Traction Control

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Background
- Annual FSAE competition
- UI team placed 54th out of 123 in 2003
- 2003 winning team implemented a traction control system

Objectives
- Improve acceleration at start up
- Maintain control when exiting corners
- Decrease race time
- Improve race standing

Procedure
- Select allowable slip percent
- Measure wheel velocities
- Compare velocities to analyze slip
- Determine if action is required
- Cut engine power if appropriate
**System Overview**

- Sensor
- User Control
- Data Acquisition Unit (DAU)
- Engine Control Unit (ECU)
- Wheel Velocities
- Engine Micro Controller

**User Control**

- System Override (On/Off)
- Adjustable Slip Percentage
- Indicator lights

**Graph:**

- Friction $u$ vs. Slip ($\%$)
- Speed: 30km/h

- Lines:
  1. Dry, Tread Depth 2mm
  2. Wet, Tread Depth 2mm
Inductive Sensors

- Measure wheel velocity
- Durable: vibrations, etc.
- Perform in dirty environment
- Non-contact
- Preferably run on DC voltage
- Tolerate angular velocities of approximately 20 rev/sec

Inductive Sensors

- Inductive vs. photoelectric and capacitive sensors
- How inductive sensors work

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Inductive Sensors

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**Inductive Sensors**
- Toothed wheel (to be made)
- Tire diameter: 20 in.
- Teeth: 6–10

**Microcontroller**
- Easy to program
- Real time control
- Expandable
- Modifiable functionality
- Operate in a harsh environment
- Analog outputs
Microcontroller

- Rabbit RCM3110
  - Clock Speed: 29.4 MHz
  - Memory: 256k (Flash)
  - I/O ports: 54
  - Inputs: 5V tolerant
  - PWMs (built in): 4

Operating temperature:
- -40°F – 185°F
- Humidity: 5 – 95% (non-condensing)
- Battery backup
- Power: 3.3V DC

Microcontroller

- Control algorithm
  - User control
  - Input signals: 4
  - Possible methods of control: 3
  - Real time response
  - Analog output
**Power Supply**

- Input Voltage AC/DC
- Rectifier Circuit
- 5V Switching Regulator
- Power Filter Circuit
- Linear Regulator
- 5V DC
- 3.3V DC

**Engine Control Unit**

- Performance Electronics, Ltd.
  - PE-ECU-1
- Inputs: 3 (analog); 2 (digital)
- Input voltage range: 0–5V

- Cut Fuel
  - + Does not emit raw fuel
  - – fuel lining evaporates
  - – possible lean burn
- Cut Spark
  - + no lean burn
  - – oil lining stripped
  - – raw fuel in exhaust
**Engine Control Unit**

- Adjust spark timing
  - precise control
  - no lean burn
  - no raw fuel in exhaust
  - linings are not compromised
  - only works for slight slippage

**Data Acquisition Unit**

- Pi System 1
  - Monitors: 6 analog inputs
  - Memory: 512k
  - Possible uses: record wheel velocity; control output; slippage

**System Protection**

- Circuit buffers
- Vibration isolation
- Enclosure
### Budget

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<th>Part</th>
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<th>Quantity</th>
<th>Cost</th>
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<td>Microcontroller</td>
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### Schedule

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<th>Task</th>
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<tr>
<td>Equipment Purchase</td>
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<tr>
<td>Program Development</td>
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<td>Working Model</td>
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<td>System Integration</td>
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