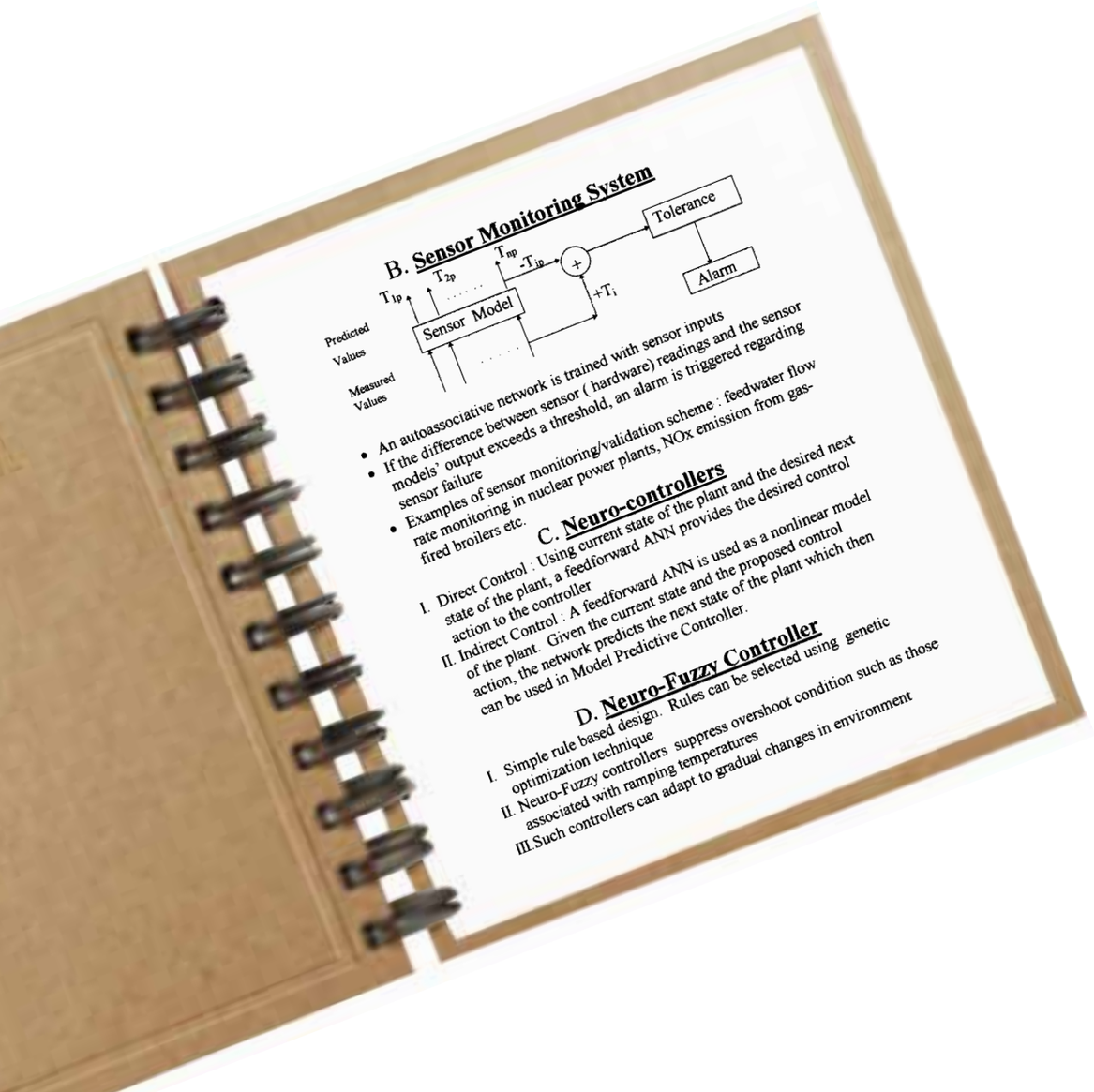
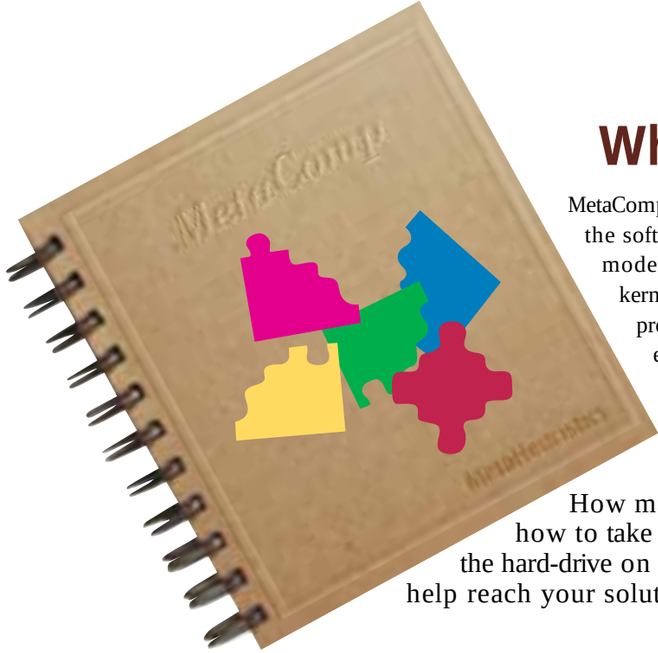
MetaHeuristics
209 W. Alamar, Suite A
Santa Barbara
California, 93105
U.S.A.

Tel: +1 -(805) 569-0347
Fax: +1 -(805) 569-6014
e-mail: mhstaff@gte.net





What Is MetaComp:

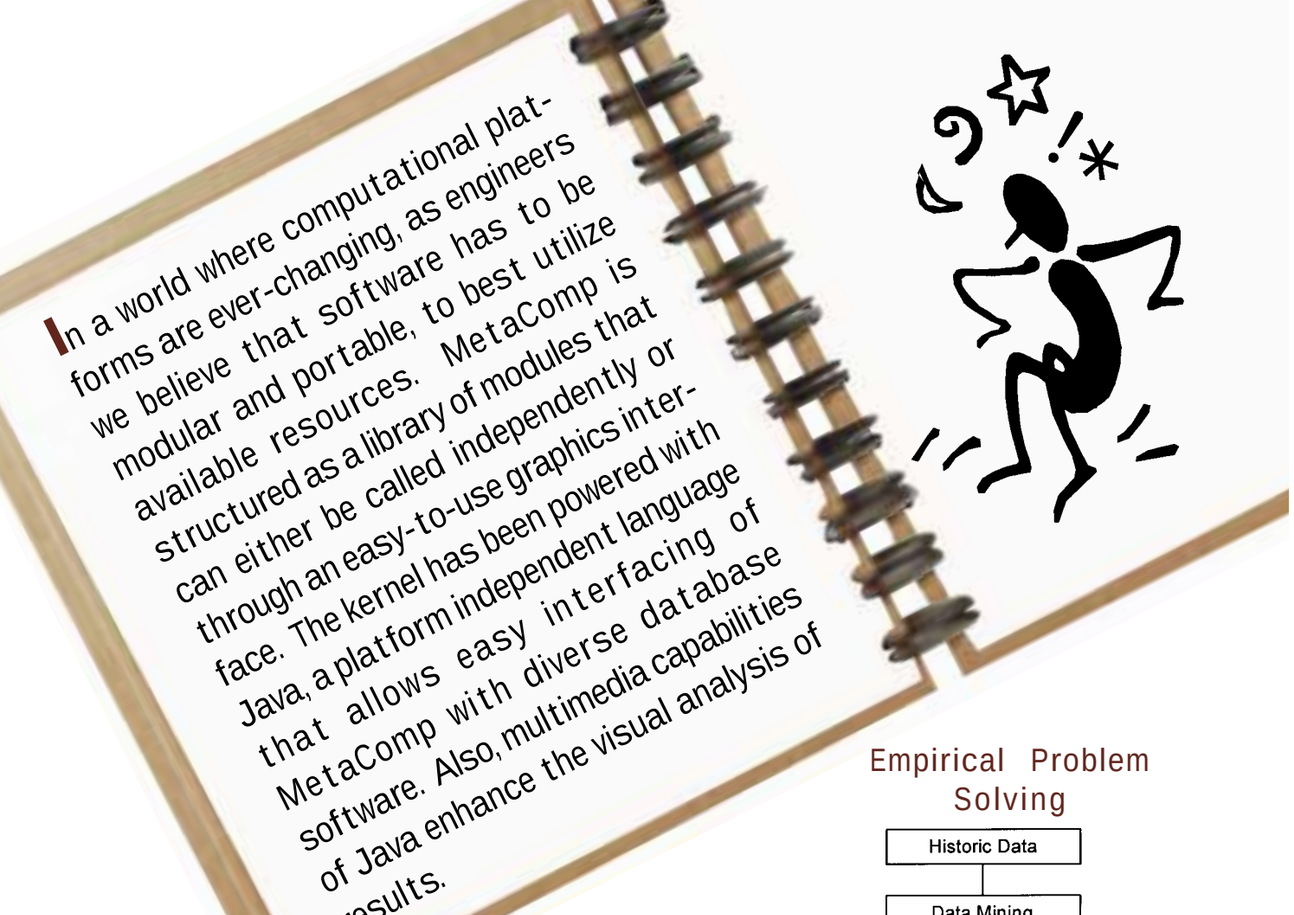
MetaComp is a suite of computer programs that provides the software to analyze databases for the purpose of modeling and optimization. The data processing kernel uses state-of-the-art developments in signal processing, neural and fuzzy computations to process existing data sets and build models that can be used for control, optimization, maintenance, fault diagnostics and development of operating procedures.

How many times have you wondered about how to take the best from that big database sitting in the hard-drive on your desk? Well, MetaHeuristics can help reach your solution!

Who Are We:

We are a team of engineers, scientists and software professionals. We have developed a powerful package to find hidden patterns in data, for process and systems modeling, and for optimization. Our expertise and software will help you to understand and run your plants, and processes, better.

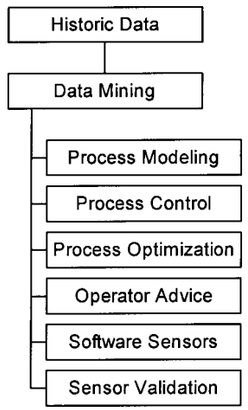
Why Heuristics — The Art of Empirical Problem Solving?



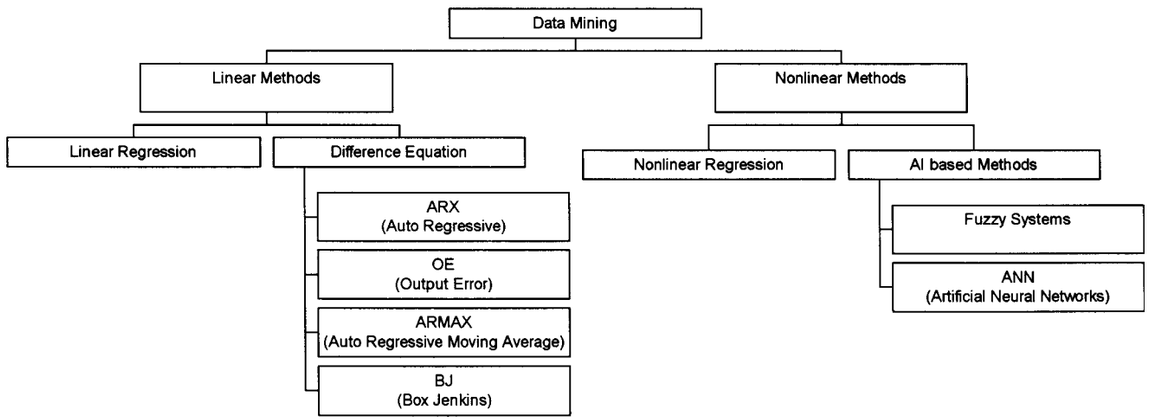
History

Our interest in AI based computational techniques arose while developing non-linear models for complex chemical and metallurgical processes, sensor validation and fault diagnostics. We have combined our skills in computational dynamics with traditional modeling techniques to make an AI based package which is fast, robust, and is specifically designed for engineering application.

Empirical Problem Solving



Data Processing Techniquies



For example, using operational data of a gravity-fed tank overflow conditions arising in transients were predicted using a feed forward artificial neural network (ANN). The output from the ANN was then used to extract the rules for deciding the unsafe combinations of initial inlet velocity and tank fluid level that lead to overflow. The knowledge of such rules, in more complicated plant conditions could avoid maneuvers leading to production losses.

MetaComp also provides the possibility of combining existing knowledge of the process with heuristic modeling methods. Phenomenological models can be solved using MetaPhen and the results can be incorporated in system simulation. For instance, when modeling leak detection in long pipelines, compressibility effects become important. The pressure measurements along the pipeline are affected by the changes in flow rate that occur at the inlet. A system based only on ANN would confuse these changes with the presence of a leak. If instead, a differential model of the pipeline is solved, spurious effects can be filtered and a very effective leak detection system can be built using ANN.

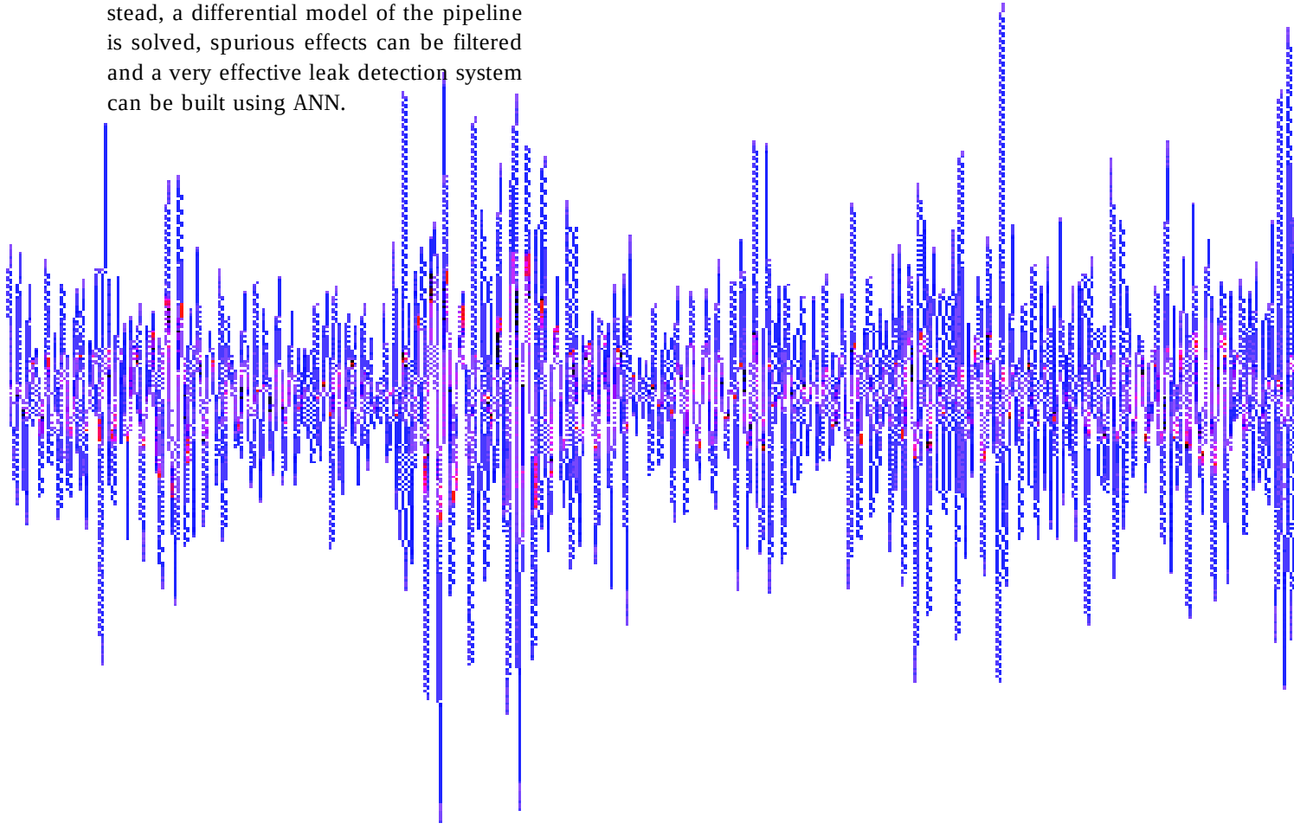
Applications of Neuro/Fuzzy System

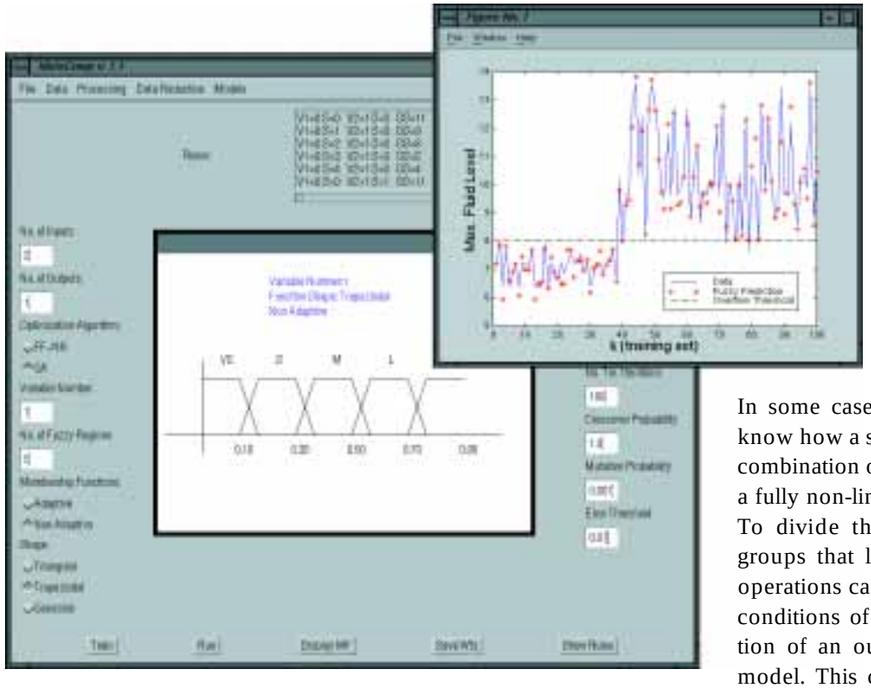
A. Soft Instrumentation

The software based instrumentation is achieved by ANN based forward prediction of the measurement device. Given the availability of historic data on the inputs to a device, and its output(s), an accurate model of the process is constructed using MetaHeuristics' fast solver. The ability of this solver to handle complex time series results in easy handling of systems with large time lags between inputs and outputs. Various step involved in the modeling process are as follows

a. Select a configuration of feedforward neural network using genetic algorithm
b. Select important process variables using Data Reducer
c. Train the network using historic plant data
d. These models can then be used at various locations in the plant after proper validation

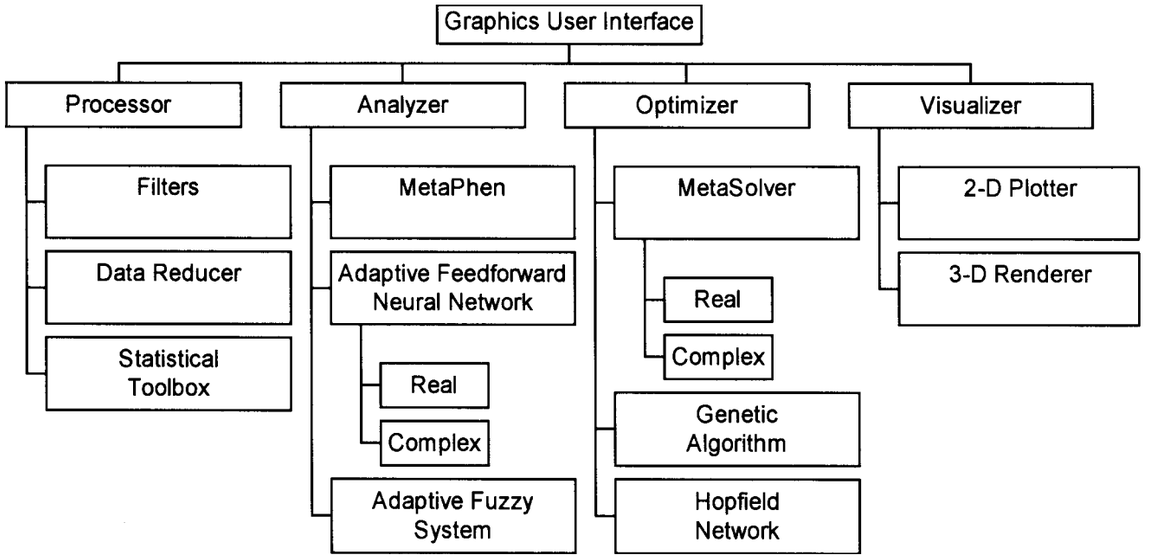
Soft instrumentation are cheap and they also provide crucial insights into the mechanisms in the process being modeled.

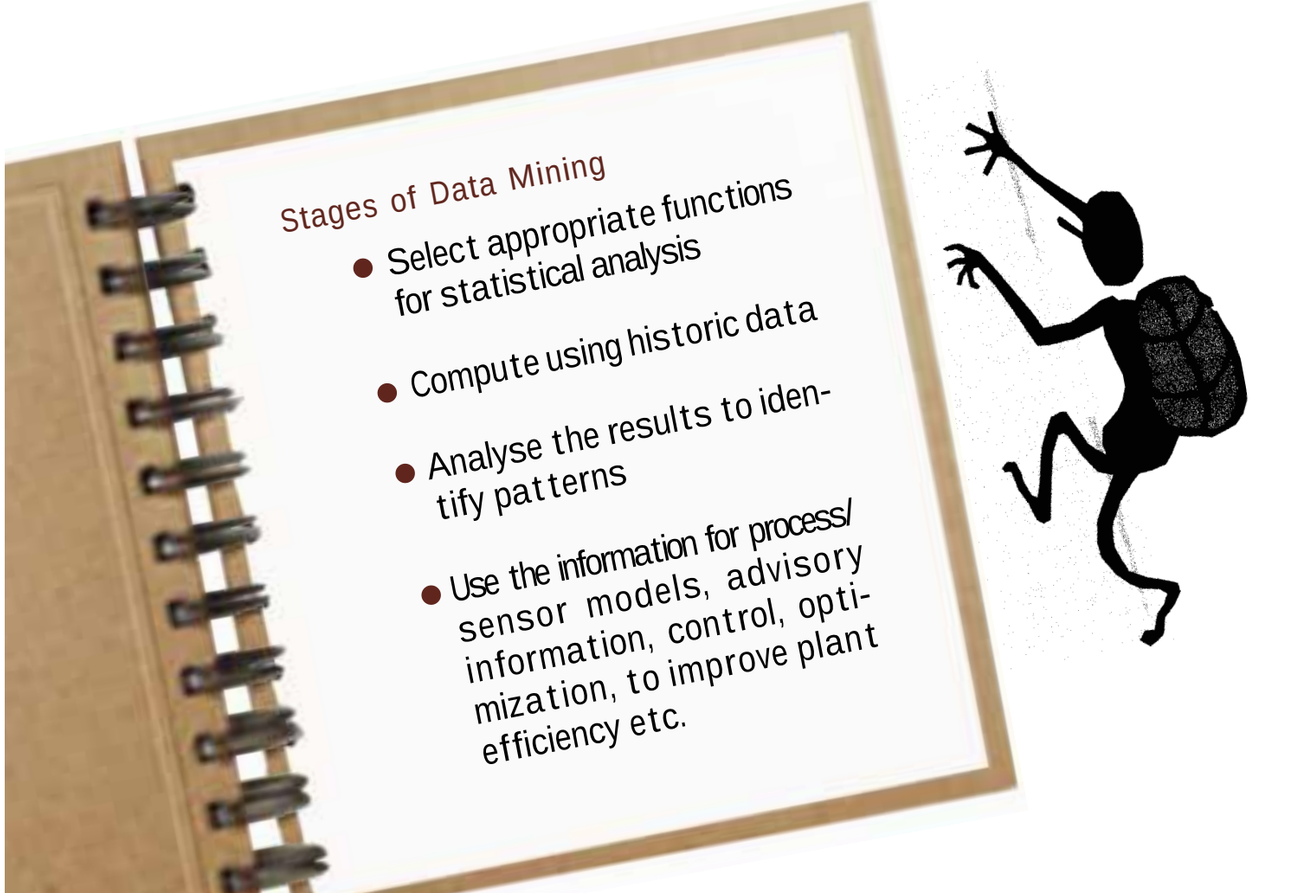




In some cases it is more important to know how a system will react to a given combination of parameters, than to have a fully non-linear model of the process. To divide the input parameters into groups that lead to safe, or less safe, operations can be a faster check on the conditions of the process than calculation of an output from a complicated model. This can be achieved with the Fuzzy System toolbox in MetaComp. Fuzzy System toolbox can be combined with the modeling and optimization techniques to extract simple rules for operator advice.

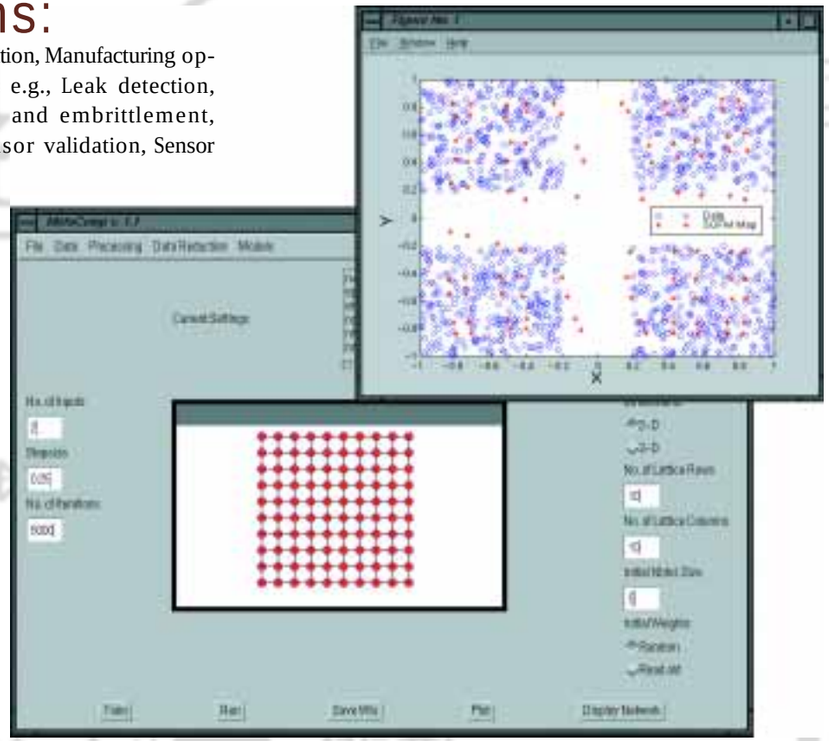
MetaComp v. 1.1





Applications:

Process modeling and optimization, Manufacturing optimization, Fault diagnostics e.g., Leak detection, Materials corrosion, erosion and embrittlement, Physical Experiments, Sensor validation, Sensor substitution, e.g., Software sensors, Acoustic and seismic analysis, Medical Diagnostics, Econometric modeling, Demographic systems



Process Modeling:

For large systems it is useful to reduce the size of the problem at hand by identifying the most important variables. This is possible with Data Reducer which provides techniques like Principal Components Analysis, Linear Vector Quantization and Genetic Algorithms for this purpose. With this reduced set of variables the statistical toolbox can be used to test the efficacy of linear models. In many cases, however, linear models are not sufficient and one must resort to non-linear modeling techniques.

Regression Models

Linear regression is of the form

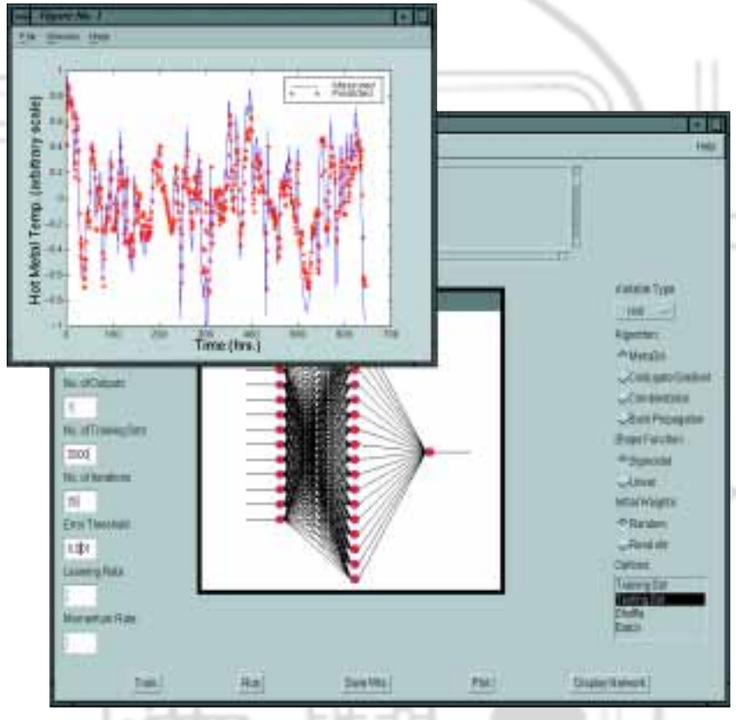
$$y = a_0 + a_1 x_1 + a_2 x_2^2 + \cdots + a_n x_n^n$$

The coefficients $a_1, \cdots, a_n$ can be computed using least square technique from the historic plant data.

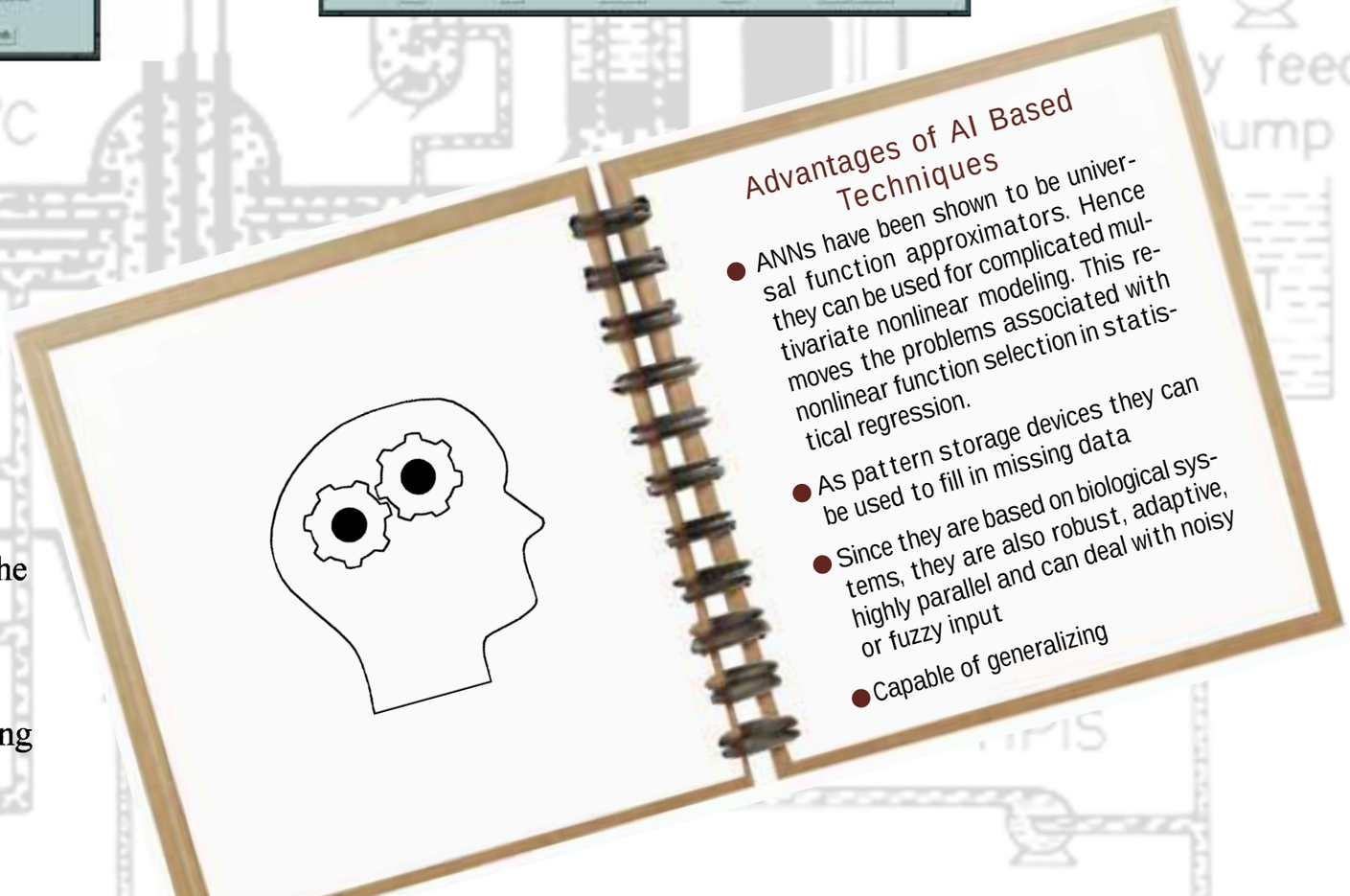
An example of nonlinear regression is an equation of the form

$$y = a_0 + a_1 \sin(a_2 x_2) + \cdots + \exp(a_n x_n)$$

The coefficients in this case have to be solved by iteration . However, there are no guidelines for selecting the nonlinear functions for the regression.



Analyzer builds non-linear models based on Neural Networks. For example, a blast furnace operation involves complex interactions between chemical reactions, heat exchange and gas flow dynamics. The resulting process is non-linear, time-variant and is characterized by a large number of input variables. For safe and low cost operation of the plant it is necessary that the hot metal temperature be within prescribed limits. Using Data Reducer the number of inputs was reduced by a factor of three and a model was constructed using feed forward neural network. The network parameters were optimized using MetaSolver, a very fast technique for function minimization.



WHY MetaHeuristics?

MetaHeuristics Provides:

- The Choice of working in either real or complex domain
- A fast solver for both real and complex feedforward networks with 200 input variables and more than a thousand network parameters (weights)
- Fuzzy and neuro-fuzzy modeling
- Combinatorial optimization techniques for network selection and for the adaptive selection of fuzzy rules

MetaHeuristics
209 W. Alamar, Suite A
Santa Barbara
California, 93105
U.S.A.

(805) 569-0347

MetaComp