This past month, Tony Koselka, COO of Vision Robotics Corporation (VRC) and his crew were here in Washington for field trials of the Newton Scout, a vision-based system for automatic crop load assessment. Developed in part through the USDA-funded project Comprehensive Automation for Specialty Crops (CASC), Newton will revolutionize orchard operations by providing growers with a map that accurately maps fruit placement, fruit size and number throughout the growing season. Fruit maps will be used to determine crop load which in turn will give growers the information to develop harvest and marketing strategies. And this is just the beginning. Developing reliable vision systems that are robust enough for use in orchards opens up all kinds of possibilities in the area of pest and disease detection, plant health assessment and the use of robotics at harvest. Newton uses terahertz (THz) imaging technology integrated with a custom image processing algorithm. THz capitalizes on hyper-spectral imaging similar to that developed for food quality and safety. As light hits the fruit, a camera takes a picture every four seconds. The pixelized fractals are then entered into a database. As the database grows, it builds a “what is fruit” and “what is not fruit” index and from this makes a determination to either count the object as fruit or discard the object as being something other than fruit.

Koselka took time out to speak with students and interns from the Washington Tree Fruit Research Center about the development of a similar unit that counts oranges. On one of the field trials for that unit, Koselka had asked the grower to estimate his crop. The grower supplied an answer of 1,000 premium oranges. The farm manager disagreed and responded with 1,200. A Vision Robotics' Scout similar to Newton accurately counted 1,900 -- a sizable difference and one that had a large financial impact.

Vision Robotics plans to develop the Newton for several different applications by combining multi-spectral-image-based perception. As Koselka stated, “not only will it [Newton] be able to accurately count a crop, it will also locate each piece of fruit, grade it, and then pick it... it is not that far off when a grower will be able to tell it he wants a certain number of grade A fruit and the Scout will go locate it, pick it and pack it for the grower.” And if that was not enough, Koselka added, “Oh, and it can prune trees too!”

Vision Robotics plans on enhancing Newton in the future with the addition of technologies such as near infrared (NIR). As Newton evolves, it will have multiple uses throughout the fruit growing cycle such as: taking assessments of sugar and acid content, monitoring for internal damage, and fruit development. CASC is also making progress in other automation fronts that bridge with Vision Robotics' work.

Carnegie Mellon University researchers, led by Prof. Sanjiv Singh, are developing an Autonomous Prime Mover (APM) to capable of towing the Scout safely through entire orchard blocks. In the future they will also automate an agricultural harvesting platform so that workers no longer need to climb on ladders to pick fruit. Its multifunctionality, autonomous drive, and wireless networking could move the APM into the center of precision management of specialty crops.

The CASC team, led by Carnegie Mellon, includes engineers, scientists, extension educators, growers, equipment manufacturers, and industry representatives. This plurality of expertise has led to synergistic endeavors that push the envelope in both the engineering and the science components of the project. For example, Ben Grocholsky at CMU is developing a geospatial system to map and locate each tree in an orchard; in cooperation with the plant science group, he was able to augment this information with local temperature and NDVI data that can be used to detect plant stress and disease.
In another example, during a field trial of an automated caliper measurement device, growers told the CASC team that a simpler tree counter would also be very useful. Sanjiv Singh’s group returned to CMU and had a prototype tree counter ready to be tested in weeks; they will return to nurseries and test the counter this fall. The total time from conception to development will be less than four months, and if successful, this device could go into production within a year. It was only because of the intentional proximity between CASC researchers and growers that new findings like this can be uncovered, with potential for significant economic returns.

The Vision Robotics field trial was conducted at Allan Brothers Othello Orchard in Washington State. Prior to VRC’s arrival, Karen Lewis, WSU Extension Educator and interns with the Washington Tree Fruit Research Commission hand tagged, mapped and sized fruit on several rows of fruit. This data allows for the groundtruthing or validation component of the test. Automated machinery and the associated decision-support systems have long ago made their way into program crop production. It will only be a matter of time before specialty crop growers too start using vehicles, sensors, devices, and software that automate farm operations, increase farm efficiency, and meets our ultimate goal of delivering to the consumer a consistently high quality affordable eating experience while returning money to the farming operation and land base.

For more information on Comprehensive Automation for Specialty Crops, please visit www.cascrop.com