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INTELIGENT MODELING RELIED ON NEURONAL NETWORKS FOR CORRECTION PROCESS MODELING

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Abstract: In the same time of the multiplication of necessities for getting large precisions and productivities, the automation of production processes has become a necessity.

Because the big majority of real systems are rely on parameters with nonlinear variation, using neuronal networks is a real method for solving because there is known the stability, the error tolerance and the tolerance at missing data and the capacity of generalization for this methods.

In this paper there is shown an intelligent model relied on the neuronal networks for the specification of correction process.

Intelligent control systems are conceived as means for overrun the limitations from conventional control methods and for the imitation of human operators' performances, they relying on expert systems and neuronal networks.

Among these, expert systems reached a large use while neuronal networks are hardly at the beginning of their way.

Expert systems, in their appliance, have some important inconveniences: established and implemented rules by human experts can't be easy changed and adapted to the dynamic of many processes; putting of new rules besides existing rules, is difficult to be realized; mathematical models that are used not only drive to the best result.

The range of the application of neuronal networks is from character recognition systems (used to correspondence sorting), of signature recognition (used in banking system) and speech recognition to automate pilots and astronauts and (real time) systems for the control of some complex processes. .

Grace of continuous improving of computer performances (storing capacity and computing speed), the applications of artificial intelligence in production processes are not only an aim. Thus, a group of researches from IBM and T. J. Watson Research Center – Brenda Dietrich, Robin Lougee-Heimer and Thomas Ervolina have pointed inside the 38-th International Conference of American Society for Production and Control Processes which occurred in Orlando, USA, in November 1995, that, in what concerning the performances realized with neuronal networks, the rapport price/performance has been improved over 10 times during last five years.

During following years, this rapport has been continuously improved, fact that allowed the enlargement of the use of neuronal networks in industrial applications. The newest of them include: real time production quality control, monitoring and error checking and correction for yielding processes and even dynamic optimization of production.

The same time with apparition of new materials and increasing of work precision, correction becomes one of the most important operations. However, for some materials like ceramics, correction is the only live method wherewith they can be worked out. Despite of its wide use, correction is an expensive process because the small amount of removed material at a single passing.

Despite of the numerous studies mad till now, all the models that describe correction process are restriction models, because they start from hypothesis of simplicity.

For this reason, making models which approach real model the most, there are necessary a lot of experiments wherewith to establish the coefficients of process equation. Right more, the precision of these models isn't warranted when work conditions are different from those wherein the model has been made.

For removing these inconveniences, we'll show as follows, an intelligent model relied on neuronal networks for the drawing of correction process, starting from existing ideas in work **[4],** being known: sturdiness, tolerance to errors or incomplete data and generalizing capacity of neuronal networks.

Basic idea of modeling consists of: first the extraction of non-linear relations from the amount of experimental data, that is, from process parameters (control variables) and resulting conditions after process (exit variables) and second of using a neuro-fuzzy model for input values control.

Major advantages of this method, in rapport to those conventional are:

- Using neuronal networks, the method needn't storage of a big number of rules, even at very complex systems, because the network organizes itself the algorithm.
- Taking decisions can be made in real time, the same time with implementation of a neuro-fuzzy model for a computer.

Going far, neuronal network can be learned by means of an analytic model (even if it isn't complete) decreasing the time for on-line training. Approximation and generalization properties of neuronal network allow them to generate themselves rules even if input data don't belong to the range of training manifold.

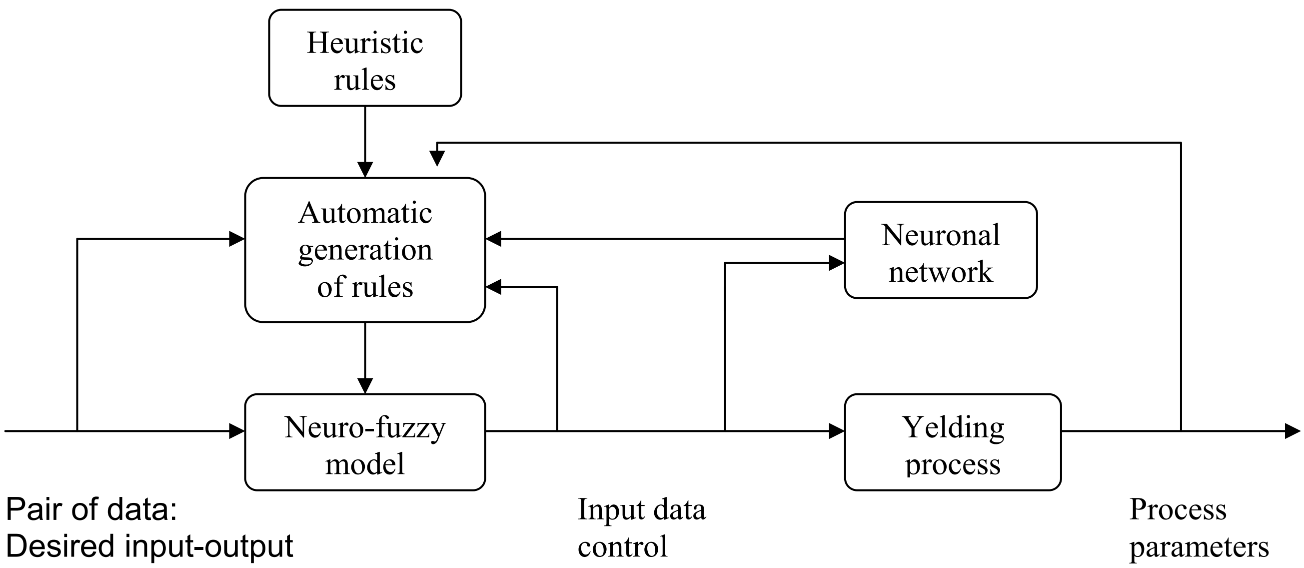

Figure 1. Bloc-scheme of a neuro-fuzzy control system

For studied real case **[4]**, correction process parameters are permanently monitored and used for neuronal network training, wherewith then fuzzy model is made.

The main linguistic encodings associated to exit variables (process parameters) considered for correction process are: the value too high (TH), high-medium value (MH), correct value (OK), low-medium value (ML), low down value (LD).

The same time, at input variables there are associated the following values: large increasing (LI), medium increasing (MI), landing (no correction – NC), small decreasing (SD), large decreasing (LD).

Correction process control using neuro-fuzzy networks arises from the following logic scheme (figure 2):

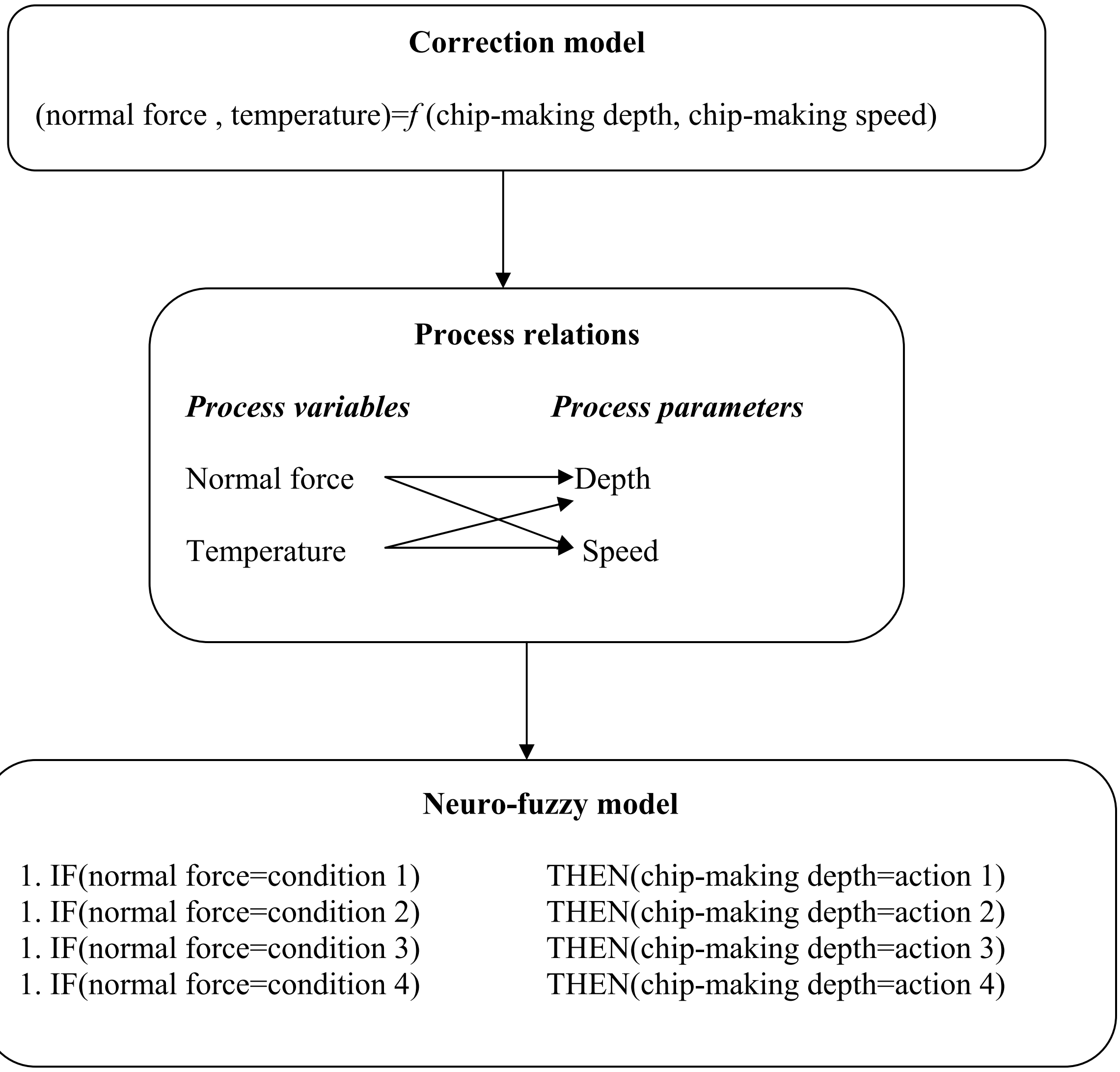

Figure 2. Scheme with two inputs and two outputs for correction process control

Neuronal network used for correction process modeling is as type as radial function and it is trained with the following parameters: needed power for work out, chip-making force, maximum temperature during the process, chip width, chip-making depth, stiffness of burnisher stone, surface roughness.

After training, the network is able to describe with much precision non-linear behavior of correction process, if sufficient examples have been delivered for it..

Another advantage consists of that neuronal network is able to model the process with all dependencies between its parameters, not being necessary occasionally other restriction rules.

Likewise another important advantage is that, when there is trained, the network classifies correctly, in real time, every other manifold of parameters which are or aren't in training manifold. The method depends neither of human experts, nor of mathematic algorithms.

Model feature being of large generalization, it can be extended to other complex yielding processes too.

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