Development of a Real-Time Operator Training Simulator for Falling Film Evaporators

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You see, wire telegraph is a kind of a very, very long cat. You pull his tail in New York and his head is meowing in Los Angeles. Do you understand this? And radio operates exactly the same way: you send signals here, they receive them there. The only difference is that there is no cat.

Albert Einstein

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Author Publications

The follow publication was prepared during research for this thesis:

S Goodwin, H Bakker, C Marsh "Development of a Real-time Operator Training Simulator for Falling-Film Evaporators", *Proceedings of Chemeca98*, University of Queensland Australia, 1998

SUMMARY

The aim of the project was to create a simulator of a falling film milk evaporator based around the normal Fix32 SCADA control system of the evaporator, in order to train operators. This aim was broken into two objectives: the development of a generic software system to create a simulator (SRTLink); and secondly the use of that software to create the evaporator simulator (SimEvap) for operator training.

The first objective was achieved by initially laying out a specification for the software. A design of the software was then made, based around the specifications. This design was implemented and then tested to ensure that the initial specifications were met. The final software program is a package of two complimentary elements; the first a set of communication drivers for reading and writing values from a Simulink model of a process into a Fix32 control system, and the second a real-time manager for the model and its embedded communication drivers.

The development of SimEvap followed, again based around a process of laying a specification, production of a design of the simulator (based around the structure of SRTLink) and finally implementation and testing. The resultant piece of software was an executable file embodying the evaporator model (with the communication drivers embedded, as per the SRTLink structure) controlled by the real-time manager. When the generated application is run in conjunction with the Fix32 control system, a real-time falling film evaporator simulator for operator training, named SimEvap, is born.

The primary aim of the project, the construction of an evaporator simulator for operator training, was met via the achievement of the two objectives – the construction of a generic software system followed by the use of that system to create SimEvap. The constructed simulator is very similar, both visually and operationally to the real plant and is being used to train both new and experienced operators.

INTRODUCTION

The Chinese say, "Experience is the only teacher", while an old Western proverb is "Practice makes perfect". In either form, the notion is identical – the more often a task is performed, or a problem confronted, the better it is handled.

In the arena of process control involving human operators, the effects of a mistake can be extremely costly to the company. One way to reduce the frequency and severity of mistakes by an operator is to provide training, ideally on a simulation of the process rather than the process itself. This allows the operator to make mistakes and hopefully learn from them, without the company having to lose revenue, lower efficiency, or produce waste product.

An operator normally controls a process by changing the settings in a piece of software, which in turn affects the operation of the plant. However, that control software is operating on a machine which is also perfect for modelling and calculating the responses of the process in question. Software to control a process is readily available in a multitude of incarnations and so are packages designed to create models of a process. Used in conjunction, a model-based simulator can be created in order to train operators.

One obstacle to creating such a simulator is the ability (or software) to convey results and changes from the modelling software to the control software; the first objective of this project was to remedy that lack. A small piece of software was written with the overall aim to allow the construction of a real-time simulator of a process plant based on a simulation model and using the existing control system of the plant. The purpose of this simulator is to train operators without the expense of errors being made on the real plant. This led to two main tasks for the software.

The primary task of the software is to provide a communication interface between a model of a process (developed in Simulink) and a SCADA system concerned with the controlling the real world process (Fix32). The software must be structured in such a fashion that it can be "plugged in" to a model of any process, and can be configured to work with an existing control system based around Fix32.

The secondary task of the software is to run the process model in real-time. This allows for the construction of a real-time simulator based on the current control system and the process model. However, this places a restriction upon the software produced – both calculation of the simulation and communication of data must be fast enough to be handled in real-time.

With these objectives for the software in mind, a specification was developed and design, implementation and testing of the software carried out. Once created, the software was used to construct a real-time simulator called SimEvap for use by Kiwi Dairies for the purposes of operator training. The simulator models a falling film evaporator used in the production of milk powder, running it in real-time and presenting the results to an operator through the standard SCADA control screens developed for the real evaporator. With the help of an experienced operator, a neophyte can be taught how to control an evaporator.

The following thesis is broken into two main parts. The first concerns the design and development of the software as a generic platform for the creation of model based real-time simulators. The second part covers the construction of a simulator for Kiwi Dairies using the developed software. Following this are conclusions and recommendations and limitations and future developments. Both of these are discussed with respect to both the generic software and to the developed simulator.