Developing a Practical Field Check for Ultrasonic Anemometers

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Ultrasonic vs Mechanical Wind Sensors

Ultrasonic

- Advantages:
  - Much lower starting thresholds
  - Responds better to quick changes
  - Less maintenance
- Disadvantages:
  - No established field checks other than collocated transfer standard (CTS)
  - Can be a bit tricky to verify alignment

Mechanical

- Advantages:
  - Well established field checks
- Disadvantages:
  - Higher starting thresholds
  - Slower to respond to changing winds
  - More prone to failure or damage

Oregon DEQ's Current Approach

- Have a mechanical and ultrasonic sensor at each site
- Audit mechanical equipment and use as CTS
- Provides a good back up and reassurance the system is working but requires more maintenance

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Motivation

- Limits of the collocated transfer standard (CTS) method
  - Calm conditions
  - Wind not covering wide range of speed and direction
  - Difficult logistically
- Streamline sites and run only ultrasonic anemometers
- Eliminate the cost of servicing two sets of instruments

First Ideas for a Field Check

- Using PC fans with tachometers
  - Didn't move enough air
- Battery powered leaf blower with pitot tube as reference
  - Slight breezes interfered more than expected
- Add a "test section" to reduce wind influences

Current Design

- Leaf blower to push air through system
- Round to rectangular duct transition
- Furnace filter to break up turbulence
- Cardboard test section

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Wind Speed Reference

- TSI VelociCalc
- Two useful probes:
  - Pitot Tube
  - Hot Wire Anemometer
- Calculates speed automatically

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Operating the Setup

- Place anemometer inside
- Set leaf blower to a constant speed
- Measure velocity immediately before and after anemometer with reference probe
- Compare velocity results

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What Worked Well

- Leaf blower held a constant speed well
- Agreement of less than 0.2 m/s agreement up to 3 m/s
- Needs no AC power source
- Reasonably portable

Limitations of Current Design

- Test section is narrow and becomes turbulent at higher speeds
- Leaf blower supplies only 6 m/s inside test section
- Hard to see inside test section
- Cardboard isn’t very durable

Improvements

- Replace cardboard test section with clear polycarbonate
- Add handles for easy field use
- Wider test section
- Moving fan upstream of test section might reduce turbulence
- Using honeycomb grid for laminar flow

Questions

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