A REAL-TIME APPROACH TO THERMO-FLUID NETWORKS IN CONTROL SYSTEM DEVELOPMENT

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ABSTRACT

Control Systems are becoming more sophisticated and more ubiquitous; from aircraft to power stations. Development of these control system requires a software simulator (software bench) in which the control system can be run during development and early testing.

These simulators must model the plant equipment or hardware being controlled as well as the environment in which it operates. Each aspect of the environment and the operating environment requires a model to represent its behaviour.

In this phase, it would be usual for the control system to be repeatedly run on the software simulator through failure modes and to perform trade-off studies using techniques such as Monte-Carlo analysis. Later on, the software models in the simulator may be replaced by real hardware to facilitate Hardware in Loop (HiL) testing. To facilitate this, the models used by the simulator must be operate in real-time (or faster) and be robust to errors.

Many applications contain complex thermo-fluid environments (such as power stations or aircraft) and modelling these has specific challenges:

- Modelling physically complex situations in real time
- Actuators with discrete control values (e.g. valves) and potentially redundant segments of the flow network when valves close.
- Thermo-fluid simulations use convergence based techniques that do not guarantee a solution.

This paper will discuss the approach developed by Flowmaster to provide robust, real-time models from complex thermo-fluid simulations by using Response Surface Models. In particular this will address specific difficulties in applying this approach to a thermo-fluid environment:

- Discontinuities in the response space caused by discrete values of components such as valves and specifically regions of stagnant flow that can occur for certain input values.

- Use of Latin Square techniques to reduce test data size and increase model performance.
- Assessment of goodness of fit.

The paper will consider applications for this functionality beyond Control System Simulators. These include:

- Operational Simulators to support Plant Maintenance.
- Support for Model Based design paradigm.
- Support for 1D-3D integration.

SUGGESTED THEMES

Response Surface Modelling

Realtime Simulation

Control System Simulator

Model Based