Feeding the World Through Embedded Vision

Travis Davis
September 2020
Overview

• John Deere Background
• What makes our solution space challenging (but awesome)
  • Hardware Examples
  • Solution Examples
• Production Considerations for Embedded Vision and Machine Learning
• Key Takeaways
• Q&A
About John Deere

GLOBAL GROWTH

Agriculture Equipment

Turf Equipment

Construction Equipment

Forestry Equipment

COMPLEMENTARY
What makes our solution space challenging?
Hardware Topics
John Deere Embedded Vision Hardware

Monocular Camera

Stereo Camera

Grain Quality Camera

Vision Processor
John Deere Testing – Dust Testing
John Deere Testing – Cold Water “Splash”
John Deere Testing – Vibration Test Example
(Early Result – obviously fixed for production)
John Deere Testing – Vibration Test Example
(Early Results – obviously fixed for production)
John Deere Temp Testing – Test Examples
(Early Results – obviously fixed for production)
What makes our solution space challenging?
Solution Examples
Challenging Solution Examples – Combine Advisor
Which Crop Types Are These?

Wheat – Different Genetics or Growing Conditions
Challenging Solution Examples – Combine Advisor

Segmentation → Segment Features

Input Image → Patch Features

Camera → Filtering → Calibration Function

Feature Sampler → Probability Aggregation → % Weight Estimates

Classifier

Classifications

Clean

MOGH

…

MOGL

…

Broken

…

Unthreshed
Challenging Solution Examples – Combine Advisor
Harvesting in Standing Water
Challenging Solution Examples – Combine Advisor
Harvesting in Standing Water
Challenging Solution Examples – Combine Advisor

Weed Seeds
Challenging Solution Examples – Active Fill Control
Trailer Varieties
Production Considerations for Embedded Vision or Machine Learning Technologies
Production Journey Image Processing Challenges – Examples
Image Quality Issue – Can you spot it?
Production Journey Image Processing Challenges – Examples
Can you spot the difference?

LED Bin “A”

LED Bin “B”

LED Bin “C”

LED Bin “D”
Production Journey Image Processing Challenges - Examples
Vibration Impact on Performance if not Addressed Appropriately
Production Journey Image Processing Challenges – Examples
Vibration Impact on Performance if not Addressed Appropriately

R4038
Welded Cradle
New Isolator Bracket
2200 RPM
Key Take-Aways

- Commercializing Image Processing & Machine Learning Is Orders Of Magnitude Harder Than Doing a Demonstration
  - Always Consider Your Environment that the Solution Needs to Operate & How You Communicate When It’s Not Expecting to Operate
  - Hard Decisions Will Need to Be Made to Choose Between Application Performance and Long Term Performance
  - Choose an Image Processing or Machine Learning Design For Future Robustness
- Commercialization of Image Processing and Machine Learning Solutions Require High Levels of Consistency of Various Components
- John Deere is Helping to Feed the World Using Image Processing and Machine Learning (It’s an awesome place to be!)
Key partners on project examples:

- National Robotics Engineering Center (NREC)
- Carnegie Mellon University
- Iowa State University

2020 Embedded Vision Summit

“Feeding the World Through Embedded Vision”

Various hardware and component suppliers