CONTROLLER DESIGN FOR VACUUM SYSTEMS

Assignment

In this assignment, the student is expected to develop a model-based control strategy for both the vacuum pump and the motorized valve, which regulates the vacuum pressure subject to varying belt coverage area.

Activities

- Describe the dynamical behavior of the vacuum control system using a physics-based model
- Validated the model with experiment results
- Develop a control strategy, which controls both the pump speed and the motorized valve
- Compare the controller's dynamical performance with the baseline controller

Context

The Vexar system is considered as the crucial component for digital ink-jet printing industry. Substrates, e.g., papers, are transported by a stainless steel belt at constant velocity with high position accuracy, which enables high volume and premium quality digital printing. During the transportation, substrates are clamped to the belt using vacuum suction. This results in dynamical disturbance to the vacuum system, as the belt coverage area constantly changes depending on the number of substrates and their positions. This

Internship overview

- Master Student
- Graduation Assignment
- Mechatronics/Control Engineering
- Location: Nuenen

Technologies

- Physical modeling
- Model-based control
- Multivariable control
- Disturbance rejection

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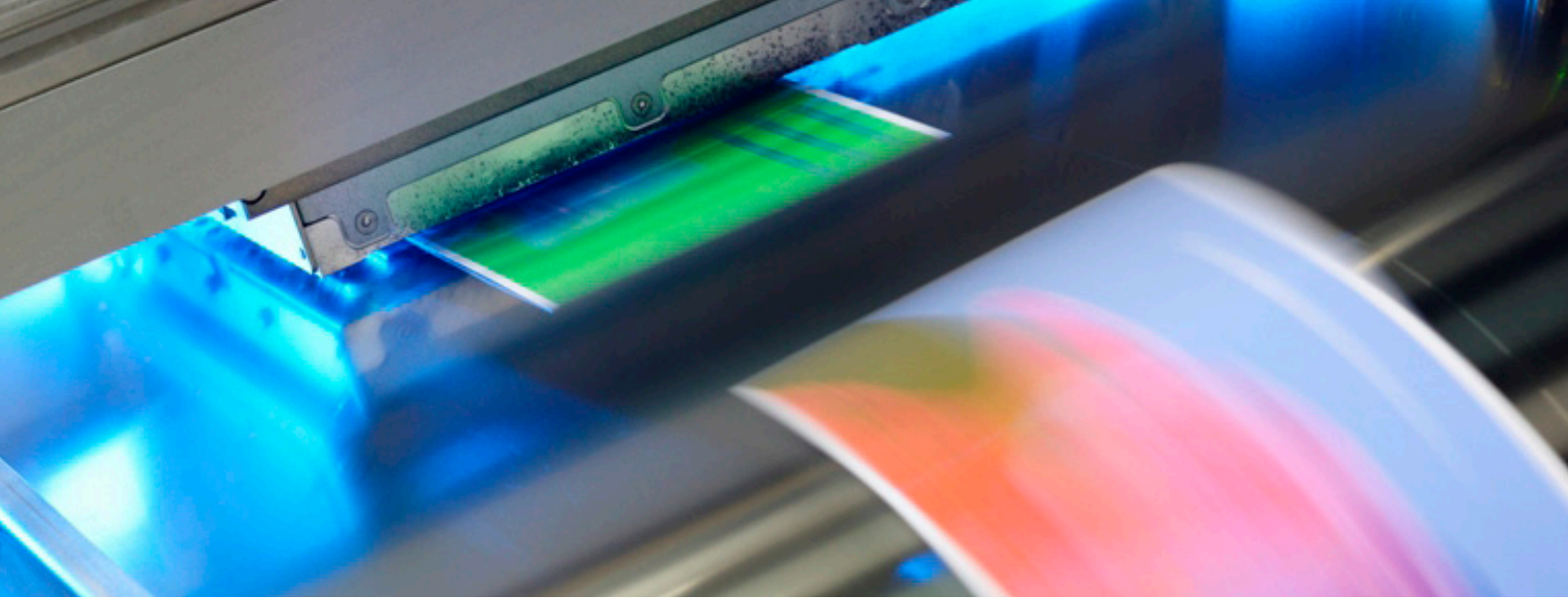
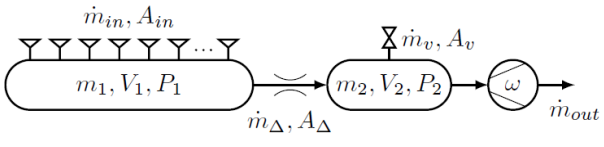


disturbance becomes problematic especially during the loading and unloading process, such that we have large belt speed variation due to dynamical friction force. In order to achieve high mass flow rate, large pumps are chosen for the vacuum system, which are often too slow to response to the dynamical disturbance. Therefore, a motorized valve is added to the vacuum system to achieve faster response time.

The schematic diagram of the vacuum system contains two vacuum chambers. Chamber 1 is located beneath the belt and clamps the substrates via many small holes. Chamber 2 is the vacuum distribution box and acts as a buffer. The connectors between chamber 1 and chamber 2 have limited cross-sectional area, which imposes airflow restrictions. The motorized valve is mounted to chamber 2 for better reachability and to achieve higher leakage flow rate. The vacuum pump is connected to chamber 2, which creates vacuum below atmospheric pressure.

Vexar system



Vacuum system schematic diagram

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Would you like to know more about this student assignment?

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