PID CONTROL FOR A SELF BALANCING ROBOT

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MOTIVATION AND RESEARCH PROBLEM STATEMENT

- Observation of Daniel Schmidt et al’s Bench Scale Model
- Variety of uses in industrial settings
WHAT IS PID?

PID consists of three parts working in unison to correct error in a system to user defined settings

- **Proportional**
  - Thinks of the present and attempts to reduce the magnitude of error

- **Integral**
  - Thinks of the past and attempts to reduce the steady state error left over by the proportional part

- **Derivative**
  - Tries to predict the future and acts against the proportional and integral parts of the controller to prevent overshooting

\[
u(t) = K_p e(t) + K_i \int_0^t e(t) \, dt + K_d \frac{de(t)}{dt}
\]

Output = Proportional + Integral + Derivative
RESEARCH

Bench Scale Model
- Recap: Slug flow phenomena is a flow regime in which large pockets of air are followed by dense liquid ‘slugs’.
- Uses PID to control actuator for valve
  - Purpose: to control back pressure in order to mitigate slugging effect which can compromise system integrity.

Inverted Pendulum On Cart
- Basis for self balancing robot
- A force $u$ moves the cart in a direction $x$
- The goal of this model is for theta to equal 0.
- Arduino UNO
- MPU6050 6DOF
- H-Bridge
- Open Source Code through Arduino IDE and libraries
Simple set up to perform quantitative analysis of PID adjustments. The readings will come from velocity which will be calculated based on wheel rotations, distance traveled, and time. Angles will be determined from Marker 1.
Discussion

- Learned about PID control theory
- Learned about programming microcontrollers
- Built functioning model
- Successful demonstration

Future

- Quantitative data analysis
- Graphing data directly from Arduino and MPU6050
- Parametric study – bot’s balance affected by surface types
REFERENCES

4. How to Make a Balancing Robot at Home, Dahake, Tarun K., YouTube, 10 June 2018.
5. “Fritzing.” Fritzing, 0.9.3b, University of Applied Science Potsdam, fritzing.org.