Nitipat Chaiwattanapong 2011: Stability Analysis of Heat Exchanger Networks Using the Passivity Theorem. Master of Engineering (Chemical Engineering), Major Field: Chemical Engineering, Department of Chemical Engineering. Thesis Advisor: Associate Professor Thongchai Srinophakun, Ph.D. 162 pages.

Passivity theorem as the stability analysis tool of the interconnected systems was studied and implemented in this thesis through both a single bypass heat exchanger and heat exchanger networks (HENs). A single bypass heat exchanger from Westhalen *et al*. (2003) was implemented with the passivity approach. Firstly, a state space model was developed along with its transfer function to test the passivity with the passivity index. This case study showed either passivity or non-passivity behavior depending upon its possible pairing schemes. Therefore, the magnitude of passivity index was used to rank the pairing schemes. Consequently, the passivity based decentralized unconditional stability (DUS) PI controllers for this system were designed and also verified with Aspen Dynamics simulator. This system was tested by making $\pm 10\%$ of setpoint temperatures and $\pm 10\%$ inlet hot flowrates. The results illustrated that the passivity approach gave better setpoint tracking than conventional PI controllers from the simulator.

The extension to HENs from Glemmestad *et al*. (1996) was further implemented. Likewise, this network was followed the passivity based DUS PI controller synthesis procedure. This network was tested by disturbing $\pm 1\%$ inlet hot flowrates. In addition, fault-tolerant control was tested by letting one of controllers failed during the network was facing disturbances. As a result, the proposed controllers could capably achieve fault-tolerant control while the other PI controllers had some deficiency and could not be controllable.

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