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
Arkadiusz Ziomek

- 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?