ID2

Equation error Identification

2.2 THE IDENTIFICATION PROBLEM

Denote with

$$\theta = [\alpha_1 \ \dots \ \alpha_n \ \beta_{11} \ \dots \ \beta_{1n} \ \dots \ \beta_{r1} \ \dots \ \beta_{rn}]^T \tag{2.2.1}$$

the parameters of models (2.1.9), (2.1.10), (2.1.16) and (2.1.17), with $\mathcal{M}$ an assumed family of equation error models and with $J(\theta, n)$ a selected cost function (usually based on one–step–ahead prediction errors); the identification problem can be defined as follows:

Problem 2.2.1 – Determine, on the basis of given input–output sequences, the element of $\mathcal{M}$ minimizing $J(\theta, n)$.

This definition does not imply that the data have been generated by a model belonging to $\mathcal{M}$ and the selection of different cost functions will lead, in general, to different models. This formulation of the identification problem relies on cost functions depending on the order of the model. Various procedures of this kind have been proposed (Final Prediction Error, Akaike criterion, Minimum Description Length); their application can however lead to uncertain results. A more pragmatic definition of the identification problem can be formulated with reference to cost functions, $J(\theta)$, that do not take into account the dimension of the model, as the following:

Problem 2.2.2 – Determine the minimal order, n, compatible with an acceptable performance of the model (in terms of $J(\theta)$ and/or other criteria) and, inside the subclass, $\mathcal{M}_n$, of models with order n, the model minimizing $J(\theta)$.

This formulation is more loose because it does not quantify the meaning of the term “acceptable”; it corresponds, however, to most practical applications of identification procedures.

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