Exploring Regression for Two Wheeled Self Balancing Robots

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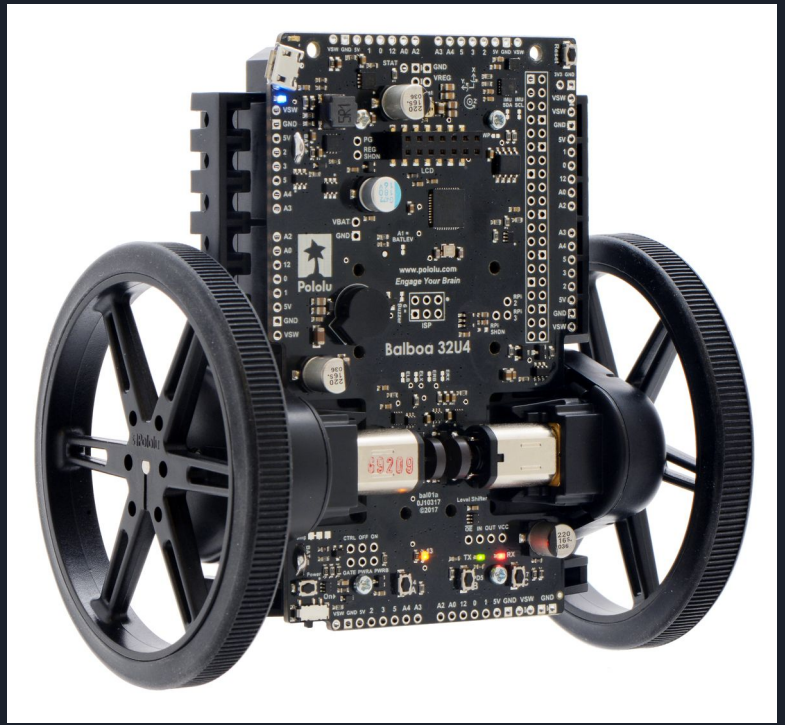
What are TWSBR?

Two Wheeled Self Balancing Robots

- Two wheels, attached to a solid body.
- Must constantly adjust to stay in balanced state.
- All samples captured on Polulu Balboa 32U4.



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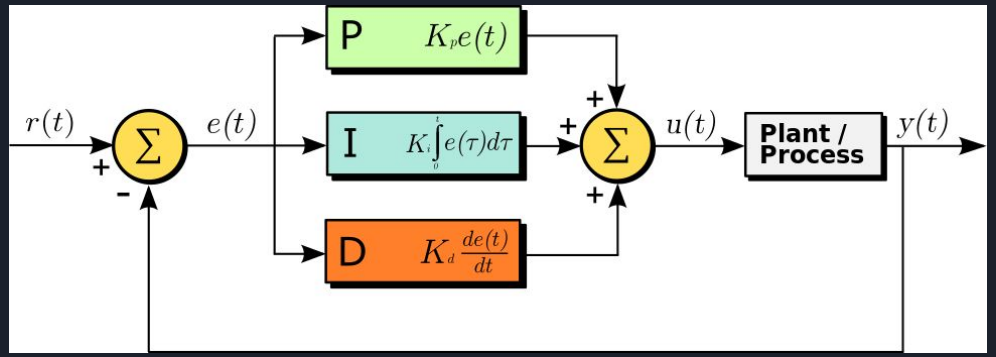
What is PID?

PID is a form of control for systems that require constant adjustment in order to reach their desired state.

Error is defined as the difference between the system's current state and desired state.

Three important coefficients:

- Kp: Adjust magnitude of linear response to error
- Ki: Reduce steady state error, and increase exponential response to error.
- Kd: Reduce oscillations caused by Kp and Ki



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Approximating PID Coefficients with Different Forms of Regression

- Angle, angle rate of change, integral of angle fed into PID function. Output (or response) sent to motors.
- PID input and output transmitted wirelessly to PC for capture
- Approximated PID coefficients using Linear Regression, Support Vector Regression.

Results of Regression

Need to capture response plots

Going Further

Many transformations on the sensor data happen before being sent to PID, using CPU time.

What if we could eliminate / reduce the number of transformations?

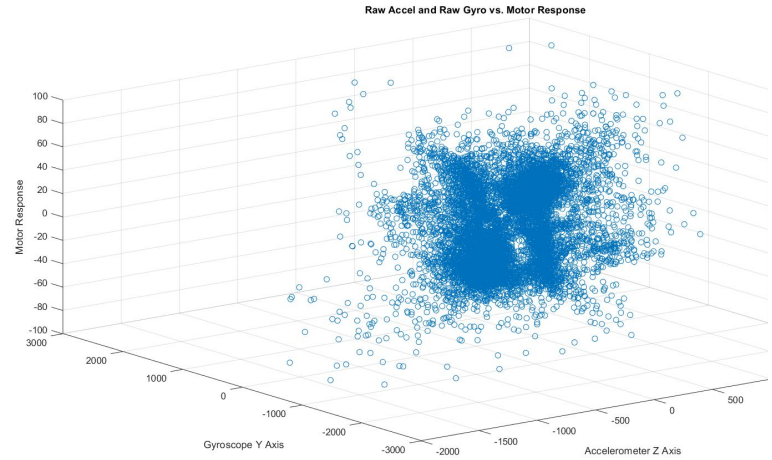
Abstracted Data

No Abstraction or Transformation

Failed Attempt

Failed to get cost to a reasonable level after trying linear regression and support vector regression.

Raw Data vs. Response



Transformed Data vs. Response