This Week's Citation Classic

For design of control systems it is useful to have mathematical models for the process in terms of differential or difference equations. The paper surveys different approaches to obtain such models from observations of input/output data. [The *SCI*® indicates that this paper has been cited over 150 times since 1971.]

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"My work in system identification dates back to 1963. When working at the IBM Nordic Laboratory in Stock-holm I was confronted with the problem of developing strategies for digital regulation of important quality variables on a paper machine. The problem could easily be formulated and solved provided that a mathematical model for the process and its environment were known. I started developing mathematical models from first principles and I proudly ended up with a model consisting of a system of 17 first order differential equations. To my great dismay the model performed poorly when confronted with measurements from the process. Luckily, I was wise enough to discard the model and start from scratch. The idea of developing mathematical models directly from process measurements then occurred to me. Various attempts to do this opened up an interesting collection of problems that were on the borderline between probability theory, statistics, time series analysis, and control theory. It led to the development of algorithms and theory. The initial attempts gave a good solution of the specific problem. The model did turn out to be simple.[1] But it was clear that the problem merited further investigations.[2]

"I got a good opportunity to pursue the matter when I took up a professorship at Lund Institute of Technology. I started to give graduate courses in the area and to get students involved in the problem. Many other persons had also encountered similar problems. This is not surprising because similar problems appear as soon as one starts to apply control theory to practical problems. The phrase 'system identification' was coined to cover the problems.

"The main international organization, the International Federation of Automatic Control (IFAC), started to organize symposia to promote an exchange of ideas in a field that was still in an early stage of development. The first IFAC Symposium on System Identification was held in Prague in 1967. It was clear at that meeting that there were a number of important problems in the area, but a wide divergence in methods and approaches existed. For the 1970 Prague symposium I was asked to give a survey lecture in the field together with Pieter Eykhoff. Eykhoff had also been working on related problems but from different points of view. The preparation of the survey lecture came at a good time because I was on sabbatical at Brown University and I had a good opportunity to spend long hours in the library. While working on the survey lecture it gradually became apparent that many diverse ideas could be unified and a structure of the field slowly emerged. The survey paper was then edited and published in Automatica.

"I believe that the reason for the frequent citation of the paper is that it gave a reasonably coherent picture of many different ideas in an important and emerging field."

1. **Åström K I & Bohlin T.** Numerical identification of linear dynamic systems from normal operating records. (Hammond P H, ed.) *Theory of self-adaptive control systems.* New York: Plenum Press, 1966. p. 94-111.
2. **Åström K J**. *Introduction to stochastic control theory.* New York: Academic Press, 1970. 299 p.