On-the-Fly Tree Caliper Measurement

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- Some caliper measurement systems
  - Ultrasonic transducer – Upchurch et al.
  - Infrared LEDs to measure tree trunk profile - Singh
  - Laser scanner – Henning, Thies
  - Laser and vision - Byrne
  - Optical sensor, laser and motion measurement Delwiche

- Our approach
  - Structured laser lines and vision
On-the-Fly Tree Caliper Measurement

- How does it work?
On-the-Fly Tree Caliper Measurement

Estimated Tree Width: 24.8 mm [3]

Estimated Tree Width: 26.3 mm [5]

Estimated Tree Width: 19.3 mm [18]
On-the-Fly Tree Caliper Measurement

- Features of our tree caliper measurement device
  - Accurate, reliable measurement
  - Can be used under any lighting condition – such as in the field under sun light or at night or indoor at warehouse
  - No precise position or movement required
  - Can be attached to moving vehicle
On-the-Fly Tree Caliper Measurement

- Indoor testing at Adams County Nursery warehouse
On-the-Fly Tree Caliper Measurement

- Indoor testing – caliper estimate error
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- Outdoor testing
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- Outdoor testing – caliper estimate error
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- Conclusion
  - +/- 2.5mm outdoor, +/- 1mm indoor
  - Operating at any ambient lighting
  - Mounted on moving vehicle
  - Operating simultaneously with other tasks
  - Counting trees while moving along
  - Automatically databasing of tree caliper
On-the-Fly Tree Caliper Measurement
On-the-Fly Tree Counter
On-the-Fly Tree Counter

- At J frank Schmidt, OR on 45 Sergeant crabapples travelling approx 3 mph. Trees were counted 5 times with an average accuracy of 97%

- At Willow Drive Nursery, WA on 20 apple small caliper seedlings travelling approx 2 mph. Trees were counted 10 times with an average accuracy of 95%.

- At Dave Wilson Nursery, CA on approx 50 cherries trees travelling approx 2.5 to 3.0 mph. Each of the tree cultivars were counted 10 to 20 times with an average accuracy of 97%

- At J frank Schmidt, OR on approx 45 Gymnocladus seedlings travelling approx 2.5 mph. Each of the tree cultivars were counted 4 times with an average accuracy of 97%
Comprehensive Automation for Specialty Crops (CASC) is a matching grant program funded by the USDA-SCRI and industry to develop comprehensive automation strategies and technologies for the specialty crop industry, with an initial focus on apples and nursery trees. We are a multi-disciplinary, multi-institutional group comprised of engineers, scientists, extension educators, growers, and industry representatives in universities, government labs, and companies spanning five states, representing some 70% of all US apple production.