TeeJet Adaptive Controls Research Project

# Background

Agricultural Spraying machines are used to apply chemical to farmland to increase the productivity of the land. Fertilizer increases yield by 40% to 60%. If pesticides are not used, yield decreases by 50% to 90%. To maximize these yields, the correct amount of chemical must be applied to the correct area of the plat or soil.

Controls Overview

All sprayers have a pump that forces chemical from a tank through hydraulic plumbing leading to the boom of the sprayer. Flow to the boom can be changed by either changing the speed of the pump or by opening and closing a regulation valve.

Across the boom are a number of nozzles that serve as the exit point for fluid. These nozzles also have a solenoid that can open or close the valve. By applying a PWM signal, we can

A screenshot of a video game

Description automatically generated

When spaying, the farmer is limited to how fast he/she can drive and apply the correct amount of chemical without increase.

In a sprayer application, we have two separate discrete-time feedback control systems to solve these problems.

One system controls to a desired flow rate. This system ensures the correct amount of fluid is applied to the field. Target flow is calculated by the prescription for the field and the speed of the vehicle.

A second system controls to a constant pressure across the boom of a sprayer. Droplet size directly correlates to pressure and can be determined from the nozzle’s datasheet. This ensures proper application of the fluid and prevents drift due to atmospheric conditions.

Flow rate controllers, pressure controllers, and sprayers can all be manufactured by different companies. This makes it very difficult to come up with a design that will preform well across different scenarios. In the diagram below, assume , , , and unknown.

A close up of a logo

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Figure 1

|  |  |
| --- | --- |
|  | Target Pressure |
|  | Target Flow |
|  | Actual Pressure |
|  | Actual Flow |
|  | Pressure Controller |
|  | Flow Controller |
|  | Duty Cycle to solenoids (limited between 0 and 100) |
|  | Open/Close signal for regulating valve |
|  | Pump Speed speed (optional) |
|  | Plant model |
|  | Pressure Sensor |
|  | Flow Meter |
|  | Pressure Sensor Noise |
|  | Flow Meter Noise |

Table 1

# Problem Statement

Develop a control system that can adapt to different plant models and rate controllers.

# Outcomes

TeeJet

1. Control System that can adapt to:
   1. different plant models
   2. different rate controllers

Students

1. Experience:
   1. implementing control system
   2. MATLAB and Simulink
   3. Embedded System

# Deliverables

TBD