens–AG Automation Group consists of developing reusable hardware and software components that can be assembled with intelligent software environment for rapid customization, ... ". Here, some interesting figures follow showing the complexity of such automation projects. First example is a factory automation system involving 5 assembly lines. The corresponding automation system involves 60 racks with regulators for 950 actuators, 290 Programmable Logic Controllers and Multi–Micro Controllers for 16000 measurement signals, 2 supervision systems with 14 stations and 9 communication busses. The engineering

delivery in this case involved 425 diskettes of application software, 24000 pages for architecture documentation, 60000 pages for program documentation, constituting on the whole of 400 volumes ... We should also mention that the cost of systems engineering for such large projects ranges typically from 50% to 80% of the total cost, and involves several hundreds of engineers participating in the project team.

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

In my work computers have essential meaning. Computers make it easier to calculate various examples in the preliminary stage of work, on the basis of which a hypothesis sometimes can be formulated. However, in the next stage of proving the hypothesis computer has usually a limited meaning. Sometimes, when it is very difficult to prove a hypothesis its validity can be confirmed by means of computer simulation technique. By this means, for instance, it was shown that in a resource allocation problem being solved in a two–level control structure it is worthwhile to accumulate in a part of the system storage some reserve resources (not controlled by the coordinator), so that the unpredictable, increased resource demands of subsystems may be covered [7].

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