INDUCTIVE MODELLING: DETECTION OF SYSTEM STATES VALIDITY

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ABSTRACT

The goal of this paper is to introduce the approach we have developed for locating correct (sufficiently defined) states of a system. Inductive models representing the system are constructed by our method (Modified GMDH) on the data set. The data set contains records of input and output variables of the system – it describes states of the modelled system. Inductive models are able to derive values of dependent output variables for every configuration of input variables. Correct states of modelled system are these that are well defined by the data set. The rest is neither enough defined nor the data set contains any records describing these states, at all. Employing our technique allows automatic detection of correct system states (correct input configurations of the inductive model) without the need of computation on the data set.

1 INDUCTIVE MODELS

The Modified GMDH, which is being developed at our university, proceeds from GMDH introduced by Ivachknenko in 1966 [1]. It uses a data set to construct a model of a complex system. The model is represented by a network (see Figure 1). Units of the network transfer input signals to the output. The transfer function of the unit is of several types (linear, polynomial, perceptron network). The coefficients of transfer functions and weights of perceptron networks are estimated using the data set describing the modelled system. Units with the smallest error of the output signal form the final network. It represents the model of the output variable used in the learning process.

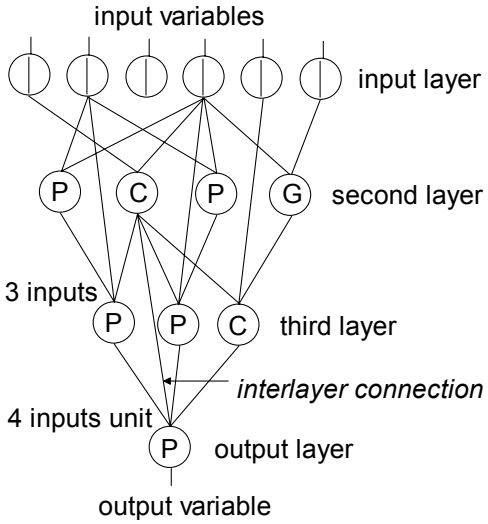

Fig. 1: *Modified GMDH network*

The description of the Modified GMDH and its results in comparison with other inductive methods can be found in [2].

2 VISUALIZATION OF MODEL RESPONSES

By visualization of model responses we can access the information abstracted by the model from data set. The easiest way to visualize how the model approximates the system is to change values of input variables and record the output of the network (Figure 2).

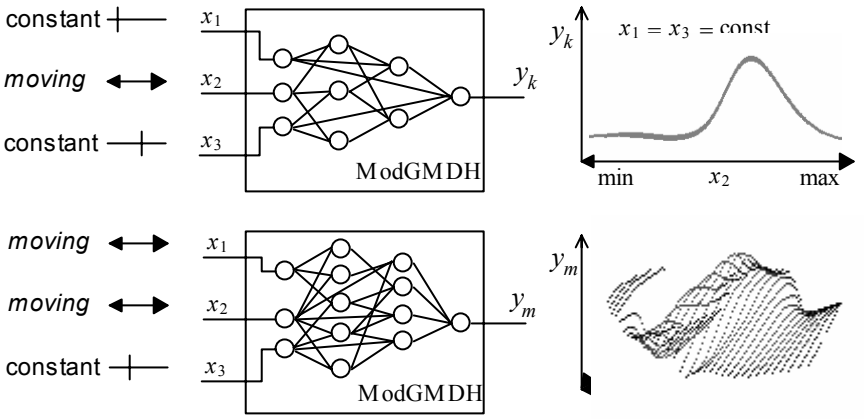

Fig. 2: *The visualization of model behaviour*

Real data sets are mostly multidimensional and define systems just partly. We need to locate just the correct states (sufficiently defined) to avoid visualizing the incorrect ones.

3 THE CORRECT SYSTEM STATE: MODELS RESPONSES COINCIDENCE

It is hard to determine correct system states unless the data set is available. Computing the distribution and the density of data vectors in the neighbourhood of the system state is often unsatisfactory. Our approach is to monitor responses of inductive models constructed on the data set (Figure 3.). The valid system states are in areas of models responses coincidence. Where responses differ, there is not enough information in the data set, the inductive models to be valid (within these areas).

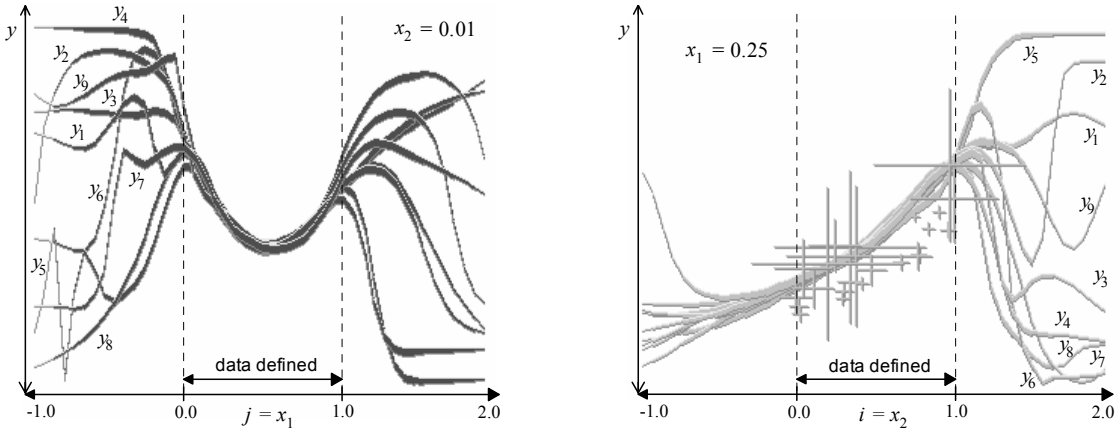

Fig. 3: *Simple data set – the coincidence of models responses*

4 CONCLUSION

We have introduced the technique for the automatic detection of system states validity. It allows us to locate interesting areas and to avoid ill-defined areas of the system behaviour.

REFERENCES

[1] Madala, Ivakhnenko: Inductive Learning Algorithm for Complex System Modelling; 1994, CRC Press, Boca Raton

[2] Kordík, Náplava, Šnorek, Genyk-Berezovskij: The Modified GMDH Method Applied to Model Complex Systems; proceedings of ICIM'2002 Conference, Ukraine, Lviv