Hardwood Lumber Grading and Process Evaluation System Test Results (Best Lumber Uses)

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Our test Scanning System and some of the Authors

Why conduct the hardwood lumber scanning R&D?

- For many reasons

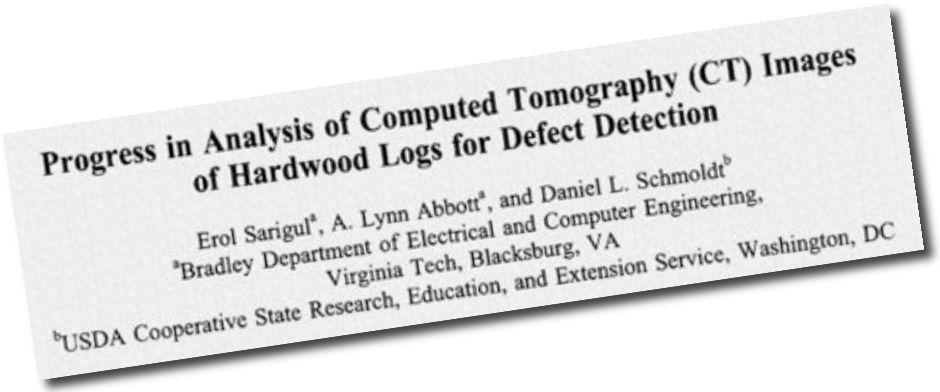
Jonathan Martin (major sawmill owner) stated at a Hardwood Manufacturers Convention that …

- On scanning and grading lumber … things will change the minute we can have a machine to accurately grade the product (lumber) and bar code it and designate a best application … molding, furniture, flooring or whatever …

Our Blacksburg based research team has been trying to address the industry needs …

Some results of our previous research -- General Advanced Processing Papers

Advanced Hardwood Log Processing – CT Scanning Related



Progress in Analysis of Computed Tomography (CT) Images of Hardwood Logs for Defect Detection

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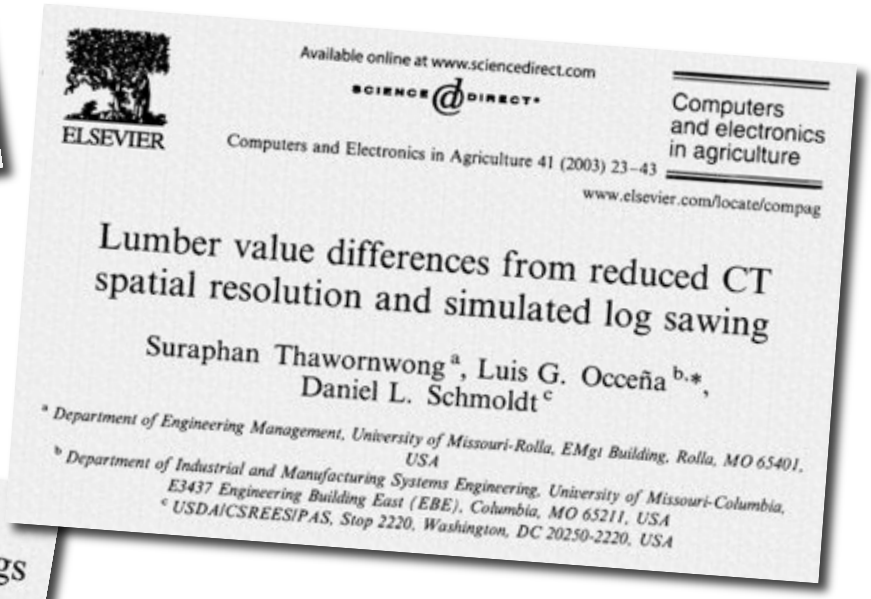
[a]Bradley Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, VA
[b]USDA Cooperative State Research, Education, and Extension Service, Washington, DC



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Computers and Electronics in Agriculture 41 (2003) 23–43

Computers and electronics in agriculture

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Lumber value differences from reduced CT spatial resolution and simulated log sawing

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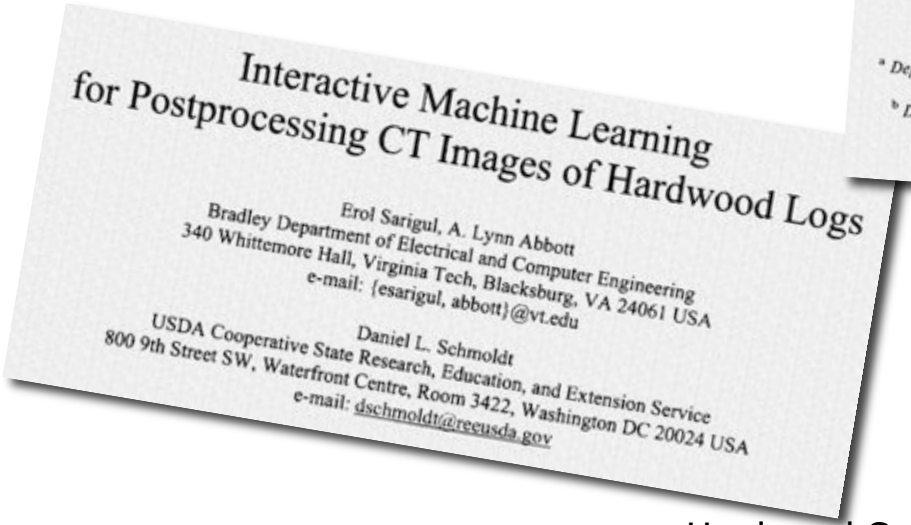
[c] USDA/CSREES/PAS, Stop 2220, Washington, DC 20250-2220, USA



Interactive Machine Learning for Postprocessing CT Images of Hardwood Logs

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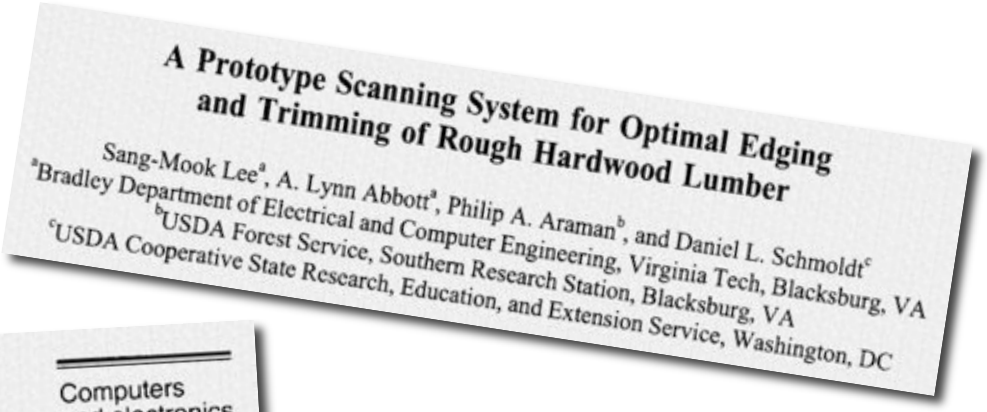
Advanced Hardwood Lumber Evaluation & Processing – Surface and Internal Scanning



A Prototype Scanning System for Optimal Edging and Trimming of Rough Hardwood Lumber

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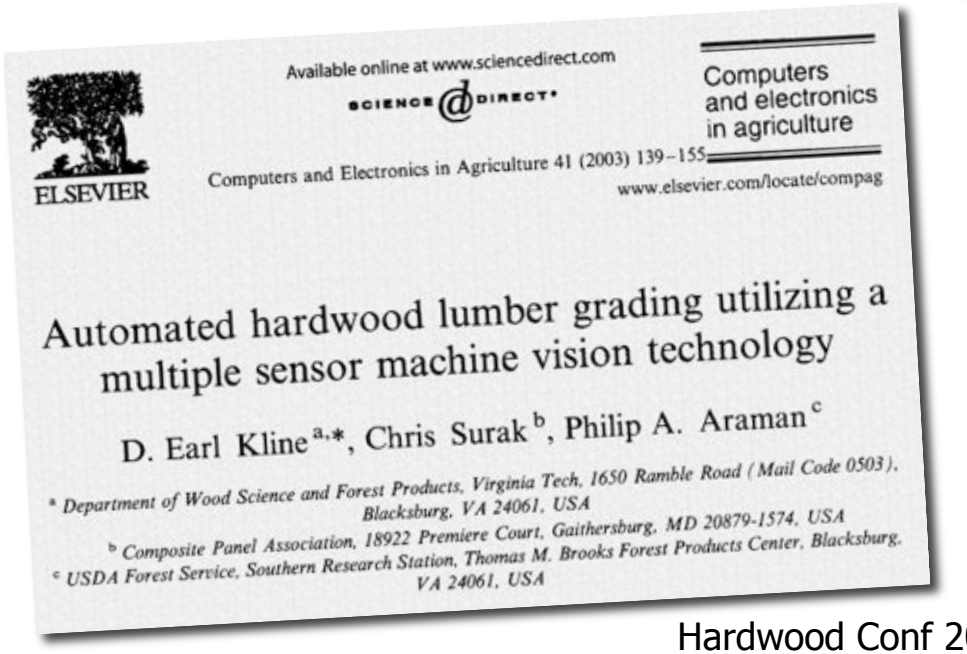
[a]Bradley Department of Electrical and Computer Engineering, Virginia Tech, Blacksburg, VA
[b]USDA Forest Service, Southern Research Station, Blacksburg, VA
[c]USDA Cooperative State Research, Education, and Extension Service, Washington, DC



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Computers and Electronics in Agriculture 41 (2003) 139–155
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Automated hardwood lumber grading utilizing a multiple sensor machine vision technology

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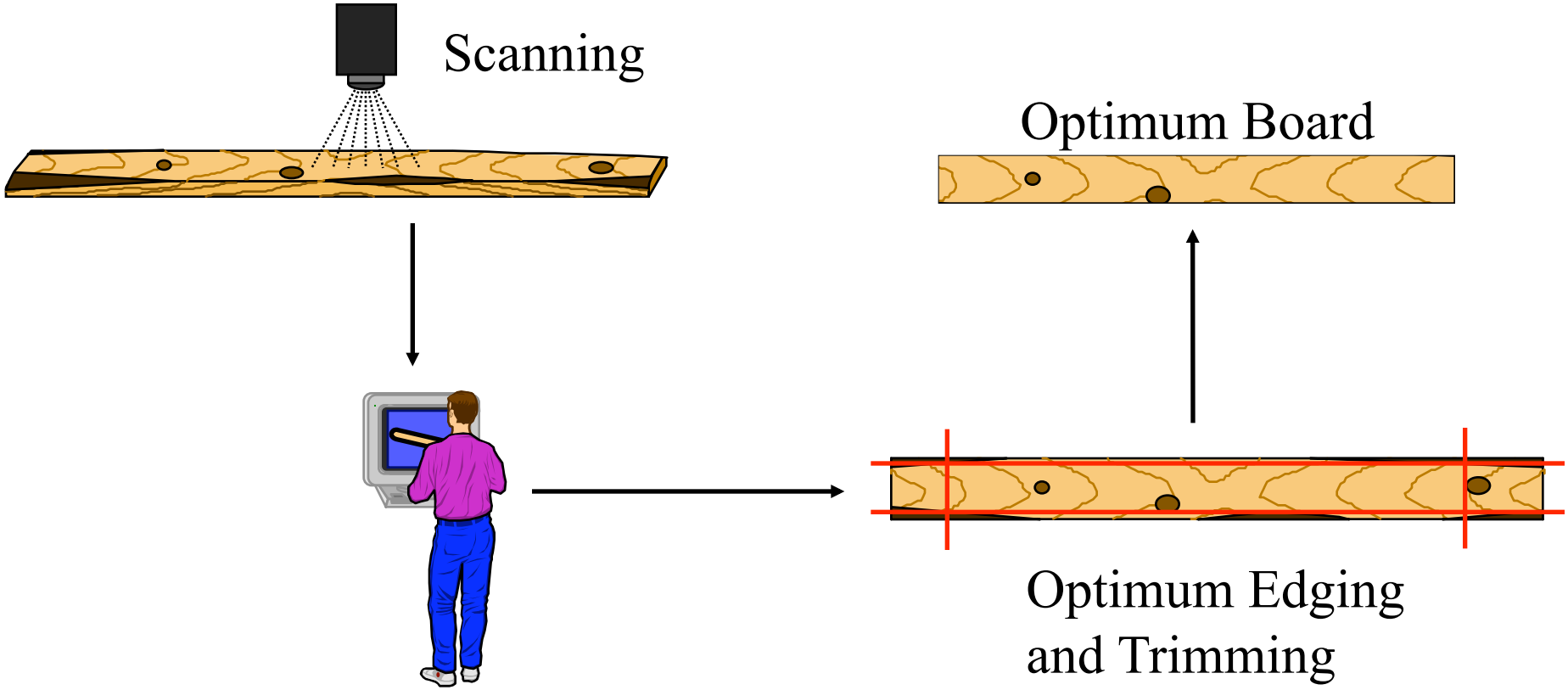
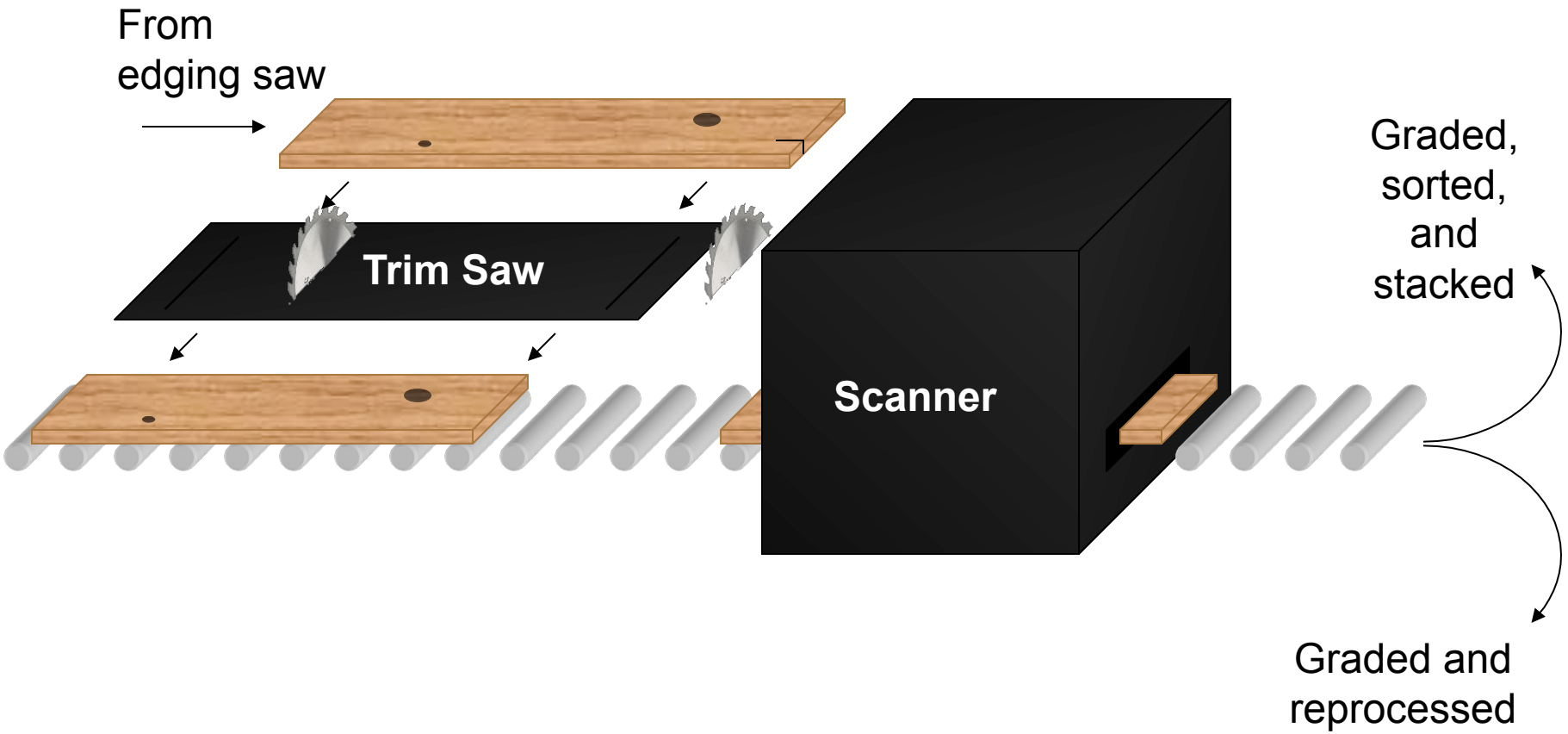
[b] Composite Panel Association, 18922 Premiere Court, Gaithersburg, MD 20879-1574, USA
[c] USDA Forest Service, Southern Research Station, Thomas M. Brooks Forest Products Center, Blacksburg, VA 24061, USA

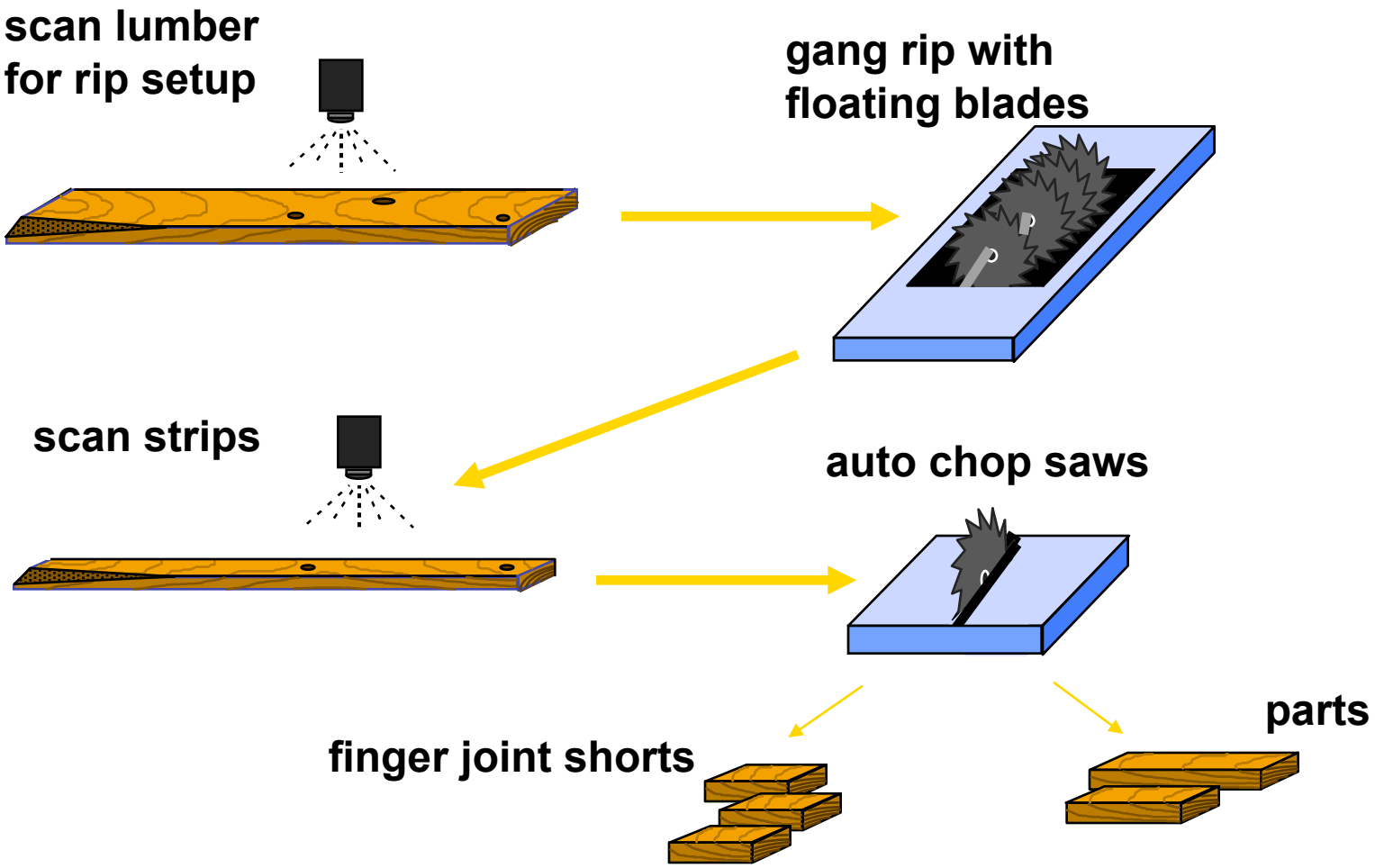
We reported on our Scanning & Computer Software Efforts at Scanning Conferences



Our current efforts that we will report on today deal with testing of a system to Automate Hardwood Lumber Grading and Predict Cuttings or Uses

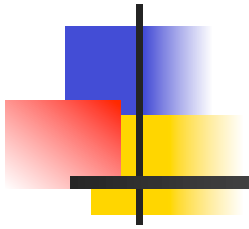


We simulate cutting yields and best lumber uses with ROMI software



Best Hardwood Lumber Uses … (yield/ value)

- Furniture
- Cabinets
- Flooring
- Mouldings
- Dimension
- Fixtures
- Export



Motivation

- Hardwood sawmills:
  They have limited graders and need to reduce costs and improve marketing

- Lumber purchasers:
  - Need to grade lumber to validate purchases
  - Need to best utilize lumber
  - Need to reduce costs

Rough lumber presents special problems – so we started with surfaced lumber

Surfaced lumber

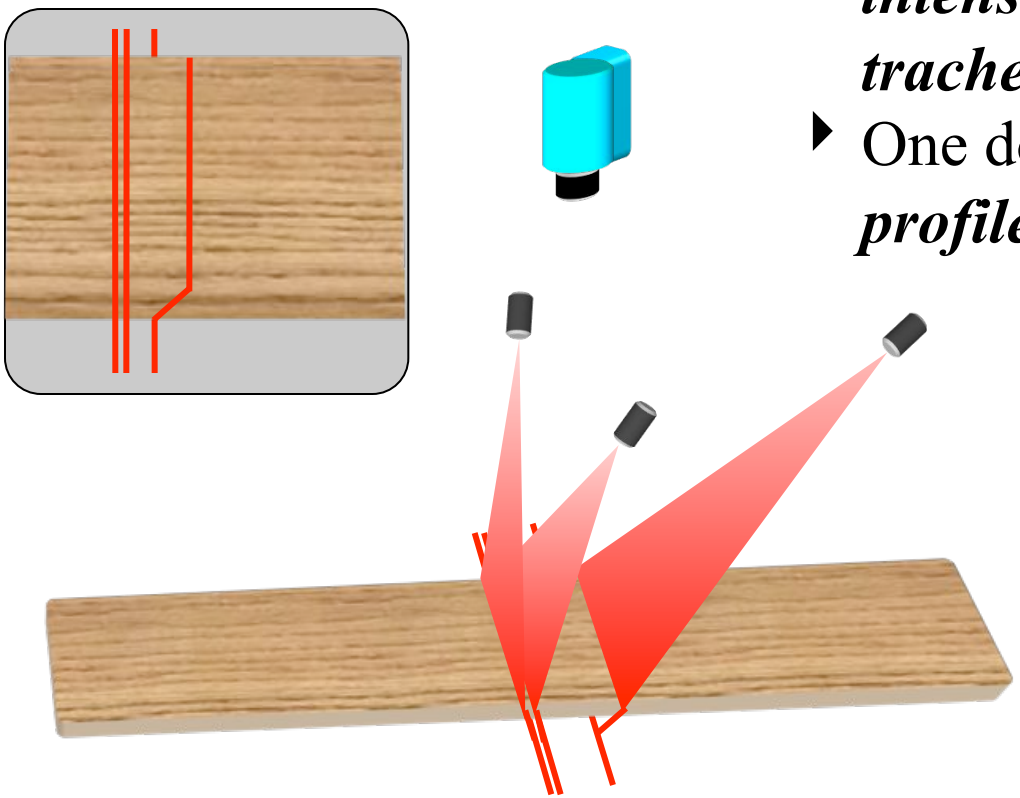
Rough lumber

Current study

- Our **prototype scanning system**
  - Designed for rough or surfaced lumber
  - Scans boards using lasers, video camera, PC
  - Detects wane, clear wood, defects
  - Interfaces with E/T and grading software
  - ROMI software used to predict cuttings
  - Focus on hardwood
  - Defect types: wane, holes, decay, knots, voids/splits

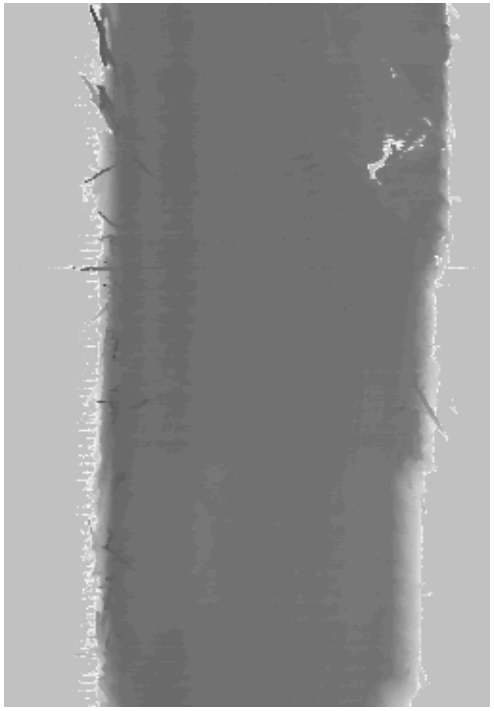
Image acquisition

3 image types

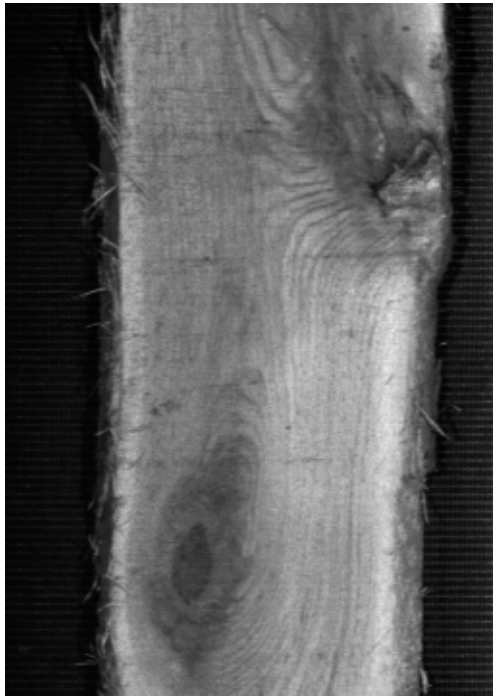


- Two side lasers for ***intensity*** and ***tracheid*** images
- One downboard laser for ***profile*** Image

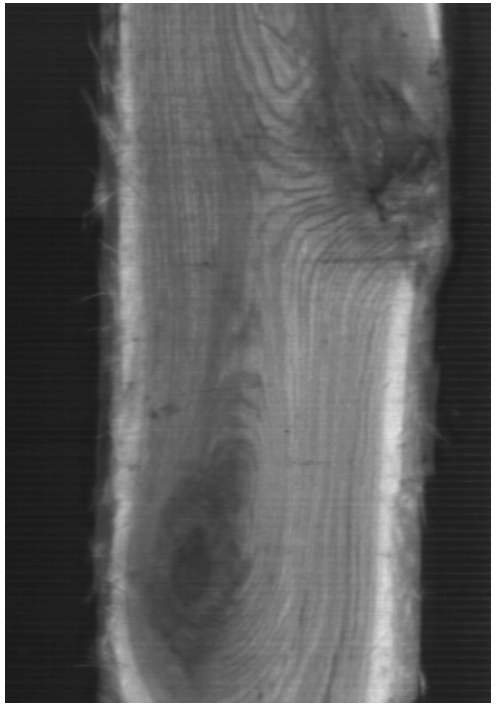
Example images



Profile image



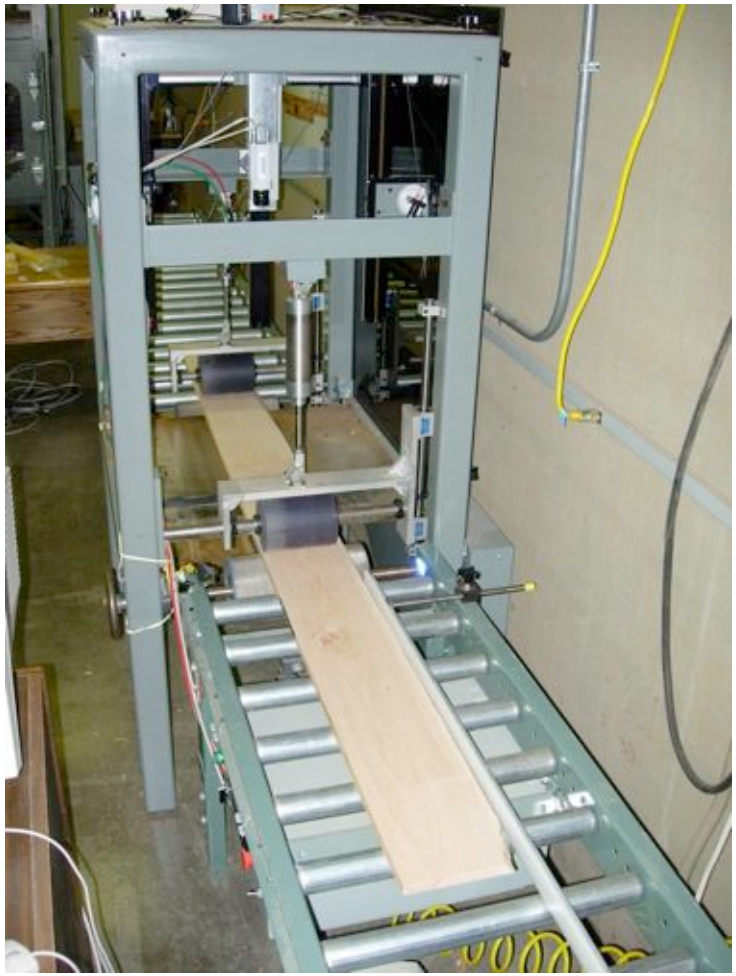
Intensity image



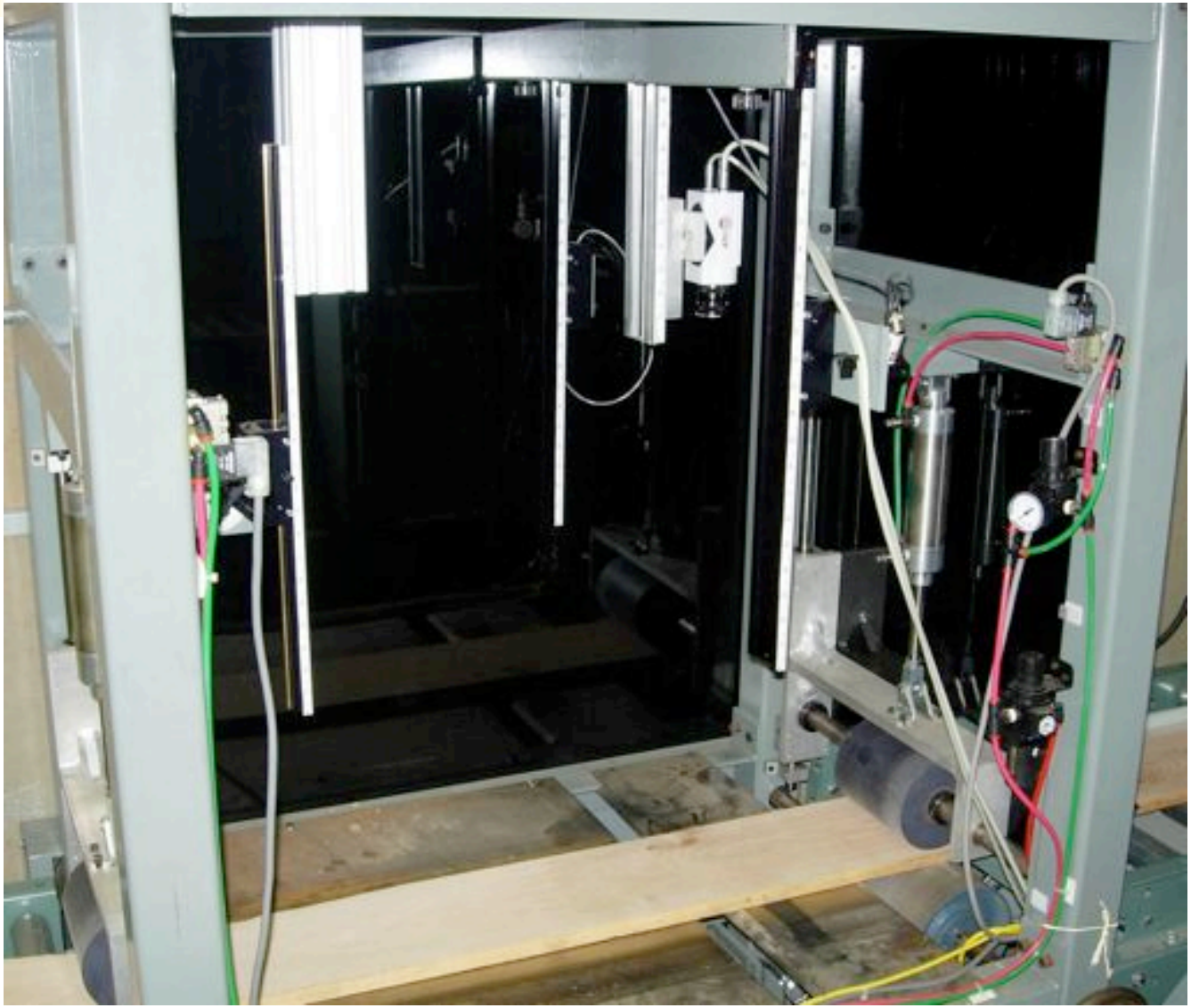
Tracheid image

Dark cover reduces ambient light

Close view, without the cover



Camera & laser sources

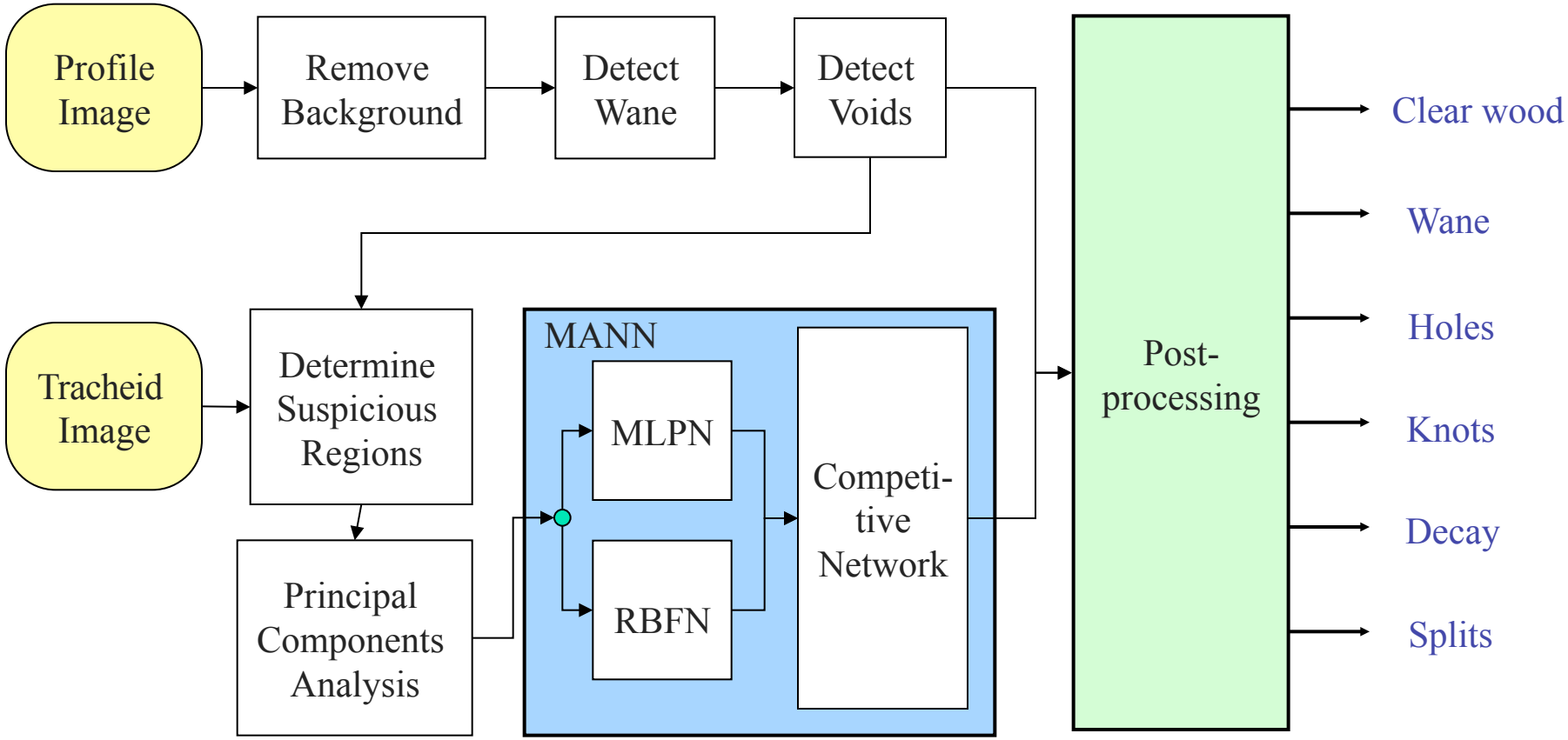


IVP Ranger M50

Technical specifications

- Performance : Over 10,000 profiles / sec
- Profile width : 1536 height values
- Sensor size : 1536x512 pixels
- Camera to PC : Up to 50 m/150 ft
- High speed link: 330 Mbit/s
- I/O : 5 in, 1 out, TTL, RS 232
- Size : 97x50x50 mm/ 3.82x1.96x1.96 in
- Weight: 380 gram/3,4 oz
- Power : 12-24 Volt DC

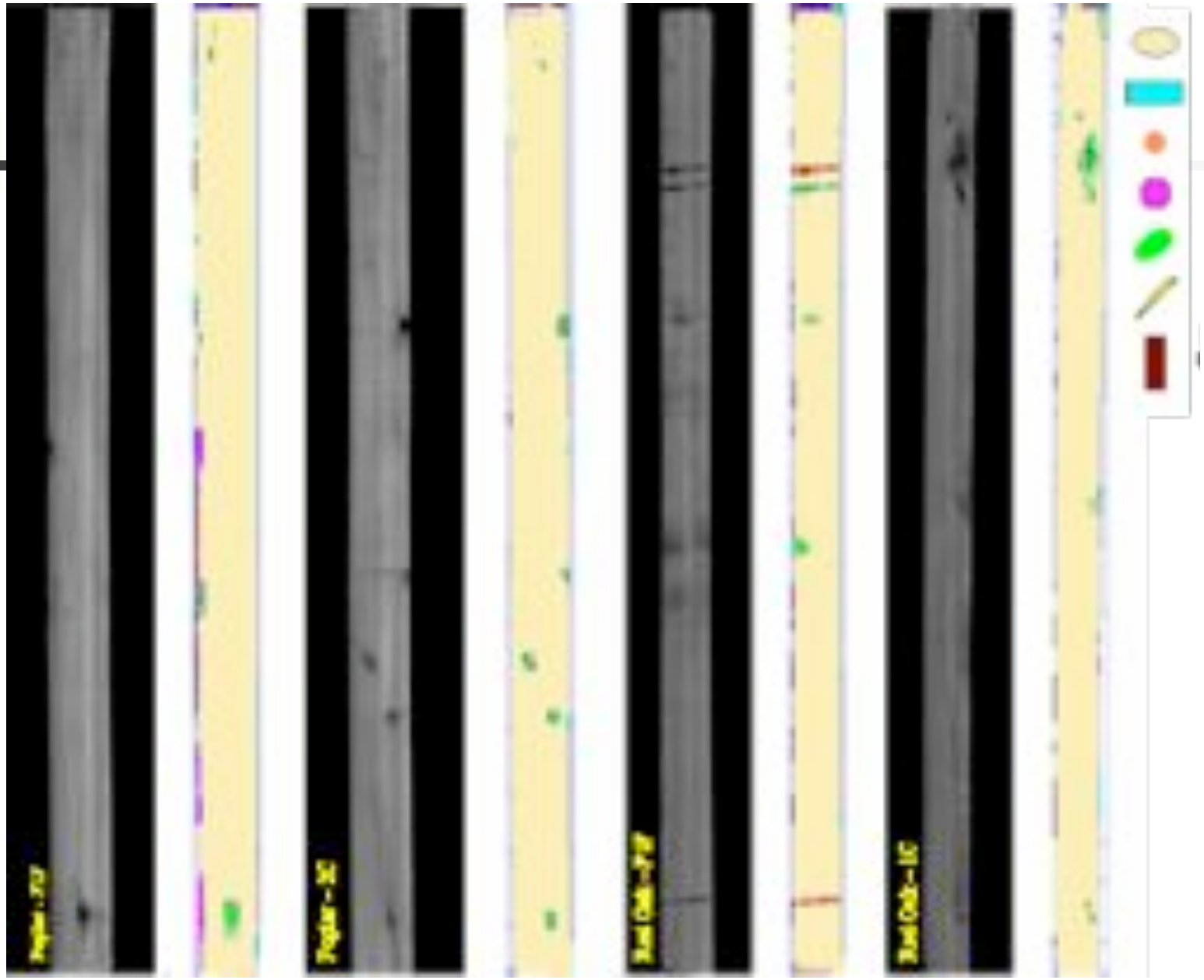
Detecting wane and defects



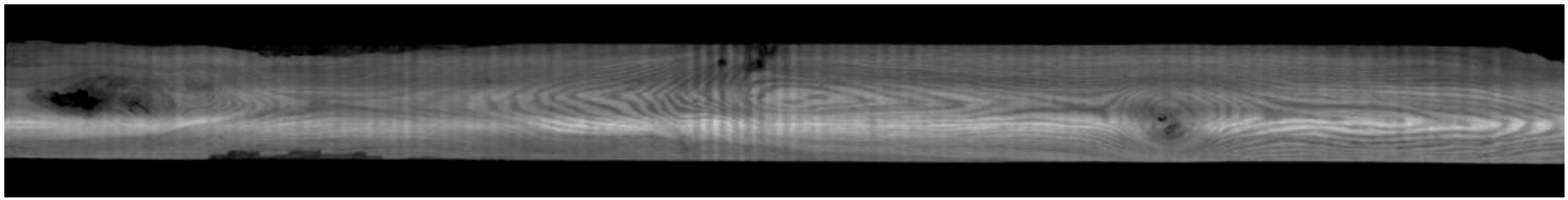
Our Tests …

- Scanning accuracy
- Lumber Grading – NHLA Rules
- ROMI -- lumber to cuttings simulations

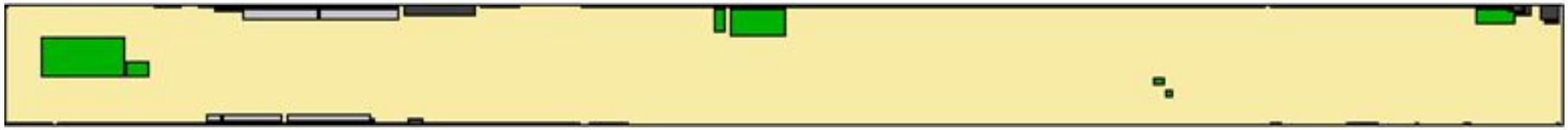
Lumber being scanned

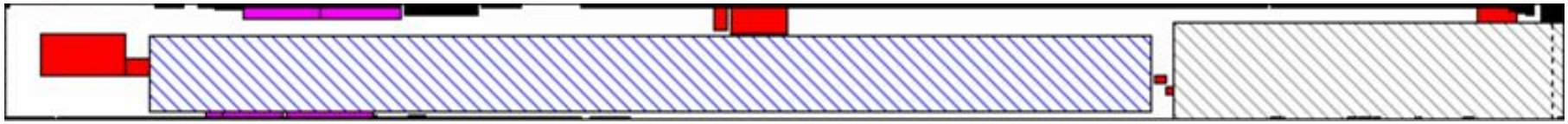


Lumber Grading -- Red Oak – Grade 2C

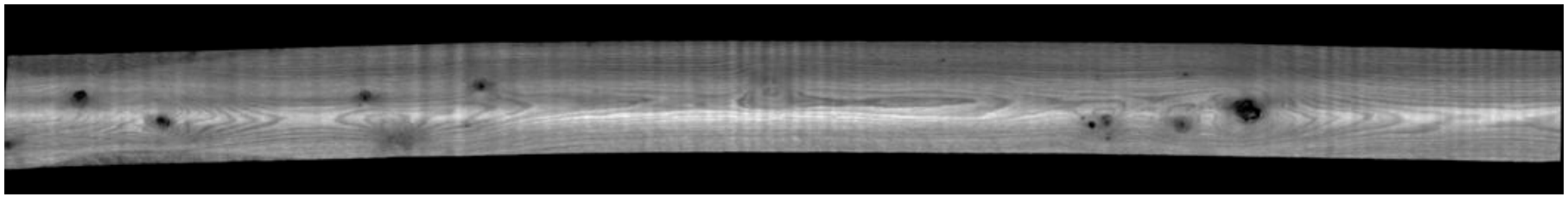


Board # 101

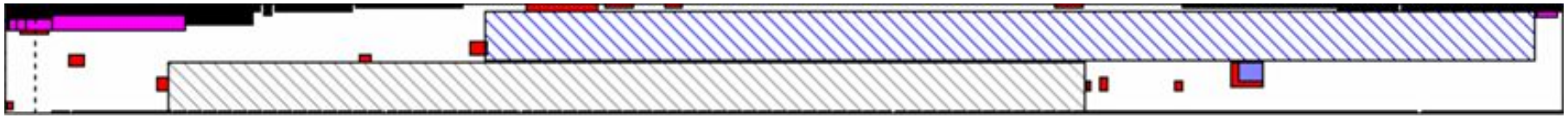




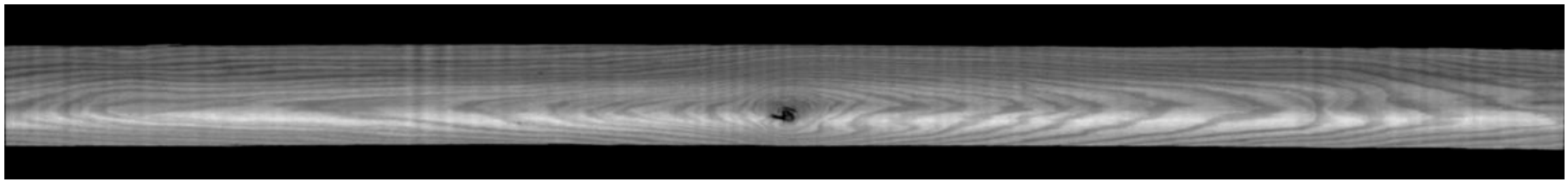
Red Oak – Grade 2C



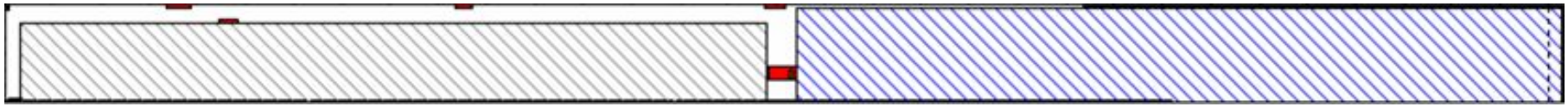
Board # 802



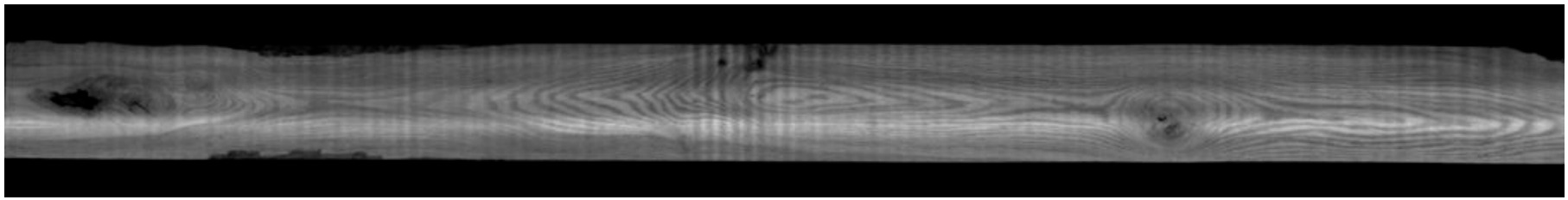
Red Oak – Grade F1F



Board # 1301

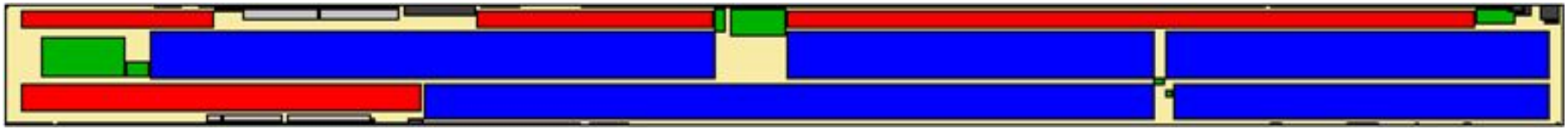


ROMI simulations --Red Oak – Grade 2C

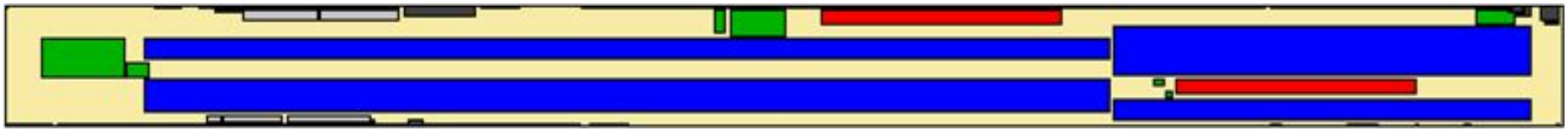


Board # 101

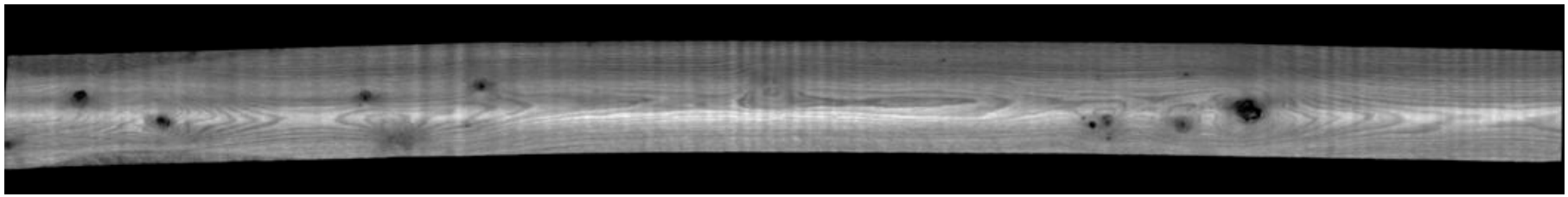
Rip-First



Chop-First



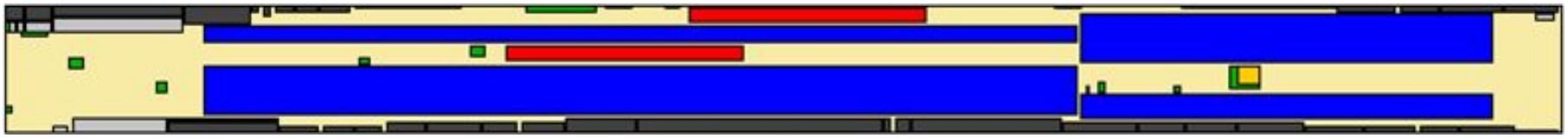
Red Oak – Grade 2C



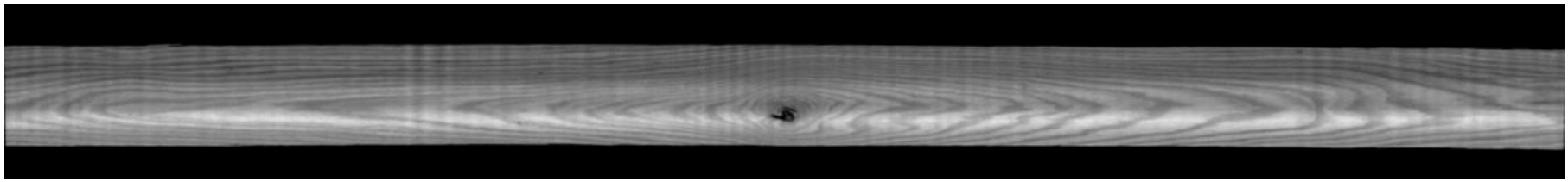
Board # 802

Rip-First

Chop-First

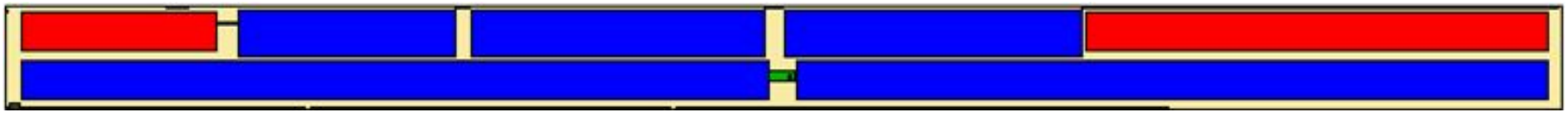


Red Oak – Grade F1F

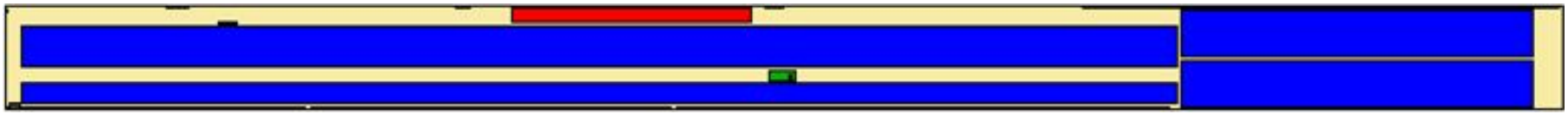


Board # 1301

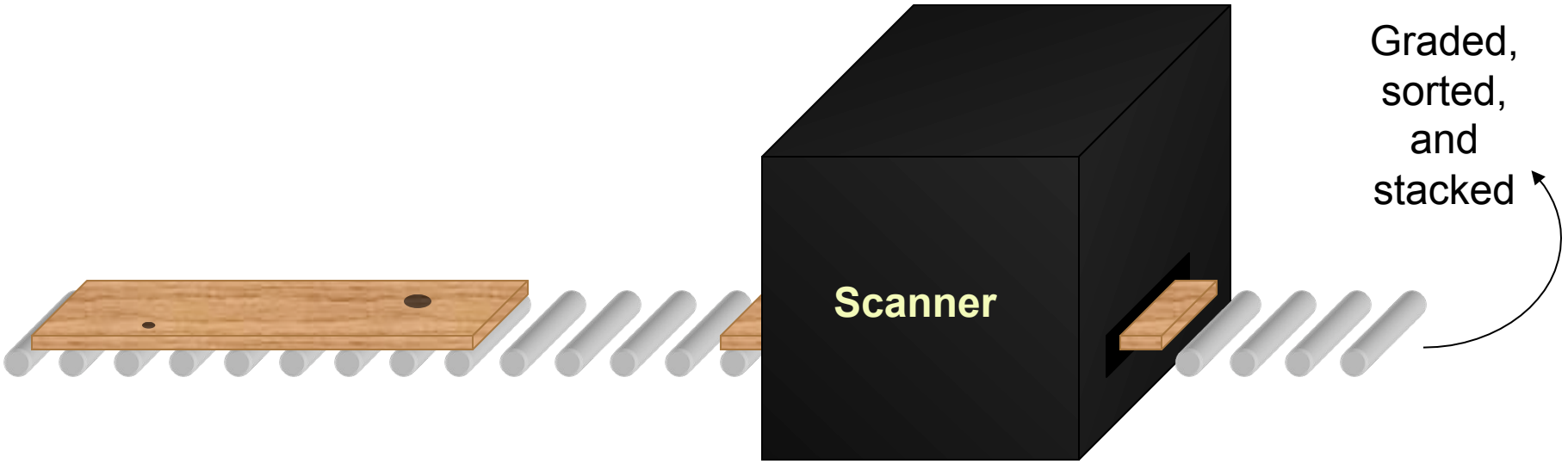
Rip-First



Chop-First



Potential System



Data for Each Board

- NHLA Grade
- Value
- Best potential use (flooring, mouldings, furniture, cabinets)
- Potential rip first cuttings
- Potential cross cut first cuttings

Summary

- Our scanning does a nice job on KD surfaced lumber
- NHLA hardwood lumber grading has been demonstrated
- (We are rechecking the grades and adding more scanned boards)
- ROMI simulated cuttings can be determined
- Best lumber use determination is possible

Thanks to the following for supporting this recent effort

- USDA Forest Service WERC
- Virginia Tech
- USDA Forest Service Southern Research Station
- Allegheny Wood Products, Inc.

Questions?