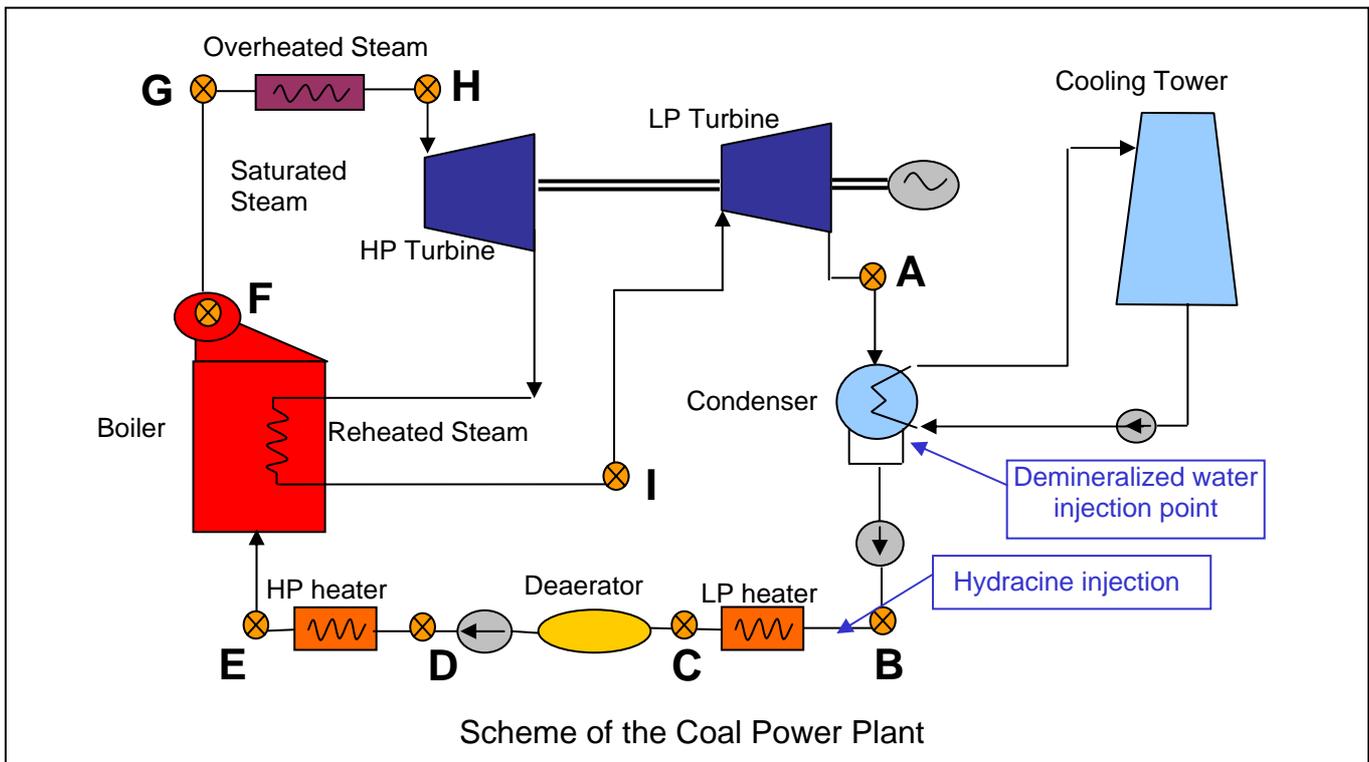


COAL POWER PLANT SIMULATOR



OVERVIEW

The Coal Power Plant simulator (**CPP simulator**) has been developed within the DIAMOND project under the Work Package 3 – Virtual Models for Test Beds, according to Task 3.4 – Development of Simulation of the Water/Steam-Cycle of a Coal Power Plant using Neural Network Techniques.

The scope of **CPP simulator** is to test the interaction between the DIAMOND Monitoring & Diagnosis system with a realistic generation of events regarding the steam-water chemistry of parts of the Coal Power Plant. More specifically the program simulates the behaviour of some real system variables under normal conditions over which abnormal events can be superposed and realistically propagated through the system. The generation of abnormal values of some considered variables results in a model reaction that causes some other related variables to exit from expected trends and values. Such process constitutes the symptoms data set to be fed to the DIAMOND agents for the diagnosis and provides a virtual test bench for testing, validating and demonstrating the Monitoring & Diagnosis system and the DIAMOND agents architecture.

PROGRAM DESCRIPTION

CPP simulator runs under The Mathworks' MATLAB/Simulink® environment: a very powerful, qualified mathematical solver and systems

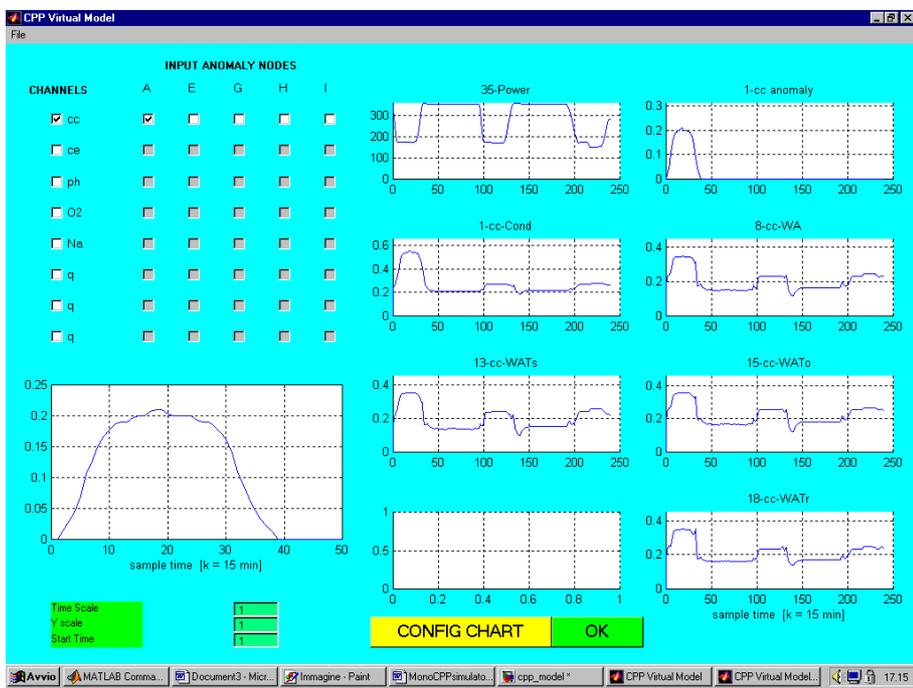
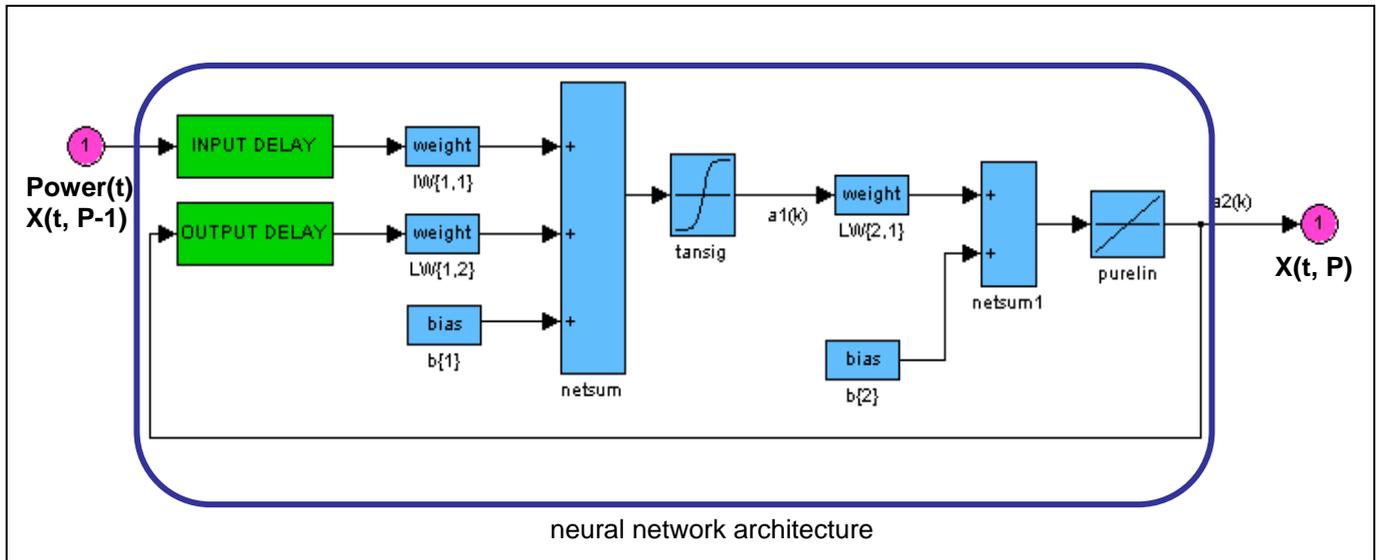
simulation tool. The program is endowed with a user-friendly graphic interface based on buttons and menu driven commands, which only require knowledge of basic pc use and MATLAB/Simulink® start up.

Dynamic simulation of the Water/Steam-Cycle of a Coal Power Plant is performed with a model based on a Neural Network approach. Such approach proved to be suitable and is motivated by the following reasons:

- given the high complexity of the physical problem, even though its basic mechanisms are known, the specific quantitative parameters and the interacting variables remain unknown
- system identification based on linear models cannot be adopted given the non linearity of the phenomena
- a set of experimental input-output data, that is the set of monitored variables time histories throughout one year of operation, is available

In order to enhance understanding of the physical problem, the whole Coal Power Plant model has been divided into the following five interconnected subsystems:

1. Low Power Heater, Deaerator and High Power Heater
2. Boiler
3. Superheater
4. High Power Turbine
5. Low Power Turbine, Condenser



At present, attention has been focused on the simulation of the cationic conductivity (*cc*) behaviour in five measure points located between the five subsystems which are modelled with the same Neural Network architecture containing both a non linear and a linear transfer function, and a time delay. The generic subsystem, located between the generic measure points *P-1* (upstream) and *P* (downstream), receives as inputs the time histories of *power* and of *cc* at point *P-1* and outputs the time history of *cc* at point *P*. Each single Neural Network is trained and validated in order to reproduce the normal behaviour of the considered variables. Afterwards simulations can be performed in two different manners that are the **open loop** mode and the **closed loop** mode.

In the open loop mode, at each time step of the simulation, experimental values of *power* and of *cc* in the measure point after the condenser are provided as inputs; thus, error propagation throughout the model is limited. In the closed loop mode the only experimental input is the *power* time history. The advantage of this latter mode is that, once the model is trained and validated, it can be used without input signals of the same type of the output variables.

PROCEDURES OUTLINE

The user chooses the mode, open loop or closed loop mode, to perform simulation. Moreover an anomaly can be introduced in a desired point of the Coal Power Plant model as a signal to be summed to the original one. Anomaly is presented as a reference signal that can be easily modified in amplitude, time scale and starting time. Results of the simulation are displayed in real time in a grid of plots where the user can select 8 variables to be plotted. Numerical results can also be saved in MATLAB® files for further analysis.

S.A.T.E. Systems and Advanced Technologies Engineering S.r.l.

Santa Croce 664/A, 30135 VENICE (ITALY)

Tel.: (+39) 041 2757634

fax: (+39) 041 2757633

Email: info@sate-italy.com

www.sate-italy.com