



New Directions with Mechanical Blossom Thinners

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Presentation



Background on thinning project



Non-selective thinning



Improved spindle positioning

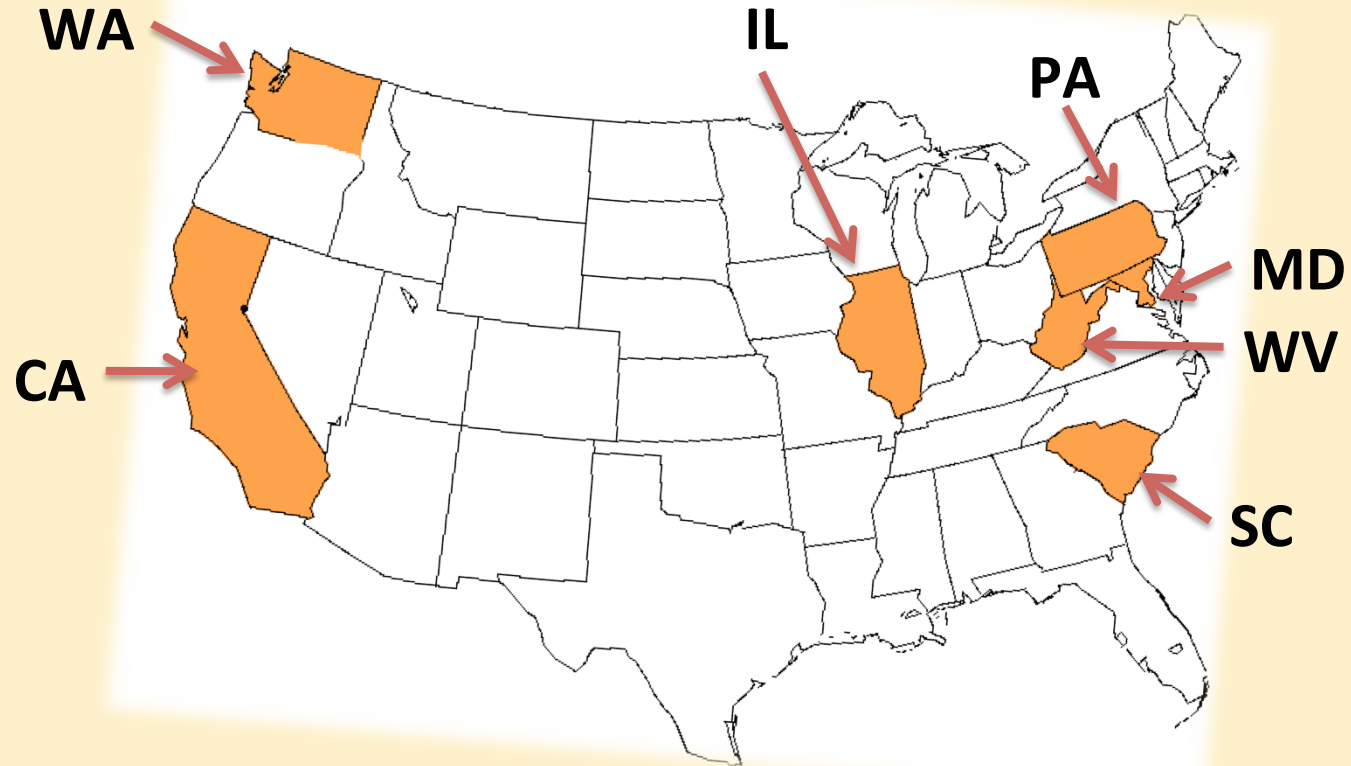


Commercialization of units, new products



Selective thinning and future technology

Multi-State Project



Partners involved:

- Penn State
- Washington State U
- UC-Davis
- Clemson
- U Maryland
- U Illinois
- Carnegie Mellon U (position controlled thinning)
- USDA
- Extension
- Grower partners
- Commercial partner (Bartlett)

Technology – mechanized thinning

Two levels of technology are being used for fruit thinning mechanization:

Non-selective

Selective

Non-selective thinners

String thinners



PT 250



Darwin 300

Positioning issues



String thinner positioning – making the work easier for the operator

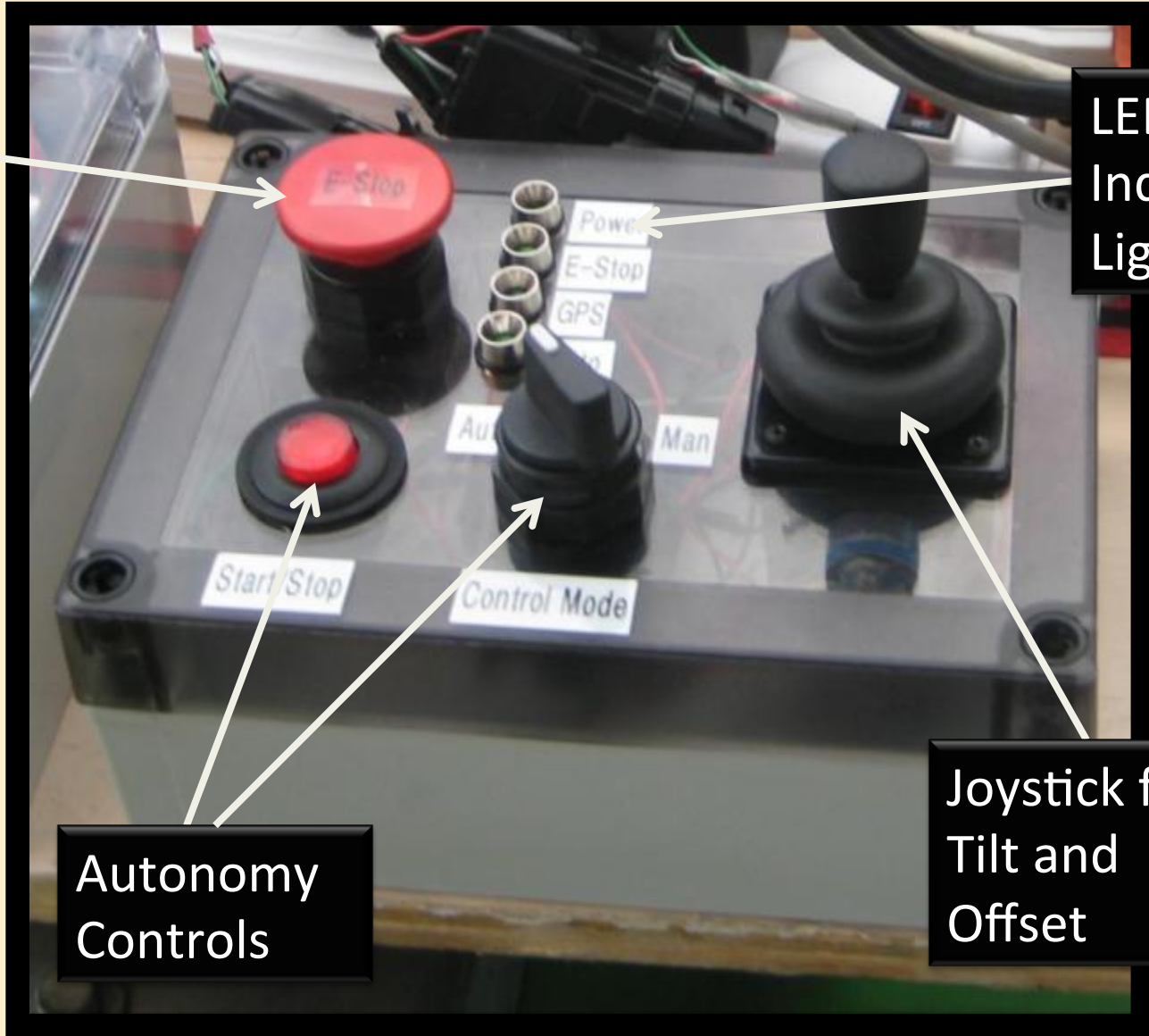
Two-tiered approach to controlled positioning

- Joystick control
- Sensor control

Joystick control

E- Stop

LED
Indicator
Lights

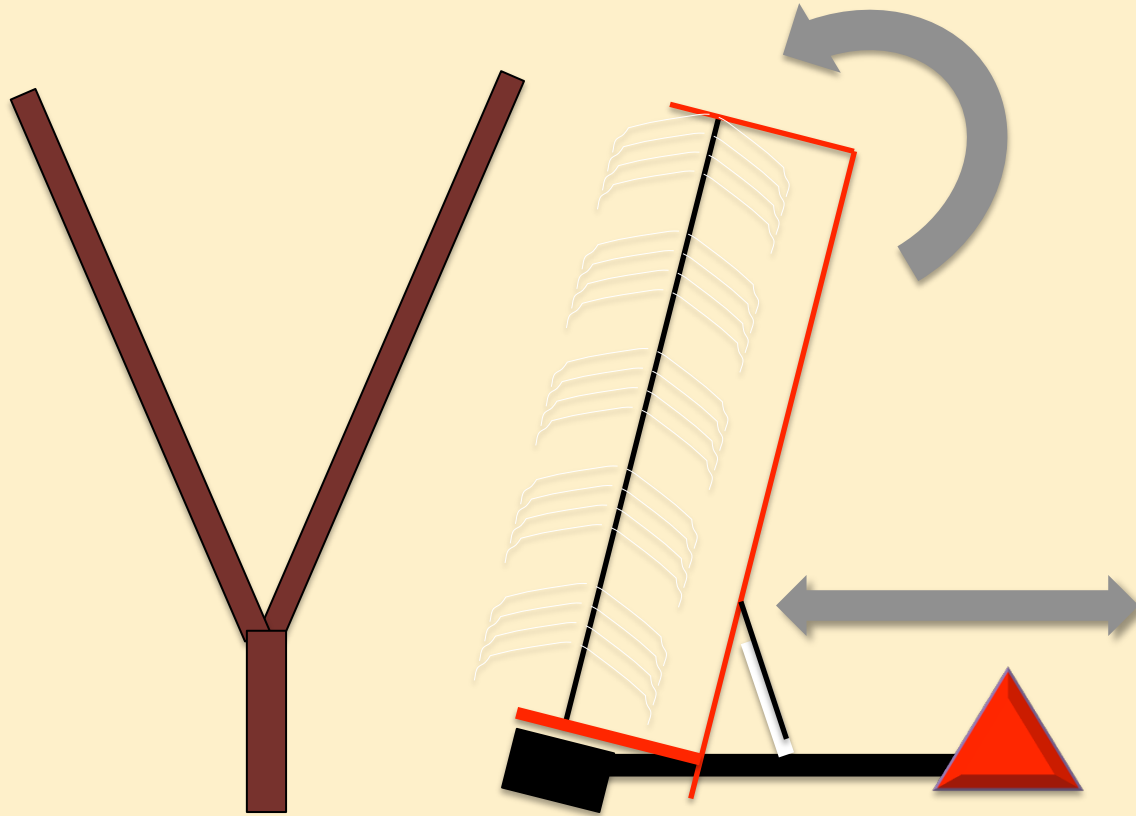


Autonomy
Controls

Joystick for
Tilt and
Offset

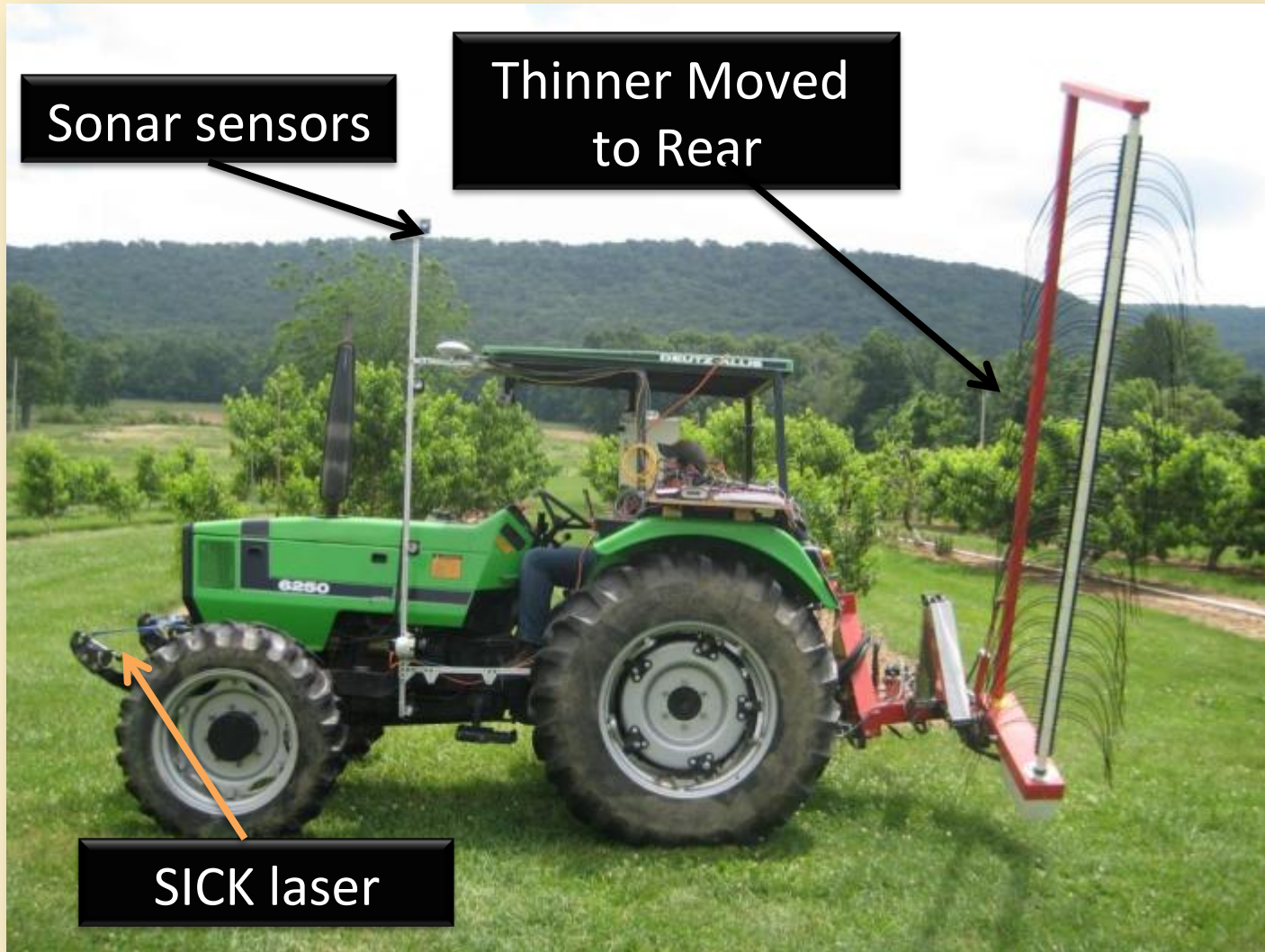
This is an interim step for providing easier manual positioning control

Controller adjusts the spindle accordingly



Two degrees of motion: angle of spindle, lateral position of spindle

Modifications:



hydraulics and
controls added



components:

**Lateral
Offset
Cylinder**

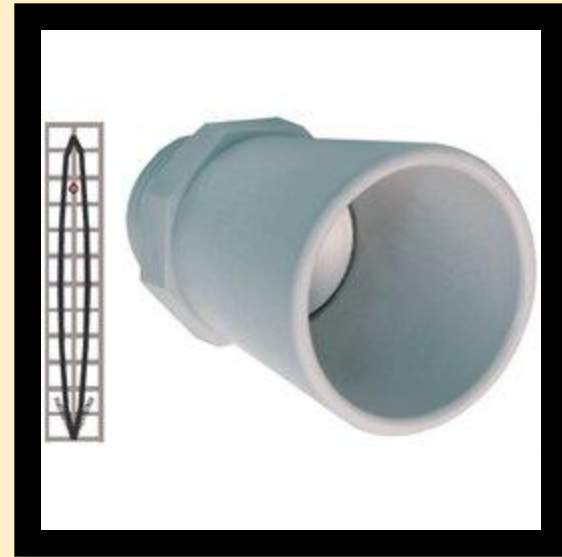
**Tilt
Cylinder**

**Proportional
Control
Valves**

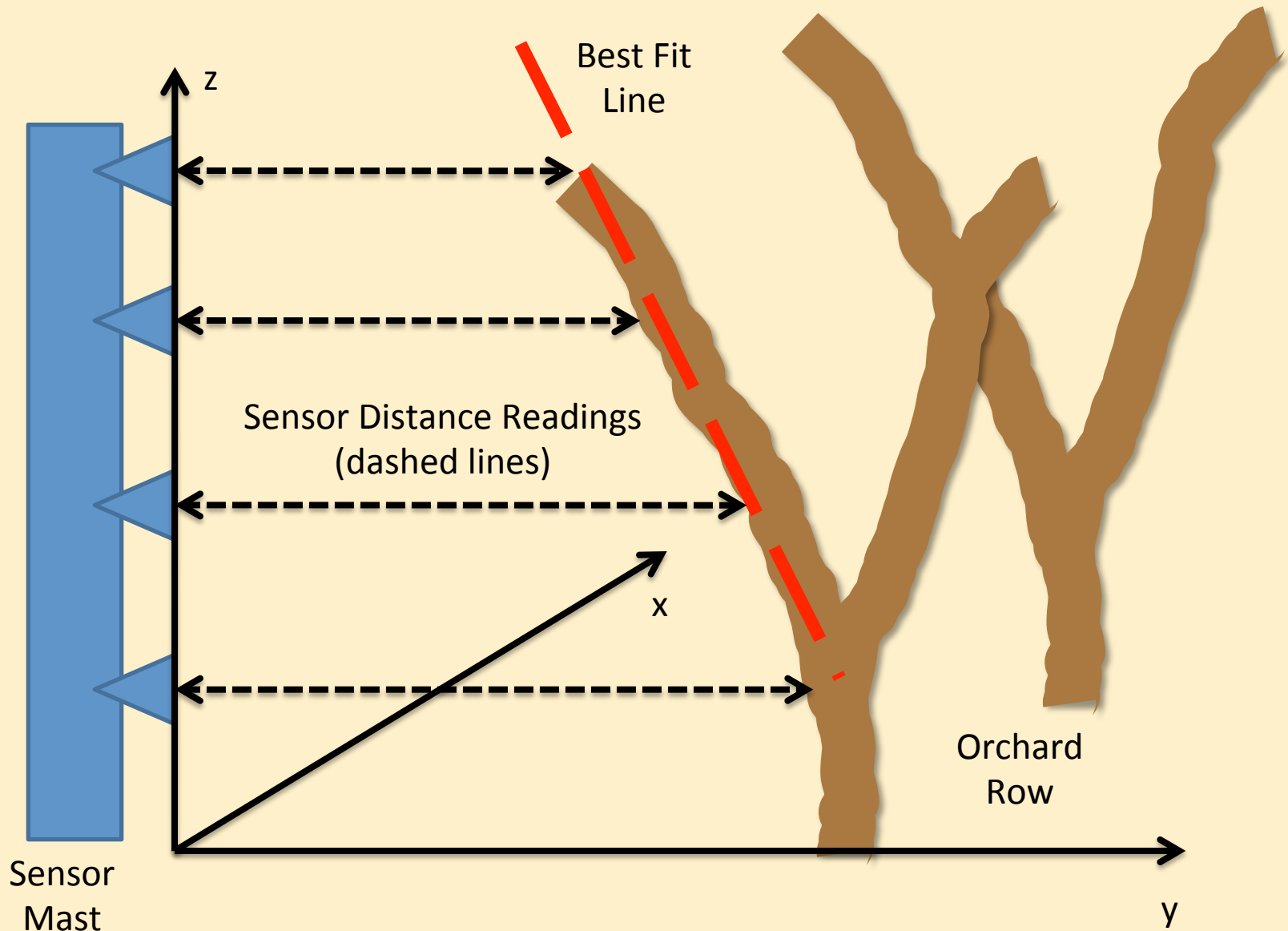
**Flow
Divider**

Ultrasonic Sensing

- Arduino Microcontroller
 - \$65
- 4 Sonar Range Finders
 - Maxbotix LV-MaxSonar-WR1
 - \$100
- Low Cost GPS
 - USGlobalSat EM-406A GPS Module
 - \$60



Ultrasonically Sensed Position



Laser Sensing

- Trimble AG GPS 442
- SICK LMS 120 Laser Rangefinder
- \$ thousands



Automated positioning



Thinning results from 2011 (controlled positioning)

% blossoms thinned

	Upper canopy	Lower canopy	Scaffold
Manually operated joystick	62.8 a	63.5 a	63.1 a
Ultrasonic controlled positioning	49.7 a	35.4 b	43.7 b
Laser controlled positioning	61.2 a	51.9 a	58.7 a


Blossom density, flowers/cm² cross-sectional area

	Upper canopy	Lower canopy	Scaffold
Manually operated joystick	3.9 a	1.3 a	3.6 a
Ultrasonic controlled positioning	4.7 a	2.7 b	5.8 a
Laser controlled positioning	4.7 a	1.9 a	4.8 a

Economic Evaluations



Commercialization – Matt Peters presentation



ESTABLISHED 1912


"The Canadian Fruit & Vegetable Specialists"

Beamsville, Ontario

1-800-263-1287

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Equipment & Parts



Mechanical Blossom Thinning


- INCREASE SIZE - - DECREASE LABOUR - - INCREASE YEILD -

The reduction of crop-load is a necessary practice in tree fruit production to promote the development of fruit that will meet or exceed market standards for size and quality. In order to be profitable, growers must meet these standards while maximizing yield and minimizing labour costs.


It is a well-known concept that the earlier in the season that crop-load can be managed, the more energy is available to store in a potentially marketable fruit. When there are less fruit demanding energy from the tree, the fruit become bigger and of higher quality.

Mechanical blossom removal by the "Darwin" or "PT" will achieve these goals.

PT Model



Darwin Model



Links to Videos (click on link to watch video)

- [Fruit-Tec Page](#)
- [About Fruit-Tec](#)
- [Technical Specs](#)
- [Trial Results](#)
- [Dealers](#)
- [Links](#)
- [Fruit-Tec Website](#)

Challenges and Limitations

- Non-selective thinners work well with stone fruit, but major challenges with pome fruit
- Mechanization of selective thinning is an extremely complex task
 - Locating branches, blossoms, 2-D and 3-D
 - Mobility of robotic in field
 - Cost of robotic approach
 - Speed of activity

Funded by the USDA SCRI Program
Washington Tree Fruit Research Commission
California Canning Peach Association
State Horticultural Association of PA
Pennsylvania Department of Agriculture
and the support of many commercial growers!



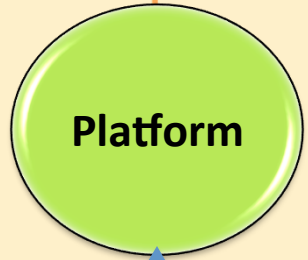
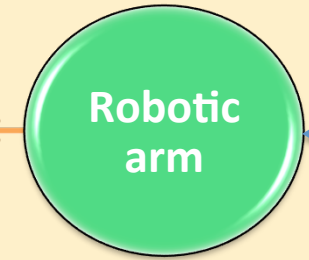
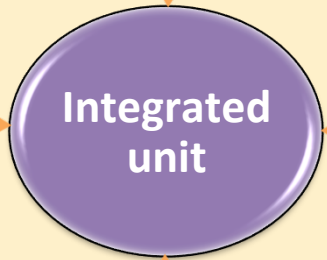
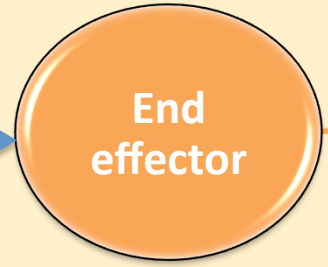
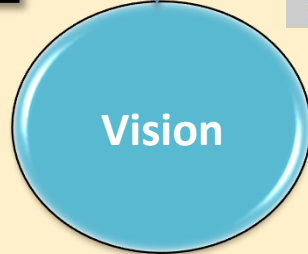
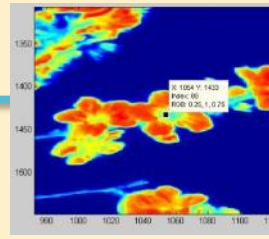
Specialty
Crop
Research
Initiative

Innovative Technologies for Thinning of Fruit



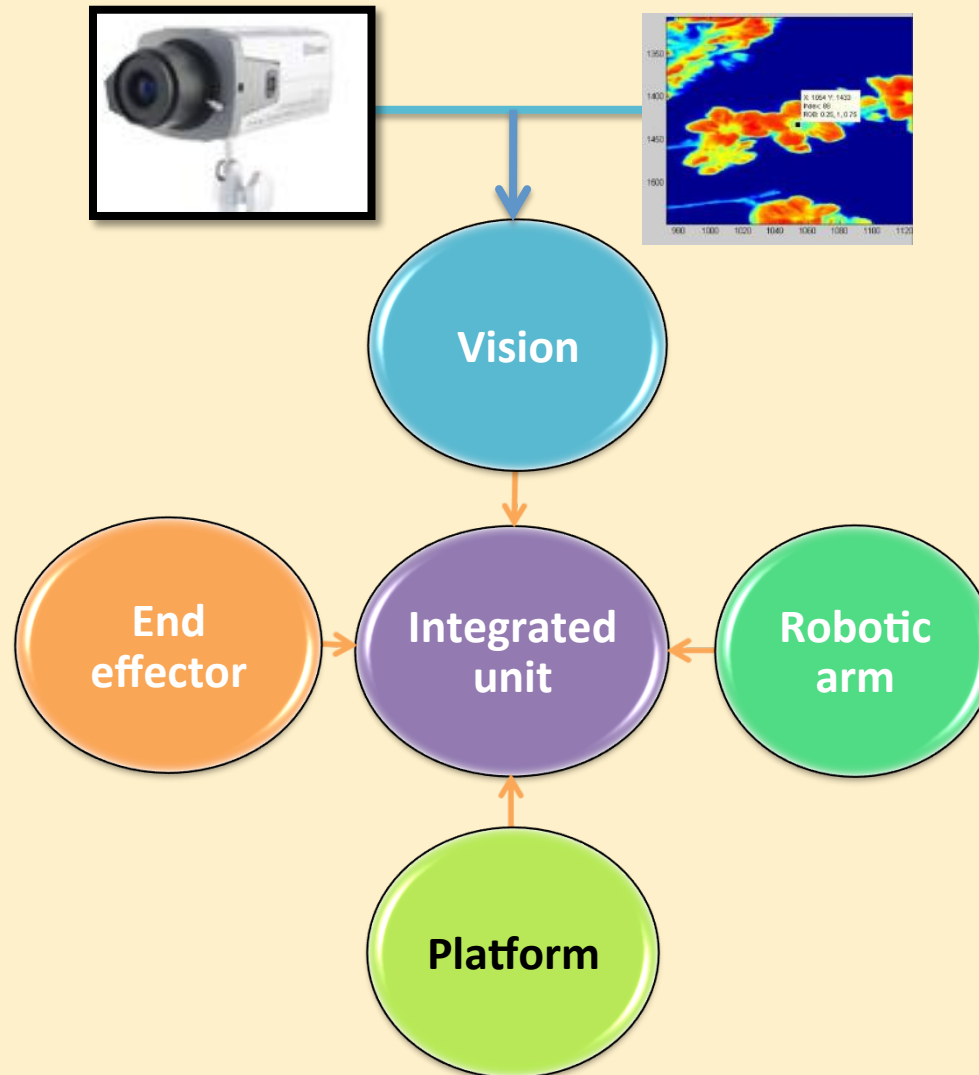
Selective Thinning

Select blossoms/small fruit to be removed for higher precision in thinning using machinery



Components

Vision system



Projected texture in 2010

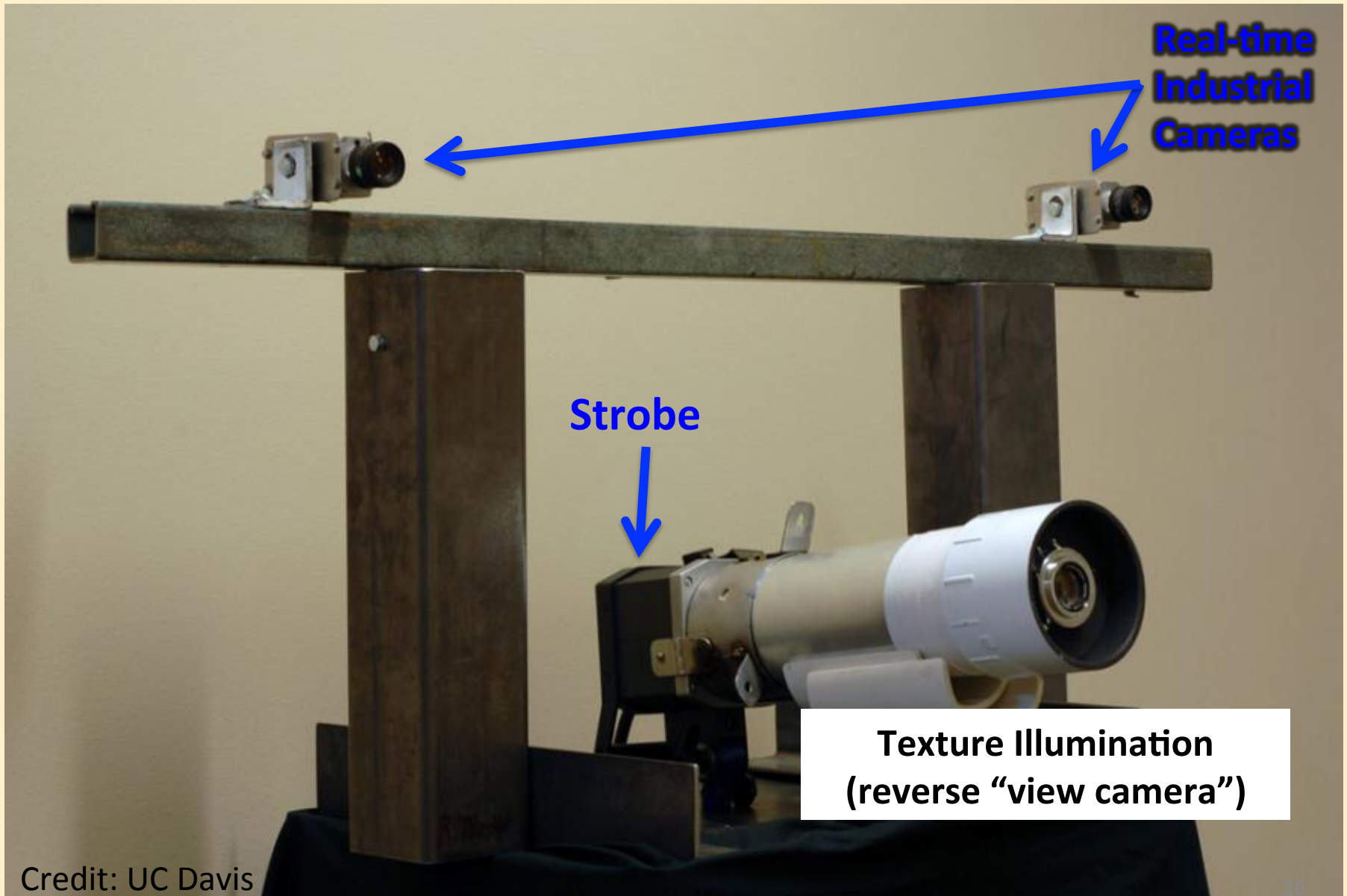


2009: White Light



2010: Textured Light

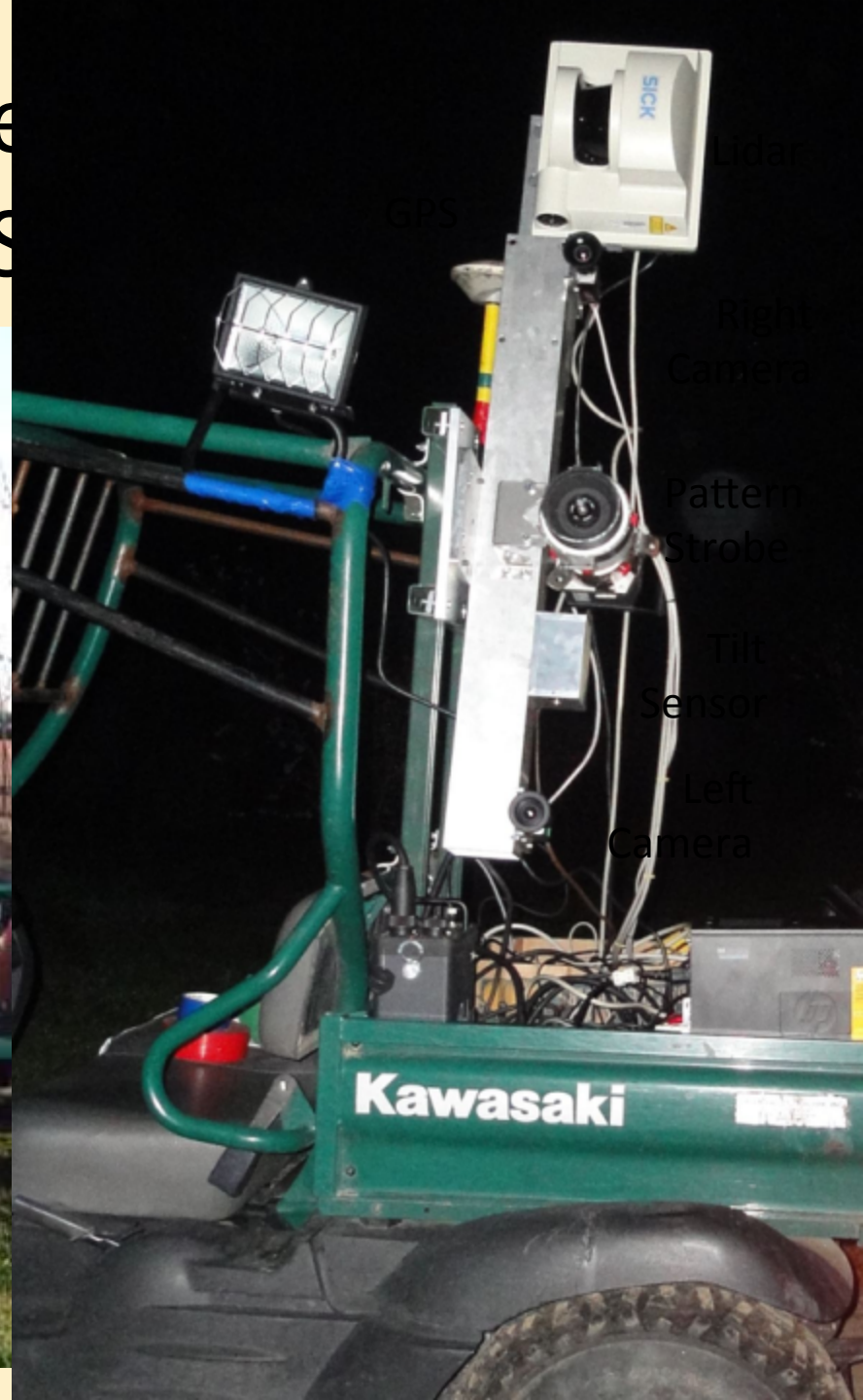
2011 System: Real-time acquisition



Real-time 3D Tree Mapping System

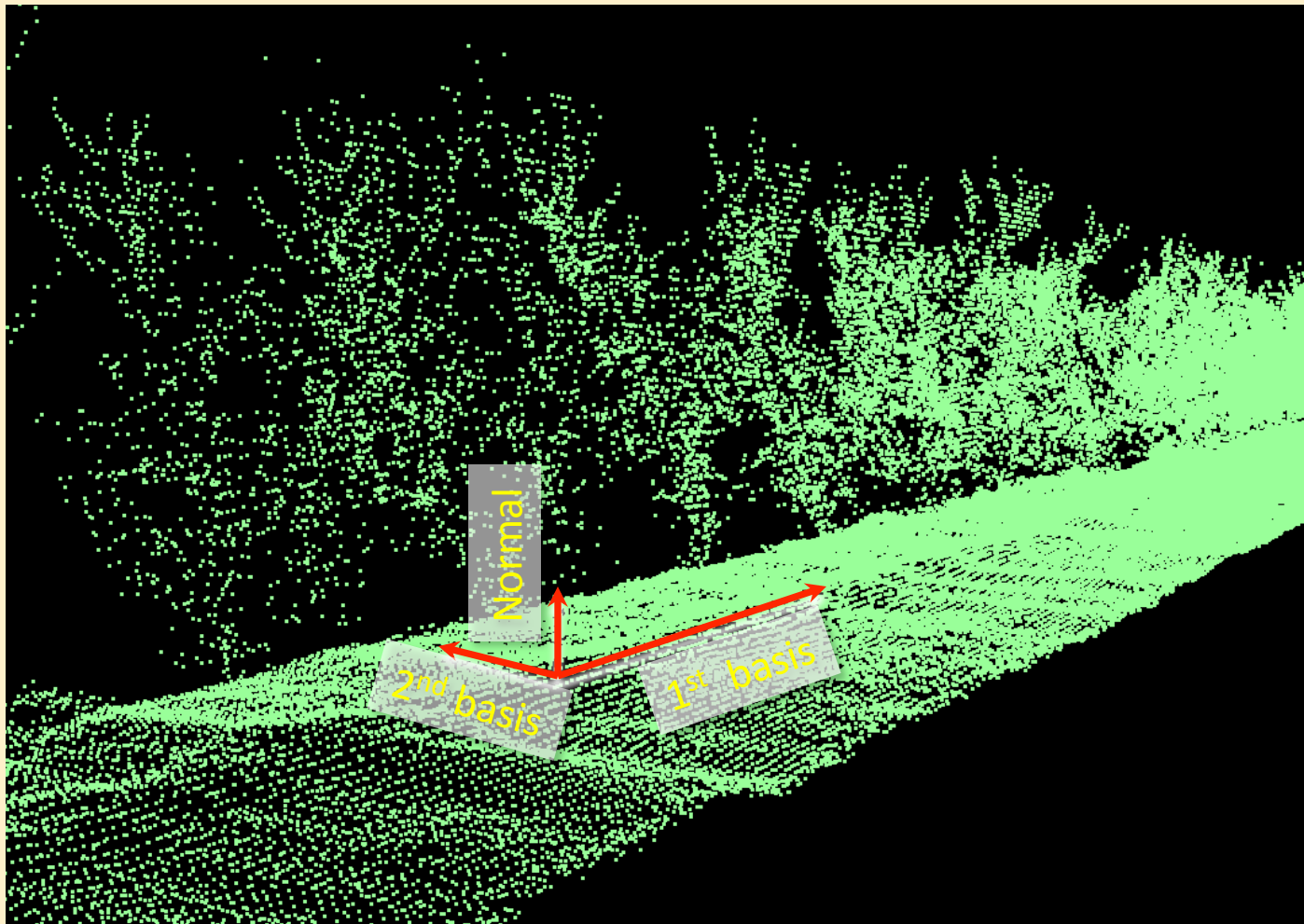


Credit: UC Davis

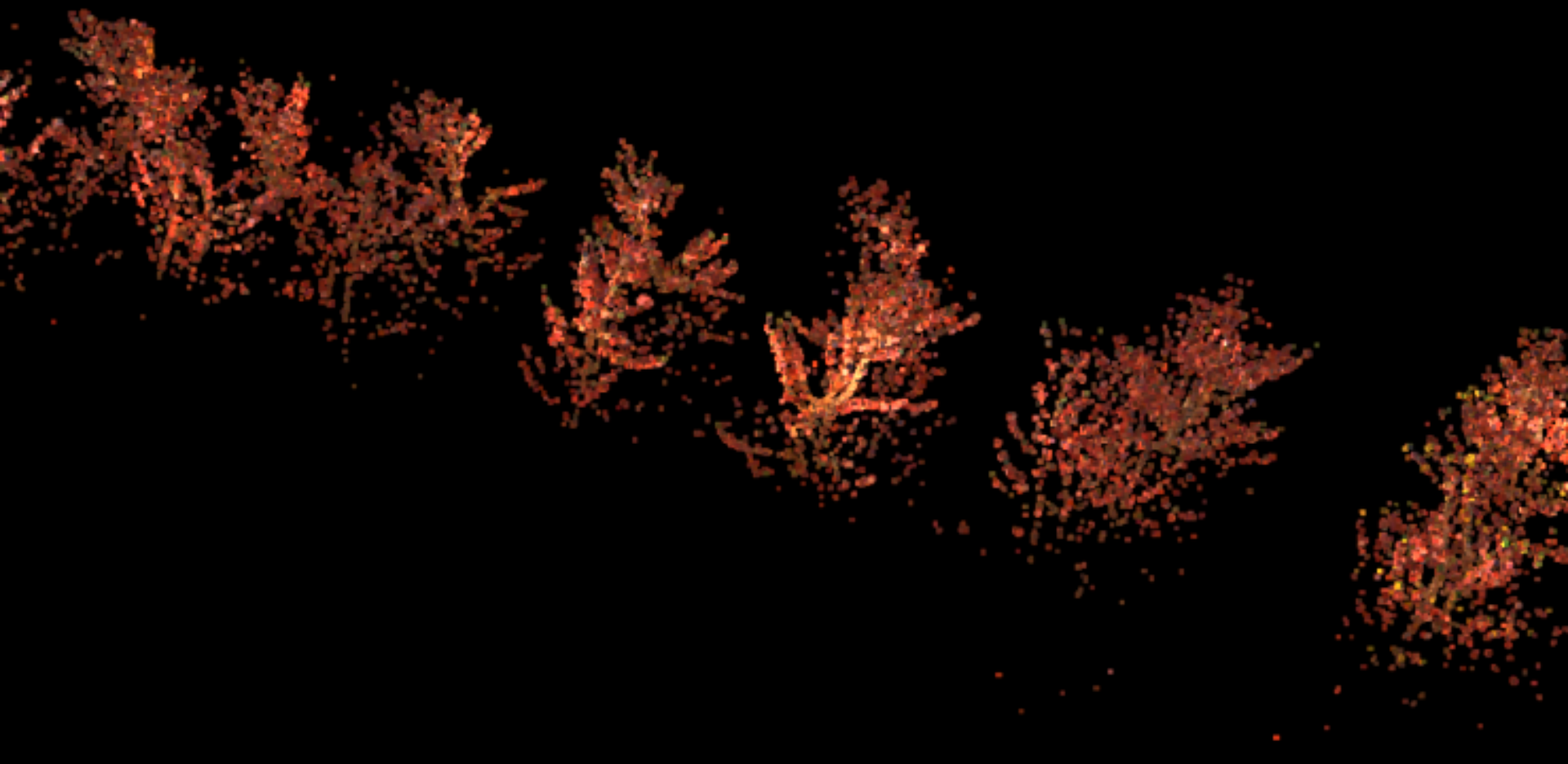


- LiDAR
- RTK
- Camera
- Pattern
- Strobe
- Tilt
- Sensor
- Left
- Camera

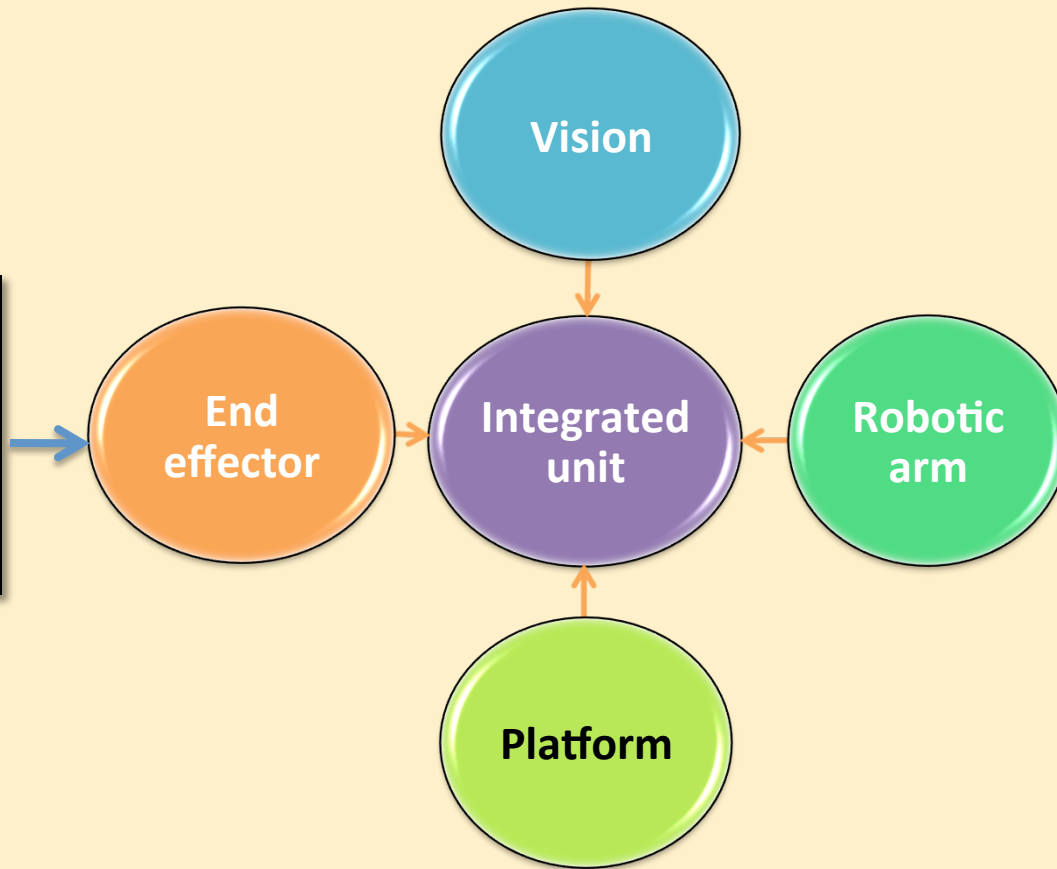
Processing the LIDAR points



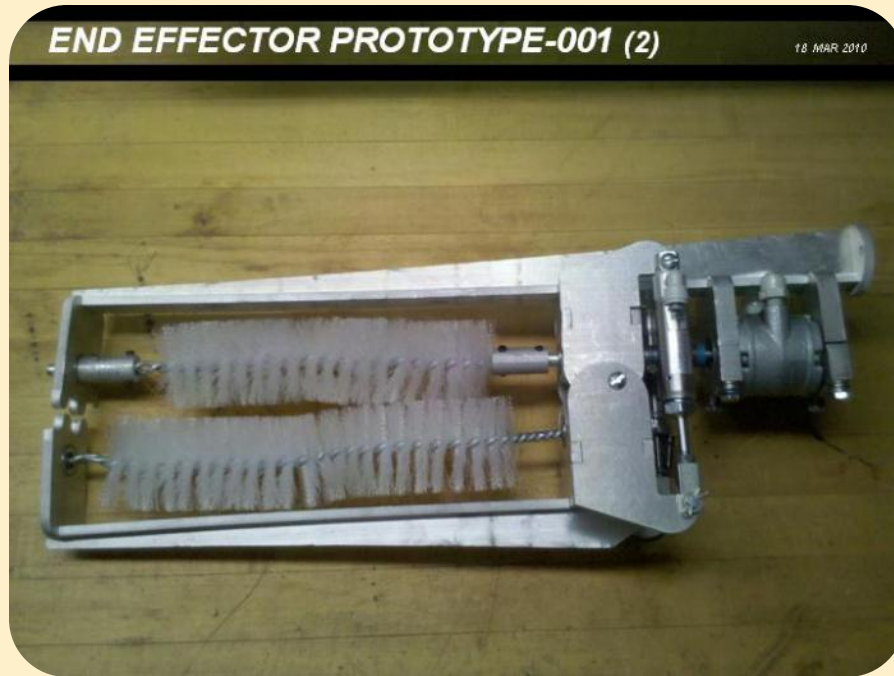
Credit: UC Davis



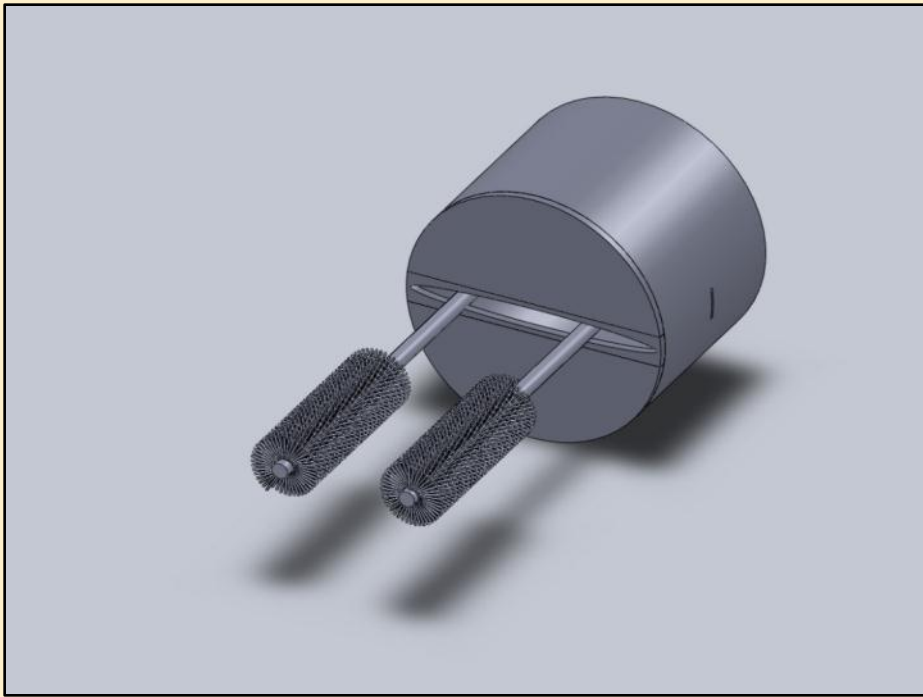
End effector



Brush end effector fabricated



Reuben Dise & David Lyons



End-Effector

2nd Generation Brush End-Effector

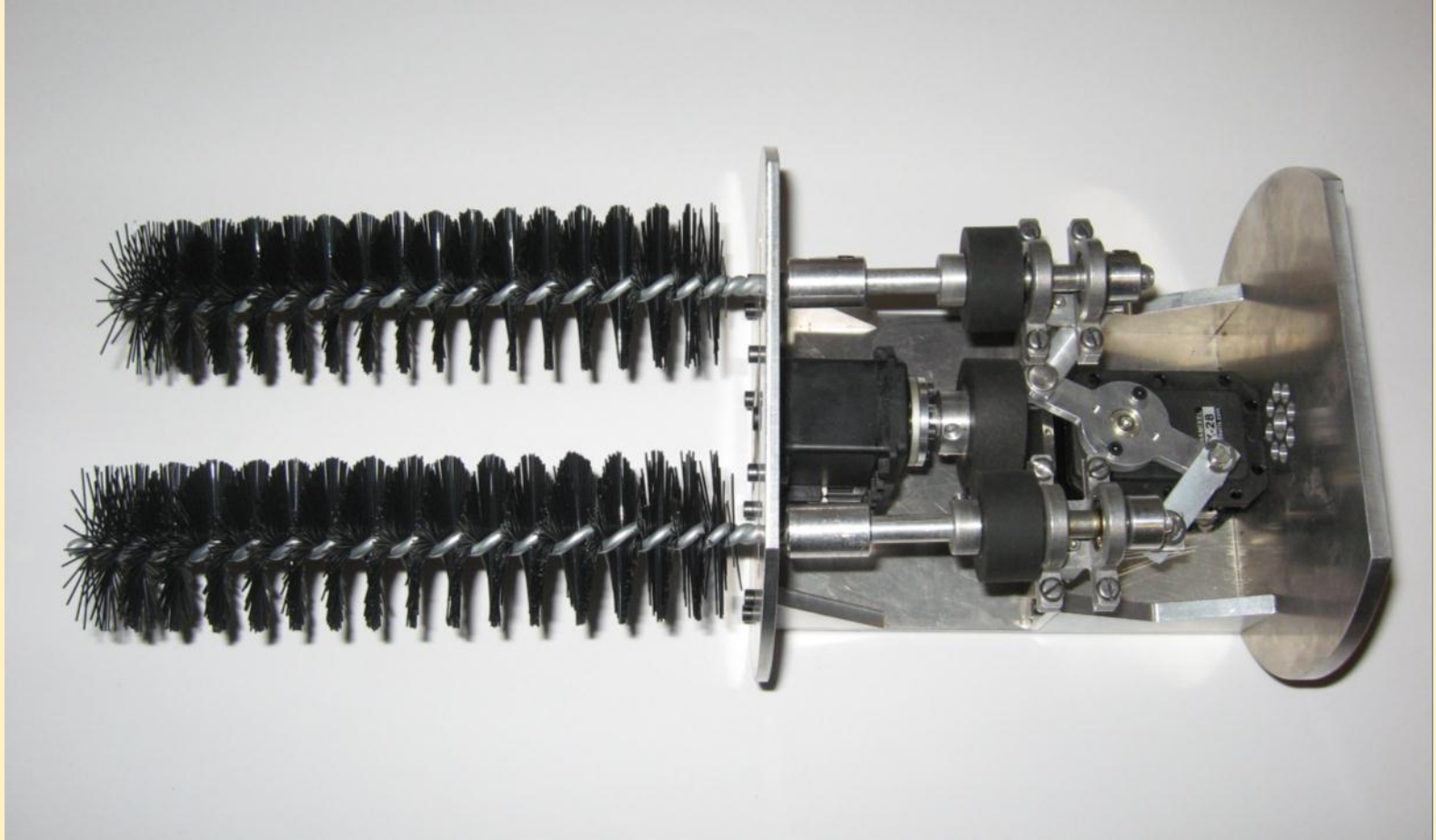
Improvements

Electric powered

Shorter Brushes

Softer Brushes

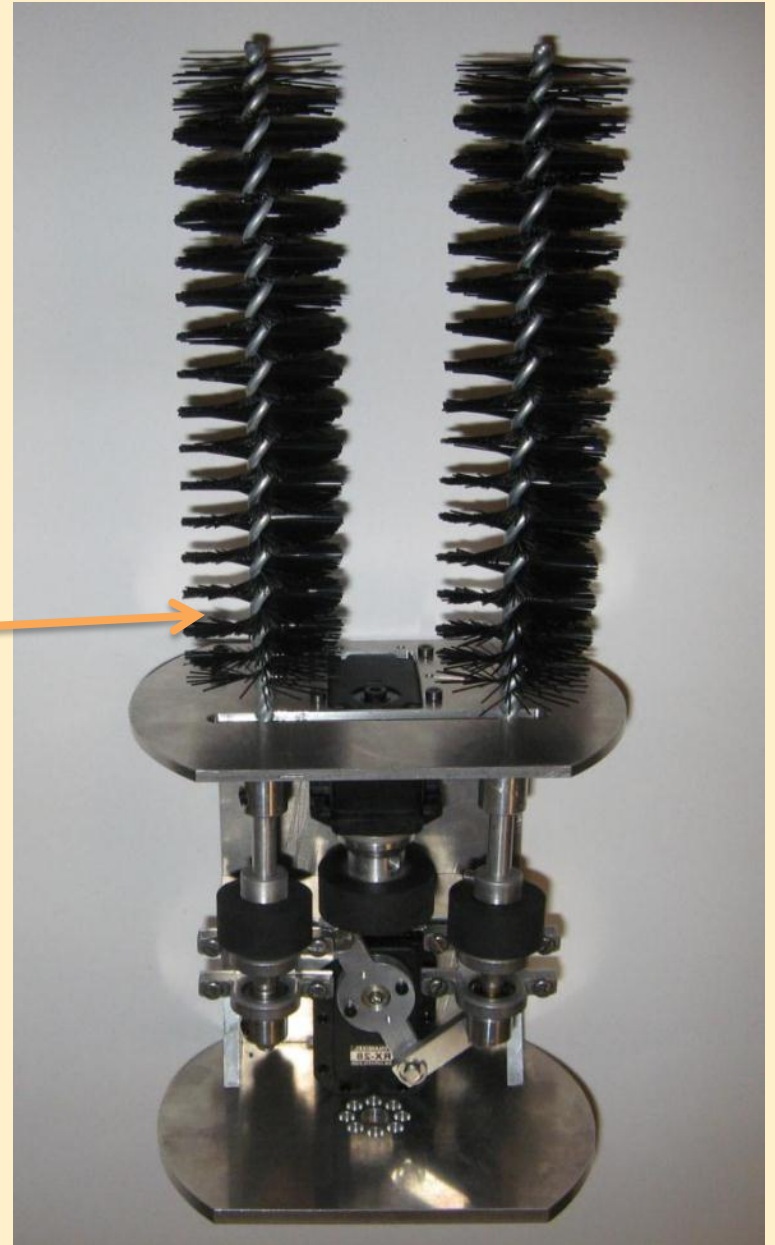
Brush end effector fabricated



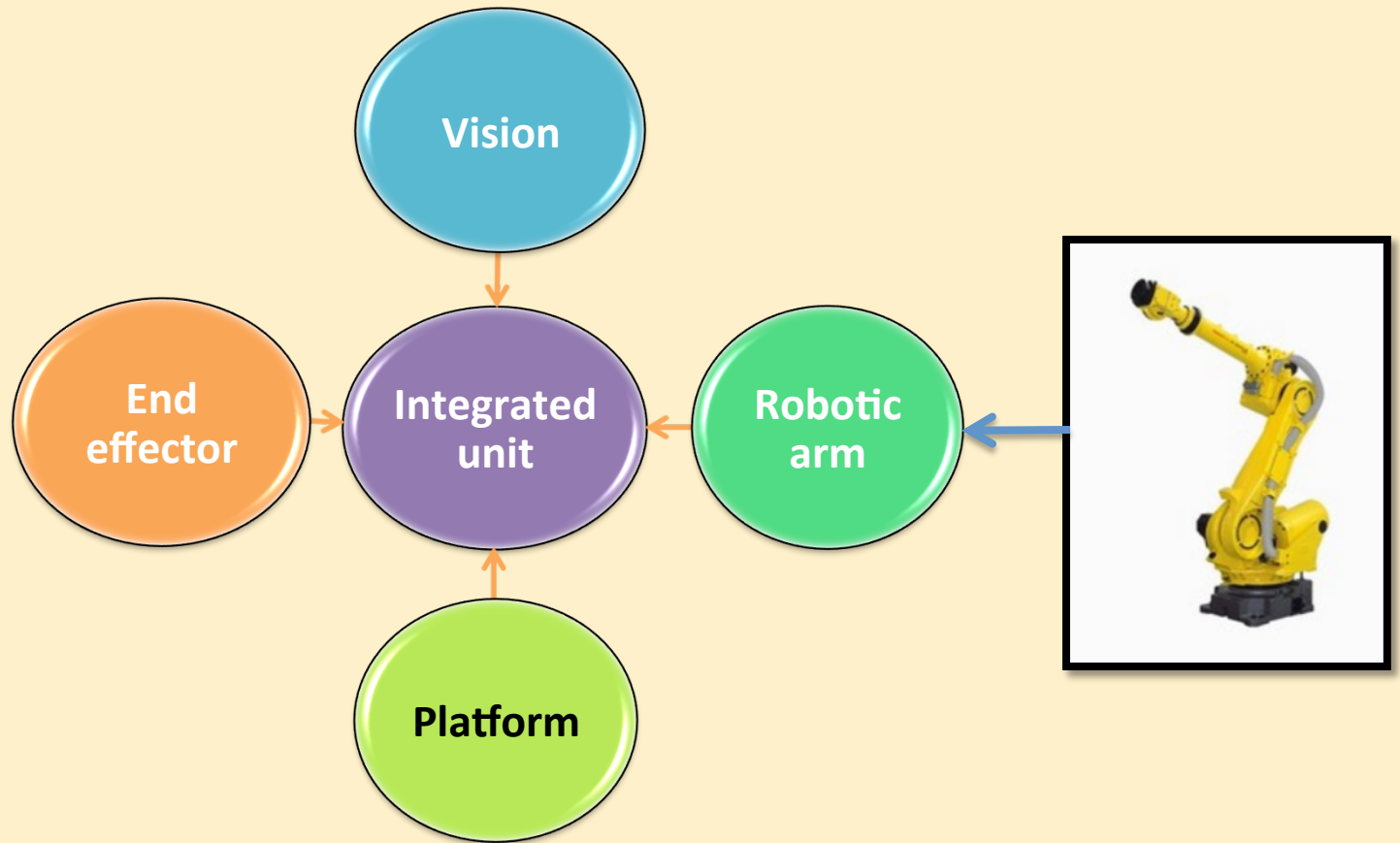
David Lyons

Counter-rotating brushes

Open/close based on
the position along
branch



Robotics

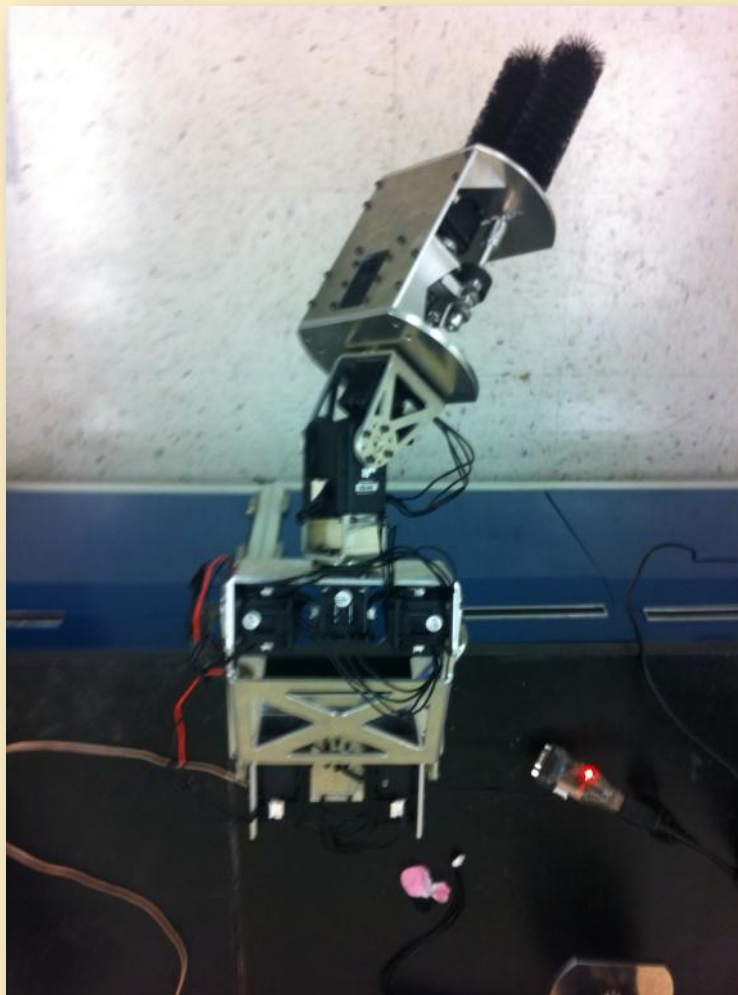
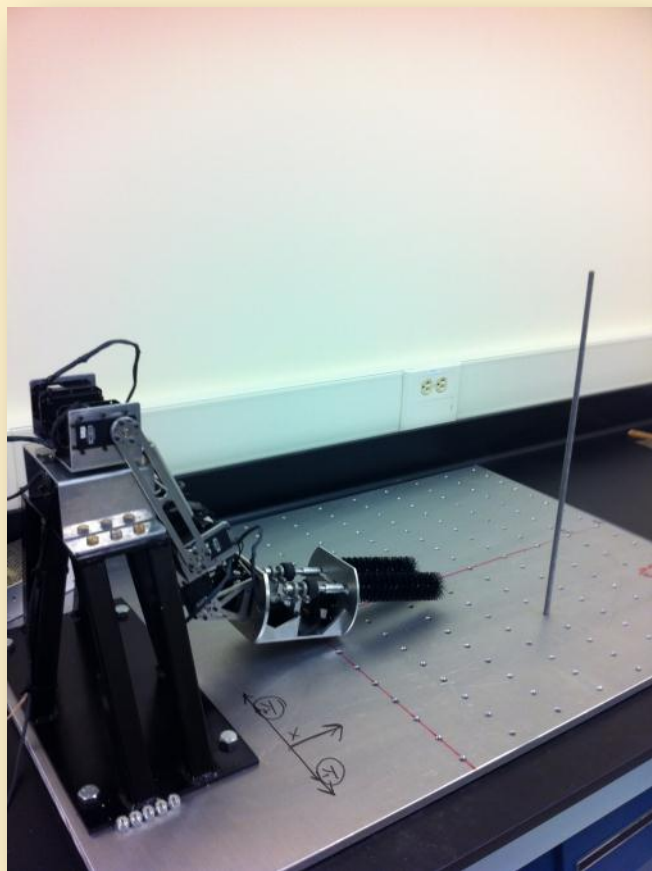


Could not gain external control of the
Fanuc unit



Fabricating components for lab unit

$\frac{1}{4}$ - scale robot designed and fabricated



David Lyons

Thank You!

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State Horticultural Association of PA
Pennsylvania Department of Agriculture
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Questions?



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