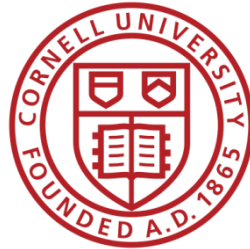


2023 Statewide Virtual Apple Conference

Co-Hosted by CCE-LOF & CCE-ENYCHP

Friday March 3, 2023



Promising Ag-Vision Technologies to Evaluate Fruit Thinning Decisions and Estimate Yields
'What Is Possible TODAY and in the FUTURE'

Mario Miranda Sazo (CCE-LOF) & Mike Basedow (CCE-ENYCHP) & Dr. Terence Robinson (Cornell AgriTech)

Invited Speakers

Dr. Dave Brown and Dr. Patrick Plonski (Pometa)

Jenny Lemieux (VIVID Technologies)

Charles Wu (Orchard Robotics)

Questions	Pometa	VIVID Technology	Orchard Robotics
<p>What are the main applications we can use this year? In the next two years?</p>	<p>Crop load management</p> <ul style="list-style-type: none"> Blossom cluster counting (beta) Fruitlet counting, growth and predicted abscission Fruit Growth Rate Model <p>Irrigation</p> <ul style="list-style-type: none"> Fruit growth rates <p>Harvest</p> <ul style="list-style-type: none"> Fruit color, size and growth Hand scans or ATV mapping (> 1 inch) Harvest forecast <ul style="list-style-type: none"> bins/acre Size distribution <p>Post harvest: bin scanning</p> <p>Weather services</p> <ul style="list-style-type: none"> Frost, heat and dew alerts Station specific forecast 	<p>2023:</p> <ul style="list-style-type: none"> Blossom counts Fruitlet and fruit sizes Counts to help with thinning and yield prediction BETA Fruit Growth Rate Model Growth curves A variety of per tree, row, and block graphs. <p>2024-2025:</p> <ul style="list-style-type: none"> Disease detection pruning insights 	<p>2023:</p> <ul style="list-style-type: none"> Bud counting, blossom counting, Counting and sizing of early-stage fruitlets and fruit all the way up until harvest. Size distribution model <p>Future:</p> <ul style="list-style-type: none"> Looking at expanding into disease detection and early-warning of fire blight.
<p>How accurate have your numbers been?</p>	<p>Final crop load is as accurate as use of hand measurements with fruit growth rate model.</p> <p>Harvest +/- 5% (within ~3 weeks of harvest)</p>	<p>90% accuracy, with variation between farms and varieties.</p>	<p>For full block yields we have demonstrated 93% accuracy. For fruitlets, we are within +/- 10% sizing accuracy at the earliest growth stages. Accuracy improves later.</p>
<p>How early can fruitlet size be assessed?</p>	<p>5 mm, 25mm for ATV scans</p>	<p>10 mm</p>	<p>About 5 mm, accuracy within 10% at 10mm</p>

Questions	Pometa	VIVID Technology	Orchard Robotics
<p>What is the set up and ground-truthing process?</p>	<p>Install iPhone app. To reach the top of trees, mount phone on a 3' to 6' long pole.</p> <p>ATV scans require mounting iPhone ~6 ft off ground on a fixed pole attached to the front of an ATV. We recommend a Quad Lock motorcycle mounting.</p> <p>Install plastic markers (~3 inches) on two trellis posts for reference row segments. For common training systems, ground truth data not required.</p> <p>Detailed vertical scans of reference segments are used to predict occlusion for ATV driving. (30 to 60 seconds/scan)</p> <p>For an unfamiliar training system, six individual tree high quality ground truth measurements should be collected throughout the season.</p>	<p>Our team conducts the initial farm mapping and software set-up.</p> <p>We also provide a mounting system to attach the camera for scanning that can be left on overnight.</p> <p>The amount of ground truthing is dependent on the amount of an orchard scanned. The person operating the camera can do the ground truthing as it takes as long to count a tree and size a sample of what is on the tree.</p> <p>For 2023, Vivid Machines will be helping by providing ground-truthing as much as possible, as part of the service.</p>	<p>A few minutes to mount the camera to a tractor, gator, or UTV. No additional infrastructure is necessary to start scanning.</p> <p>The system requires a one-time setup of your orchard structure for reference (telling it the name, variety and location of each block).</p> <p>For accurate absolute data, we highly recommend calibration counts, to inform our system's occlusion models. Calibration counts are done by the grower, and the time varies depending on the number of calibration counts and blocks, but calibrating a single block should not take more than an hour of counting.</p>
<p>What is your pricing structure?</p>	<p>\$100/acre starting price for a minimum 100 acres.</p> <ul style="list-style-type: none"> - Unlimited use for the season. - Per acre price declines substantially with volume. <p>\$1000/orchard one-time setup cost.</p>	<p>\$5000/yr hardware lease and a \$80/acre subscription fee.</p> <p>Talk to us about our 2023 new customer pricing.</p>	<p>Camera system at-cost for \$10,000, option to lease a system for \$4,000 / year. Free camera upgrades.</p> <p>Software subscription at \$96/acre/year. Risk mitigation pricing strategy for first year users.</p>

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<p>What is the data collection process and how much of the data collection and processing is automated?</p>	<p>Scans are uploaded and processed automatically when phone connects to wifi.</p> <p>Hand-held scans of reference segments between two marked trellis posts. Growers set up ~10 of these per block. Scanning takes 30-60 seconds depending on fruit size and post distance. Scans are used to measure fruit growth rates, and to build occlusion models for ATV scanning. During the fruitlet phase, growers scan reference segments every 3-4 days in order to predict fruitlet drop.</p> <p>Ideally, growers scan blocks with an ATV mounting after fruit set to provide the first harvest forecast, then again an additional 1-2 times before harvest to dial in that forecast.</p> <p>In bin-scanning mode, post harvest, growers can pass the phone over a bin to obtain size and color distributions for their harvest.</p>	<p>The user needs to hit 'start/stop' on the mobile app to record, and predictions are automatically displayed after each section is scanned.</p> <p>Once the sensor is plugged in – all data uploads to the online dashboard as well, and visualization is automatic.</p> <p>Camera sensor updates are done automatically.</p>	<p>The entire process is automated. Doing an orchard scan is a simple, two-click process: one click to start the scan, and one click to stop the scan.</p> <p>All of the processing is handled automatically after the conclusion of the scan, and does not require any additional work from a grower (other than plugging the camera in at the end of the day to recharge!)</p> <p>After the couple of hours of processing time, growers can then view the data on either our provided tablet, or on our website. We supply everything you need to start scanning (tablet to control the camera, the camera system itself, and an external battery + charger).</p>

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<p>How long does it take data to be processed into and actionable report?</p>	<p>An hour for reference segment, overnight for ATV full block scans.</p>	<p>Immediate data to growers in the orchard on a tablet/phone once they stop recording (within 10-15 mins).</p> <p>The data is also uploaded to an interactive cloud dashboard, once the camera is plugged in. New data is added to the dashboard by 9am the next morning (and the entire season's previous data is also available).</p>	<p>We have a very powerful computer inside of the camera system that processes all the data on-device, which means that you do not need a fast internet connection to upload tons of data. This also means that data can be returned as an actionable report quickly, usually within 2x the scan time. (i.e. for a 5 hour scan, you will have the data back within 10 hours, and this is something you can leave running overnight).</p>
<p>Can I integrate your hardware/software over my existing equipment?</p>	<p>Yes. iPhone can be mounted on ATV or gator.</p>	<p>Yes, we have built a mounting system that can be adapted for different farm equipment allowing our sensor to be attached to a variety of vehicles.</p>	<p>No additional infrastructure is necessary to start scanning.</p>

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<p>How do we view the data?</p>	<p>Web application for data display iPhone app for data collection</p>	<p>We have an app and a dashboard. The app runs on any phone or tablet. The data is aggregated on a row level at the moment, but individual trees can also be selected.</p> <p>The cloud-based dashboard can be viewed in a website browser and allows growers to get a more extensive view of their orchard. You can filter by date, variety, block etc, and provides information such as growth curves and size and count distribution.</p>	<p>Scans are run on a tablet app we have developed. This tablet interface lets growers start, stop, and view orchard scans + the status of the camera system.</p> <p>We have a mobile/tablet app to view processed data immediately in the field, as well as a cloud-based website where growers can access, interact with, and export data.</p>
<p>What do you offer in terms of tech support?</p>	<p>Remote support for east coast and midwest growers Targeted in-field training and support for larger Pacific Northwest producers.</p>	<p>We provide field staff to scan and collect ground truth points for growers.</p> <p>Field staff are also available to email, call, or message for quick answers when they're not on the farm.</p> <p>More technical support is available should product suggestions or more complicated issues arise.</p> <p>Currently, our field staff communicates with the technical team on behalf of growers.</p>	<p>Full on-site support and servicing whenever a grower needs it – just give us a call and we'll be there!</p>