Energy Efficient Control of a Multi-Pump Boosting System

Introduction

The pump systems are being used in over 80% industrial systems, such as the pump systems used in the oil and gas transportation, waster water treatment etc. Normally within a pump station a number of different pumps are usually used and controlled by a central control unit or human operator(s). Besides maintaining and monitoring the concerned system, the controller/operator's main task is to determine when and which available pumps should start/stop in order to achieve a given requirement.
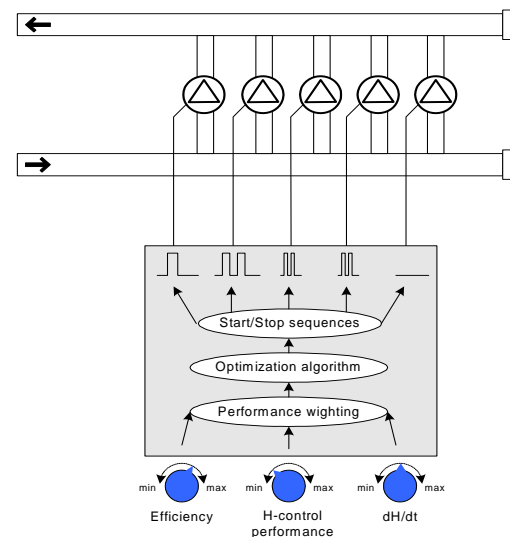

Fig.1 Grundfos set-up in AAUE

Fig.2 Scheme optimal control

Objective

For a multiple-pump system, there is a potential to achieve some optimal solution to operate the system in terms of least energy consumption. Thereby the project aims to investigate some optimal scheduling methods so as to control the on-and-off of potential pumps and the running pump speeds as well.

The objective could be one of the following considerations depending on your current semester level:

- Pressure control for a single pump. For instance, for a given set-point of the pump head, how to control the speed of the considered pump so as to achieve the set-point tracking ability. Some classical control methods could solve this problem (suitable for junior semesters, e.g., DE5 semester).

- Optimal scheduling development of the considered multi-pump system. The task includes the selection of operating pumps and the speed control of each running pump as well, as

shown in Fig.2, so as to have a high system efficiency meanwhile keeping the system performance acceptable.

Content

In general, the project contents could include:

- Hardware development/improvements;
- Mathematical modeling and Matlab Simulation;
- Be familiar with Labview Software and programming
- System property analysis and Control design;
- Validation and comparison if more than one kind of controllers is developed.
- The developed methods are expected to be tested on the practical benchmark provided by Grundfos A/S as shown in Fig.1.

References

- Materials from Grundfos A/S and some previous reports are available.
- Zhenyu Yang and Hakon Børsting (2010), "Energy Efficient Control of a Boosting System with Multiple Variable-Speed Pumps in Parallel", in Proc. of *49th IEEE Conference on Decision and Control*, Atlanta, Georgia USA, December 15-17, 2010, pp.2198-2203.
- Zhenyu Yang and Hakon Børsting (2010), "Optimal Scheduling and Control of a Multi-Pump Boosting System", in Proc. of *2010 IEEE Conference on Control Applications (CCA)*, YOKOHOMA, Japan, September 8-10, 2010, pp.2071-2076.

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