Motivation and Abstract

The world energy consumption increases every year. With more countries becoming industrialized nations it is to be expected that the increase in energy consumption will become faster in future. This increase results first of all in a drastic reduction of the world's energy resources and as well in an increase of the world wide pollution and the production of CO_2, which is to a big part responsible for the Global Warming effects.

In this light every effort is to be undertaken to decrease the waste of energy around the world. One way to achieve this is to aim for the best possible use of energy and preventing any kind of waste of energy. The aim for an optimal use of energy cannot be achieved by one method alone but much rather by many methods building up a big mosaic. One stone this project wants to put into the mosaic is a tool to predict system behavior in a non-conventional way.

One way to detect faults in a system is to compare measurements of significant parameters with the theoretical value of those significant parameters. In order to achieve a reliable comparison the theoretical values of those parameters have to be as precise as possible. If changes that will occur in a system are known in advance than it is often possible to change system settings such that the total energy consumption is minimized. The process of feed forward control needs good estimates of significant variables in the future. A reliable and precise tool to predict system behavior for the use in feed forward control, fault detection and

may be more applications is necessary. In this project a relatively new method was tested and modified.

Often a mechanistic model is used to model a system. The mechanistic model includes equations that usually have a physical meaning to them. With these equations it is possible to predict the system behavior in a relatively accurate way.

Neural Networks are one alternative way for modeling of systems. Neural networks have the ability to adjust to their task in a very flexible way. They have certain strengths but as well certain weaknesses. Several well known tools for modeling are discussed, the downsides and the strengths were shown. The advantages and disadvantages of curve fit, Splines and B-Splines and Backpropagation Neural Networks are discussed and shown. The conventional way of modeling has different strengths and different weaknesses as alternative ways. The goal of this project was to investigate in the strengths and weaknesses of one particular Neural Network, the General Regression Neural Network [Specht 91].

The General Regression Neural Network (GRNN) as it was proposed by Specht in [Specht 91] proved not to perform as well as desired. Some effort was needed to improve the performance of this Neural Network. A new empirical method was developed to select the only parameter in the Neural Network. Some more general guidelines for any prediction method were outlined.

Every method of modeling has certain downsides. Such does the approach of Neural Network as well as the conventiolnal way of modeling. The downsides of these two

approaches are different from each other and it was shown in this paper that the two different approaches help each other in the prediction, in a way they complement each other. The combination of these two approaches was thoroughly tested.

Using a conventional heat exchanger as an example, the different approaches were tested. From those results some general conclusions were drawn. The heat exchanger was modeled with a relatively detailed model to generate training samples necessary for a Neural Network. The detailed model was as well used to compare the results of the predictions to the result they should yield.