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

Machine Vision Systems for Processing Hardwood Lumber and Logs

Virginia Polytechnic Institute and State University
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Future Automated Rough Mills Hinge on Vision Systems

A segmental analysis of current and future scanning and optimizing technology in the hardwood sawmill industry

Scott A. Bowe, Robert L. Smith, D. Earl Kline, Philip A. Araman
Advanced Hardwood Log Processing – CT Scanning Related

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

Erol Sarioglu, A. Lynne Abbott, and Daniel L. Schmidt
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Lumber value differences from reduced CT spatial resolution and simulated log sawing

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Interactive Machine Learning for Postprocessing CT Images of Hardwood Logs

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Hardwood Conf 2009
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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Automated hardwood lumber grading utilizing a multiple sensor machine vision technology

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Available online at www.sciencedirect.com


www.elsevier.com/locate/compag
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

Profile Image → Remove Background → Detect Wane → Detect Voids

Tracheid Image → Determine Suspicious Regions → Principal Components Analysis

MANN → MLPN → RBFN → Competitive Network → Post-processing

Clear wood → Wane → Holes → Knots → Decay → Splits

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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
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?