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Engine Control

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Overview

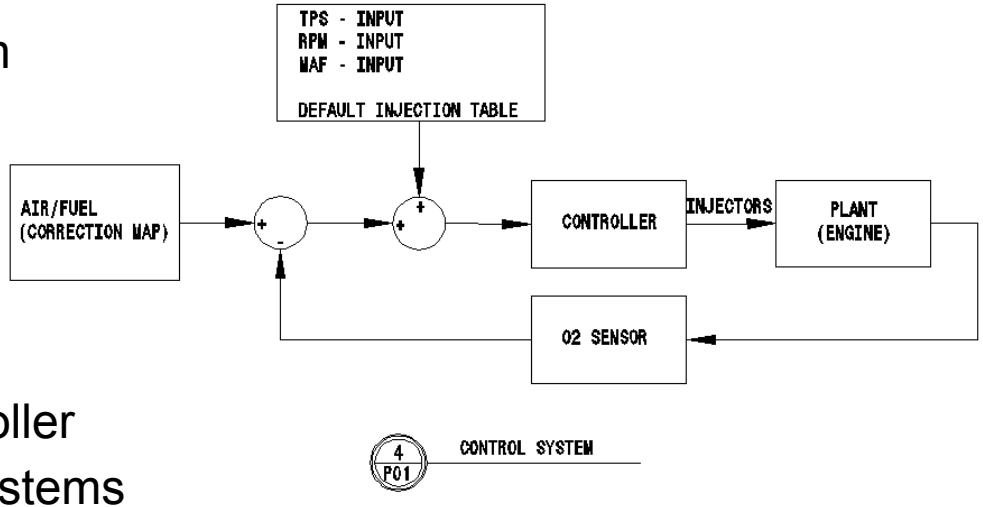
- Objective: Design an engine control system and use it on a motorcycle engine (600cc, 4 cylinder motorcycle engine).
- Problem: CSU lacking engine infrastructure
- Problem: Increasing demand on vehicle fuel efficiency in near future. Increase in the demand for an electrical engineer in engine design.

Solution

- ADRC - Active Disturbance Rejection Control
- Will help achieve fuel efficiency targets - excellent dynamic response
- Rejection of electrical disturbances (from spark plugs, injectors)
- Reacts well to unexpected changes in engine plant load parameters
- Our engineering team is part of the solution
- We hope to jump-start an engine study infrastructure

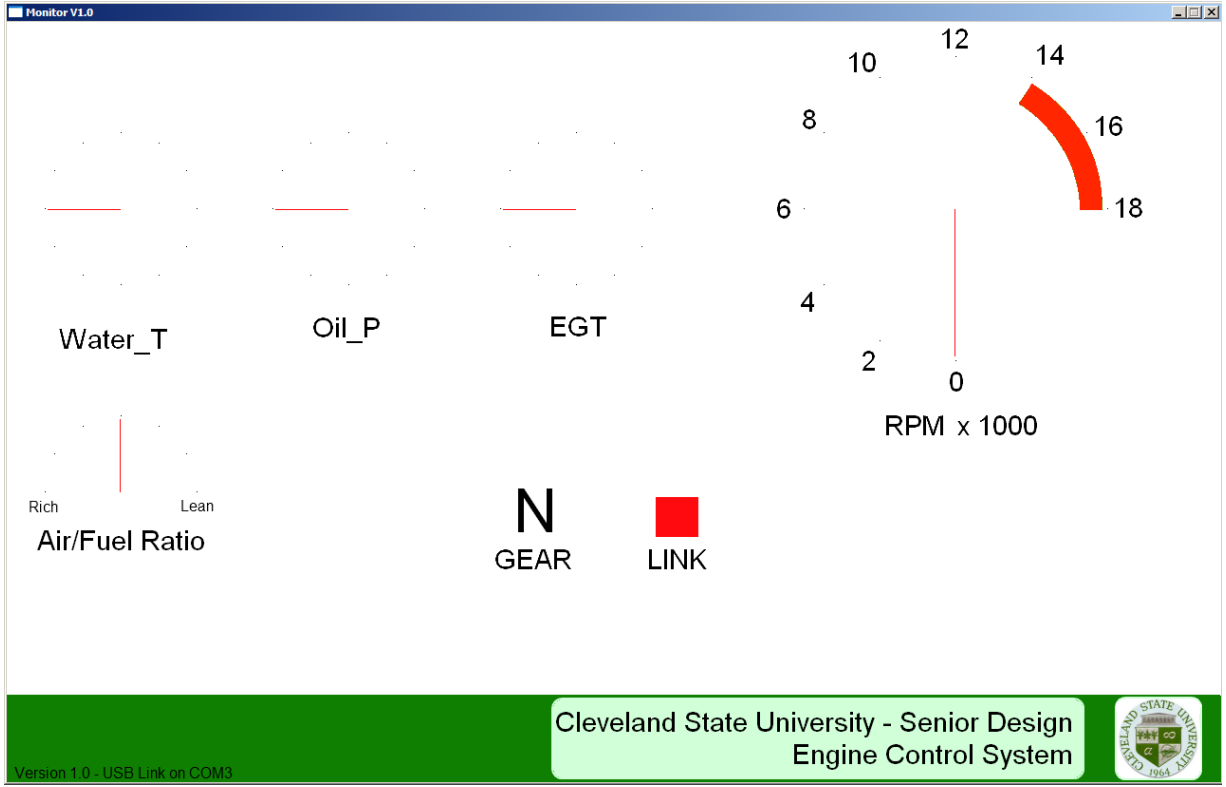
Design Process

- Block diagram of control system



- Migrate ADRC onto microcontroller
- Piecewise testing of sensors/systems
- Fabricate, intake and exhaust and engine test stand systems
- Run engine, record default parameters
- Run engine with our ADRC controller

Graphic User Interface (GUI)



Management

The next step:

Derive application specific model for use with ADRC system:

$$\dot{m} = C_d \cdot A(t) \cdot \frac{p_{in}(t)}{R \cdot \vartheta_{in}(t)} \cdot \Psi\left(\frac{p_{in}(t)}{p_{out}(t)}\right)$$

[1] Intake mass airflow model

Digitize the ADRC algorithm onto a microcontroller

Design Challenges

- Safety
- Supplying load to engine in test cell – dynamometer
- Not having a mechanical engineer in our team to help with some of the mechanical issues we might face
- Organizational technical hurdles

Cost

Total cost split into the required parts shown below :

- Engine: Internal combustion 4 cycle
- ~600 cc (Same size used for student run formula SAE cars)

Examples:

Honda Engine cbr600 F4i

Suzuki gsx-r600

Daytona Triumph 600

- Mass air flow sensor

Cost

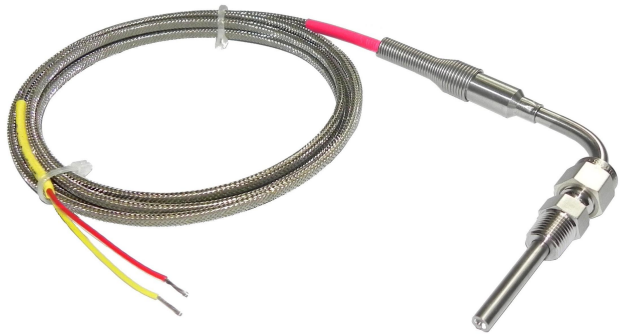
Oxygen sensor

Dynamometer
(water brake absorber)

Water radiator

Cost

- Exhaust gas temperature sensor



- The total cost for this project is between $ 2500 and $3500

Conclusion

- Robust controller needed for rapid changes in mass air flow rate:

  Heavily turbocharged applications, high speed engine applications
- Quick & accurate response to system
- Robust in ability to maintain accuracy in varying climate/altitude
- Our controller will combine all of these traits to achieve a fuel efficient system