

University of Wales, Aberystwyth visit Report

(23 – 27 August 2004)

Artificial intelligence evolved by the increasing complex models and problems in real world systems. Hence, more sophisticated techniques are being explored to resolve complex engineering problems. The proposed system model (control and optimisation of a solar assisted air-conditioning system) is to enhance autonomous performance. The visit objective was to develop a computer model of a simple conventional air-conditioning system and to identify potential control strategies and components of the system. This will evolve into an intelligent control mechanism and a more complex simulation system; ultimately we hope to implement and control a real prototype rig.

The conventional system described consisted of a compressor, evaporator, condenser and an expansion device. Each component was modelled, developing arguments for its operation, to generate results that could be compared to a real system of comparative capacity. We did not have sufficient manufacturer's data of a real system, to perform a perfect simulation of the system. However, we fabricated an idealised simulated system which gives the expected qualitative results. We identified measurable parameters that will be used to develop the controller. Inputs considered were temperatures, pressures and to some extent relative humidity. These and other parameters will be considered in detail in a control algorithm. The conventional system operates under pressure and temperature changes of the working fluid (the refrigerant), that experiences phase changes while going through the cycle.

Air-conditioning systems are dynamic and move towards a state of equilibrium (homeostasis) when "stimulated". Hence, it was decided to take an organism view of the system and implement a control algorithm with effective control of the system. In my discussions with Mark Neal, he suggested a biological inspired control mechanism/algorithm (Artificial endocrine system-AES) to be employed for the proposed system. For this research, AES exploits the function of the endocrine system, to provide long to medium term control mechanisms for the system. The AES will function in conjunction with an artificial neural-network (ANN). The research proposes that each functional unit (for example the solar collector, the combustion generator, the compressor etc...) of the system will be controlled separately using an ANN, which may share inputs. It must be noted that the absorber is one of the key factors of the system and must be considered carefully in the system development.

The neural-network controller for each section is stimulated or suppressed by artificial hormones, which are released in response to stresses/stimuli of the changing environment. The neural network is trained so that each subsection works sensibly in a static environment and then the hormone mechanisms are used to adjust the control of each subsystem to attempt optimisation in the changing environment under varying circumstances. An object-oriented model approach was considered to be appropriate in order to provide flexibility to the system. If an additional component is required for the

system, it may trigger stress or stimuli, releasing hormones with an attempt to achieve homeostasis. The system could accept or reject the new component depending on its contribution to improving or hindering the total system performance.