6 INTELLIGENT AND SMART ADAPTIVE SYSTEMS

The recursive approach for on-line identification of flexible rule-based models is presented in more details in the next Chapter 7. The considered evolving flexible Rule-based models (eR) could be used as a tool for building smart, intelligent adaptive systems.

Necessity for such systems has been emphasised recently (EUNITE, 2000). They are a response of the science and theory to the pressing demands from different branches of industry and science to find an effective approach to adaptive yet flexible and robust representation, which to be computationally effective. They could be used in autonomous robotic systems, evolving and re-usable decision support systems, hardware, smart and truly (or, correctly, more) intelligent systems for fault detection and diagnostics, on-line control and parameter estimation, knowledge extraction and intelligent agents etc.

6.1 Intelligent Systems

6.1.1 Loose Definition

Generally speaking, intelligent systems (i-systems) suppose:

- capabilities for learning behaviour of the object of modelling or control;
- being able to take autonomous decisions, self-adapting and self-enriching their structure.

A more formal definition could be given as:

i-system is an adaptive flexible systems able to learn on-line behaviour of the object of modelling and control, to enrich, re-use and self-tune its structure and parameters.

It have to be noted, that i-systems are nowadays existing practice in areas like decision support, medical diagnostics, risk assessment, process control etc.
The area treating such systems is highly multidisciplinary. It is formed by the confluence and interaction of control theory and computational intelligence. More specifically, it includes knowledge extraction and data mining, behaviour-based modelling and control, intelligent agents, and other emerging branches.

6.1.2 Problems

Its main problems are:

- To find computationally effective precise, compact and transparent description of objects behaviour based on both quantitative and/or qualitative data available in on-line mode;
- To develop adaptive modelling and (optimal) control techniques based on such description;
- To bridge the gap between the theoretical advances and real engineering limitations in application of these techniques in practice;

6.1.3 Importance

This area has significant importance for making products and services more custom-oriented and flexible. Very often it leads to additional savings (energy, costs) by incorporating into the model factors, which has been previously ignored, possibly due to their qualitative nature.

i-systems normally surpass conventional ones, typically based on linear or simplified descriptions bounded to a number of assumptions, which are far from the real practice. Recent publications, including on the Internet, are emphasising its global importance. Internet itself has already employed many such customised and intelligent techniques in search engines, intelligent agent technology etc. (Bigus and Bigus, 1998).

For so called intelligent agents, which could be seen as a realisation (often software) of smart or intelligent systems an additional condition has place:

- they are normally part of a hierarchy trough a network of information and resource flows.

The main beneficiaries of the fast development of i-systems are the large companies, providing more customised products and services, saving costs and energy and being ahead of the competition with flexible and intelligent solutions. Consumers themselves