IPRO 324 Power Measurement for Road Bikes

Midterm Presentation

The Problem

- Cyclists have great interest in measuring their mechanical power output on the bicycle
- Practice/Performance optimization
- Existing available solutions
  - Expensive
  - Can not be retrofit
- Strain gauges are an inexpensive practical solution
- Require advanced signal processing
- Signal needs to be transmitted wirelessly to a bicycle computer

Team Structure

Team Lead
Crystal Lybolt

Mechanical Team
Nathan Knopp – Lead
Crystal Jankhot
Brandon Marcellis
Ryan Ruidera
Henrietta Tsosie

Electrical Team
Bryan Kaminski - Lead
Sergio Aguilar
Patrick Becker
Daniel Gonzalez
David Poli
Jaewon Yoo
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- Apply and test strain gauges on various areas of the bike's spider
- Analyze results of strain gauge testing
- Reverse engineer commercial device
- Design device to measure bike RPM

- Develop microcontroller and circuitry for strain gauges and RPM measurements
- Interface standard bike computer with measurement circuitry
- Reverse engineer commercial device

Some Background

Sram Force Crank Set

Quarq Cinco Power Measurement Spider

Garmin 705 Bicycle Computer

Objective/Goals of the Project

- Develop a configuration of strain gauges
  - Accurately measure the output of the strain gauges under various load conditions
    - Crank angle
    - Direction of applied force
    - Point of force application
      - Left pedal
      - Right pedal
      - Both left and right pedal
- Develop an electronic processing unit for post-processing the strain gauge signals
  - Implement an algorithm to calculate the applied torque at the bicycle crankset
  - Transmit the data wirelessly to the Garmin Edge 705 using the ANT+ protocol
  - Must be power efficient
- Package the system
  - Must work under realistic conditions
  - Needs to conform to the space requirements associated with a bicycle

Progress Thus Far

- Mechanical
  - Strain gauges added to outside of spider
    - Strain gauges were on different locations prior to beginning of semester
    - Moved to outside to try to minimize effects on strain due to bending, torsion and other sources
- Electrical
  - Work with Garmin 705 and Quarq Cinco
    - Paired the Quarq to send power signal to the Garmin
- General
  - Research
    - Patent for Quarq device
    - ANT+

Obstacles Dealt With

- Reverse engineering the Quarq
  - Unable to without destroying the casting
    - any reverse engineering will only involve examining the communications between the Garmin and Quarq computer.
- Finding times to meet outside class
  - Could not meet in Lab on Fridays
    - Two sessions scheduled on Tuesday (morning and night)
- Application of Strain gauges
  - Group had no experience
    - Had a session in which the Mechanical members learned and did test runs

What Lies Ahead

- Mechanical Aspects
  - Need to develop a configuration of strain gauges under various load conditions
  - Measure the torque accurately at the bicycle crank
- Electrical Aspects
  - Need to develop an algorithm to process the strain gauge signals for power measurement
  - Design a power circuit that optimizes the battery lifetime
  - Networking between a bicycle computer (Garmin 705) and other electronic processing and transmission units
- Financial Aspects
  - Requirement to make a product cheaper than existing products

Thank You

Questions?

Suggestions?