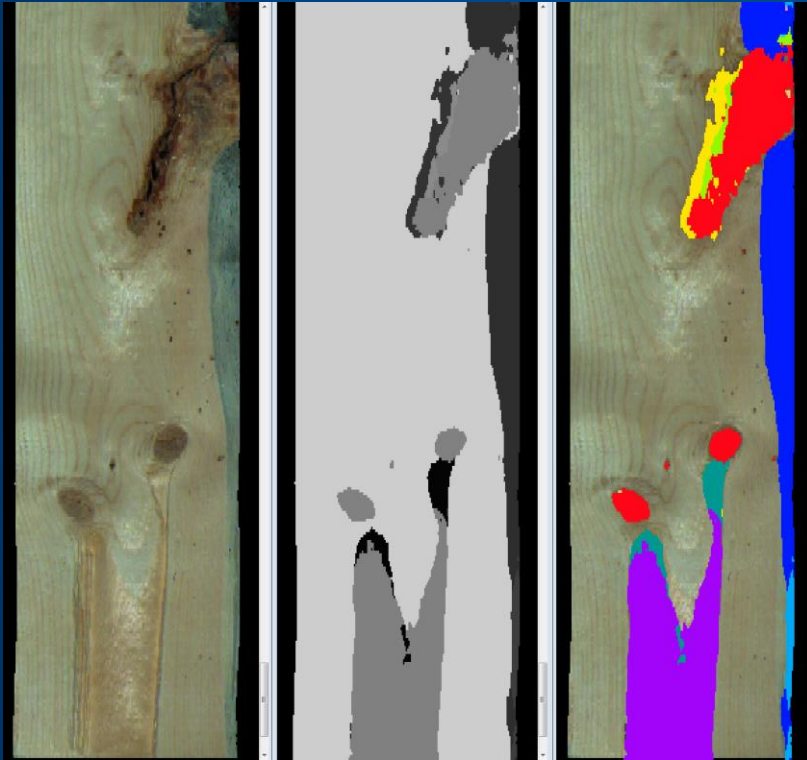


Deep Learning Artificial Intelligence for Lumber Defect Detection



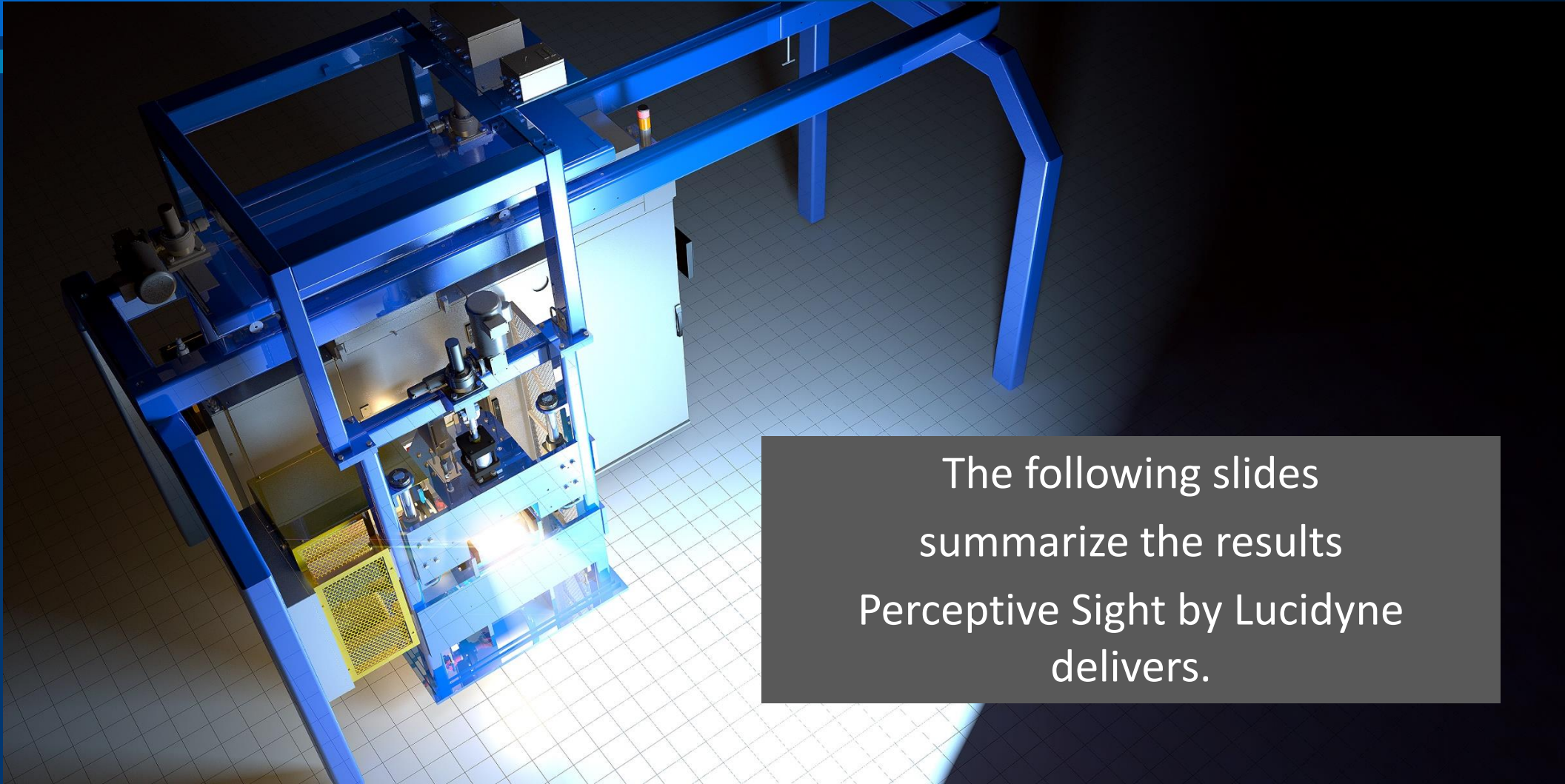
Patrick Freeman
Chief Technology Officer



GradeScan® by Lucidyne Technologies, Inc., is delivering a quantum leap development in automated scanning and optimization that is breaking records for on-grade lumber production.

The new software, Perceptive Sight™ Intelligent Grading, uses Deep Learning (artificial intelligence) to dramatically improve lumber grading results.

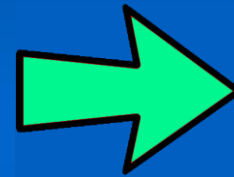




The following slides
summarize the results
Perceptive Sight by Lucidyne
delivers.

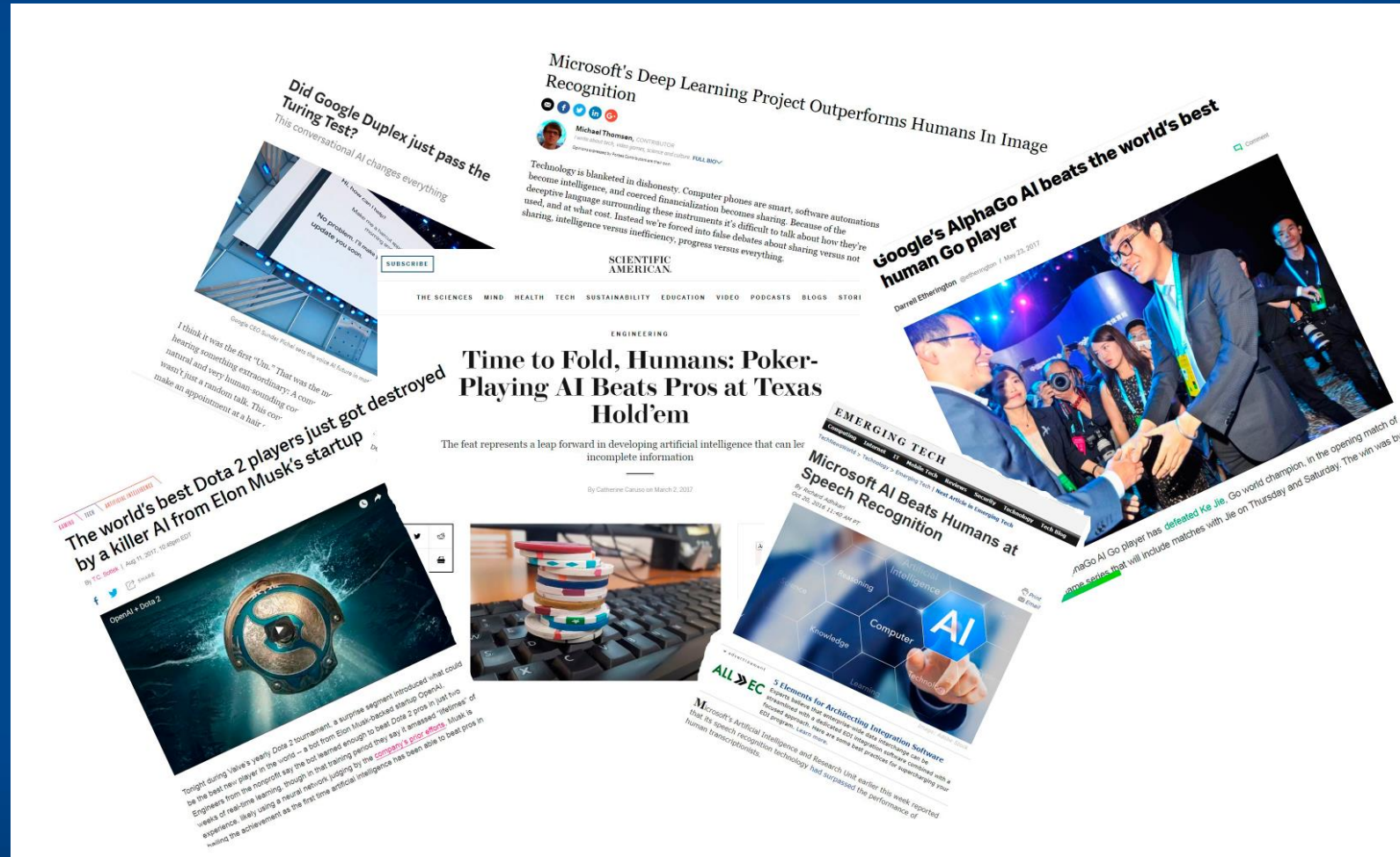
Advanced AI in Lumber Detection – Why?

- Increased accuracy
- Solve the previously unsolvable
- No expert engineer input required – teach from example

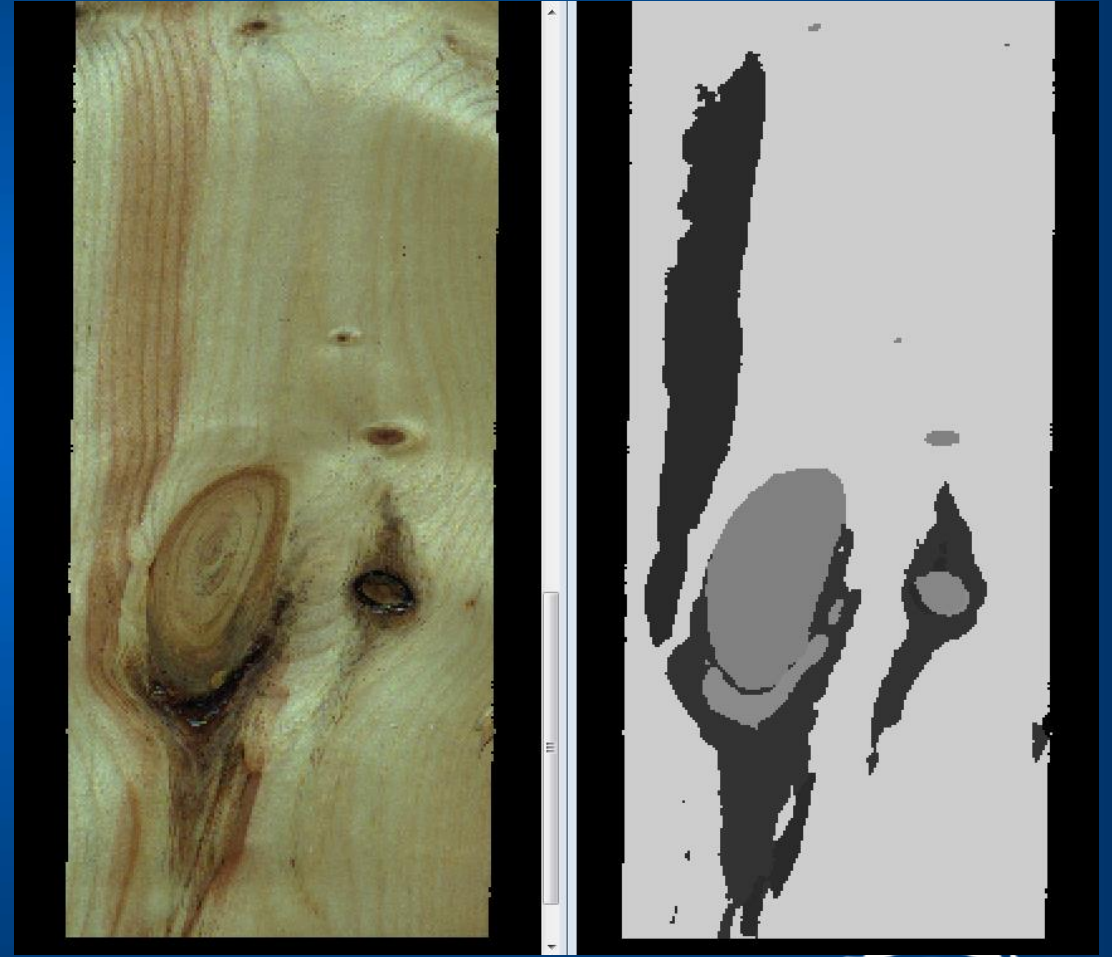
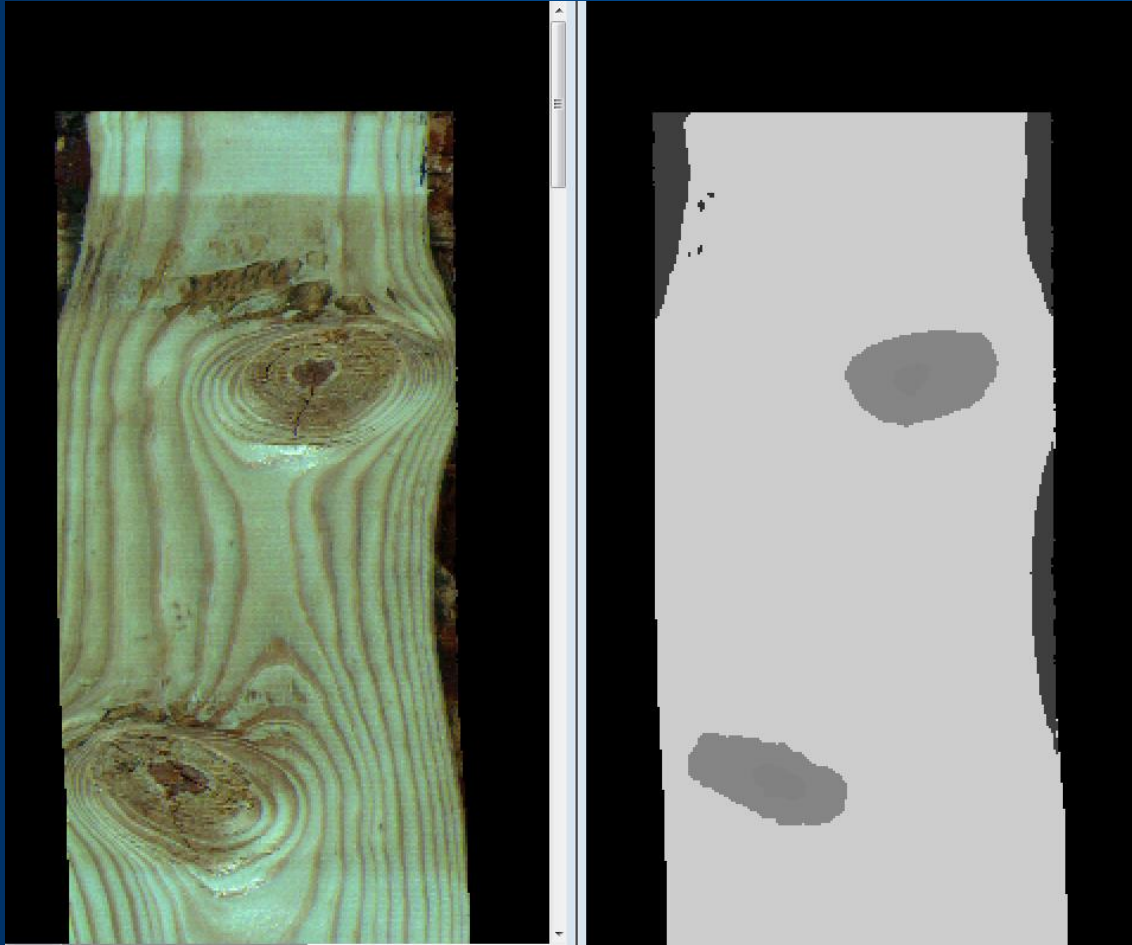


- *Higher Value*
- *Timely solutions*

Deep Learning Recent Milestones:



CNN Defect Detection in Wood



GradeScan Sensor subset:

RGB color

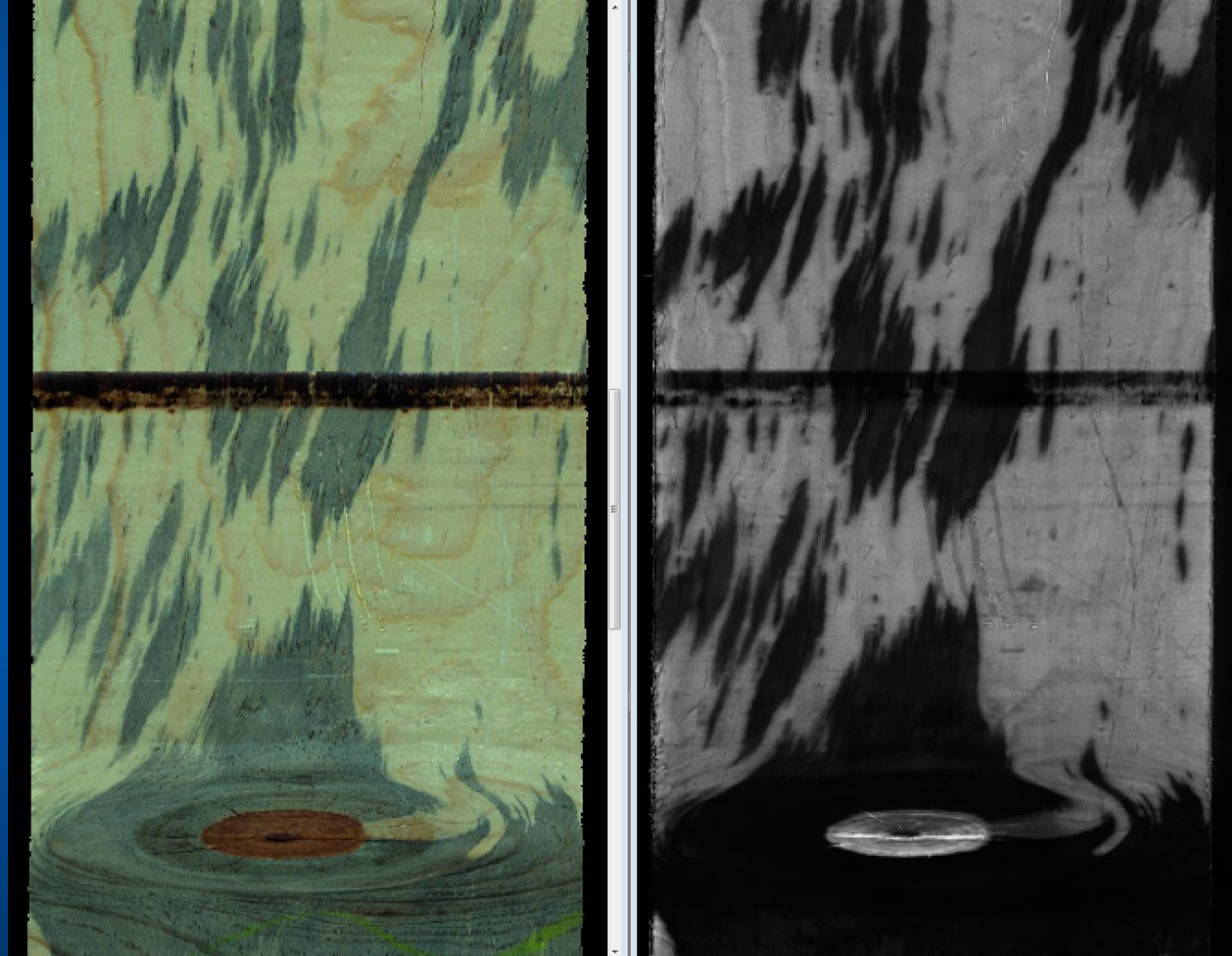
Tracheid sensor

T3 Sensor

Throughboard Sensor

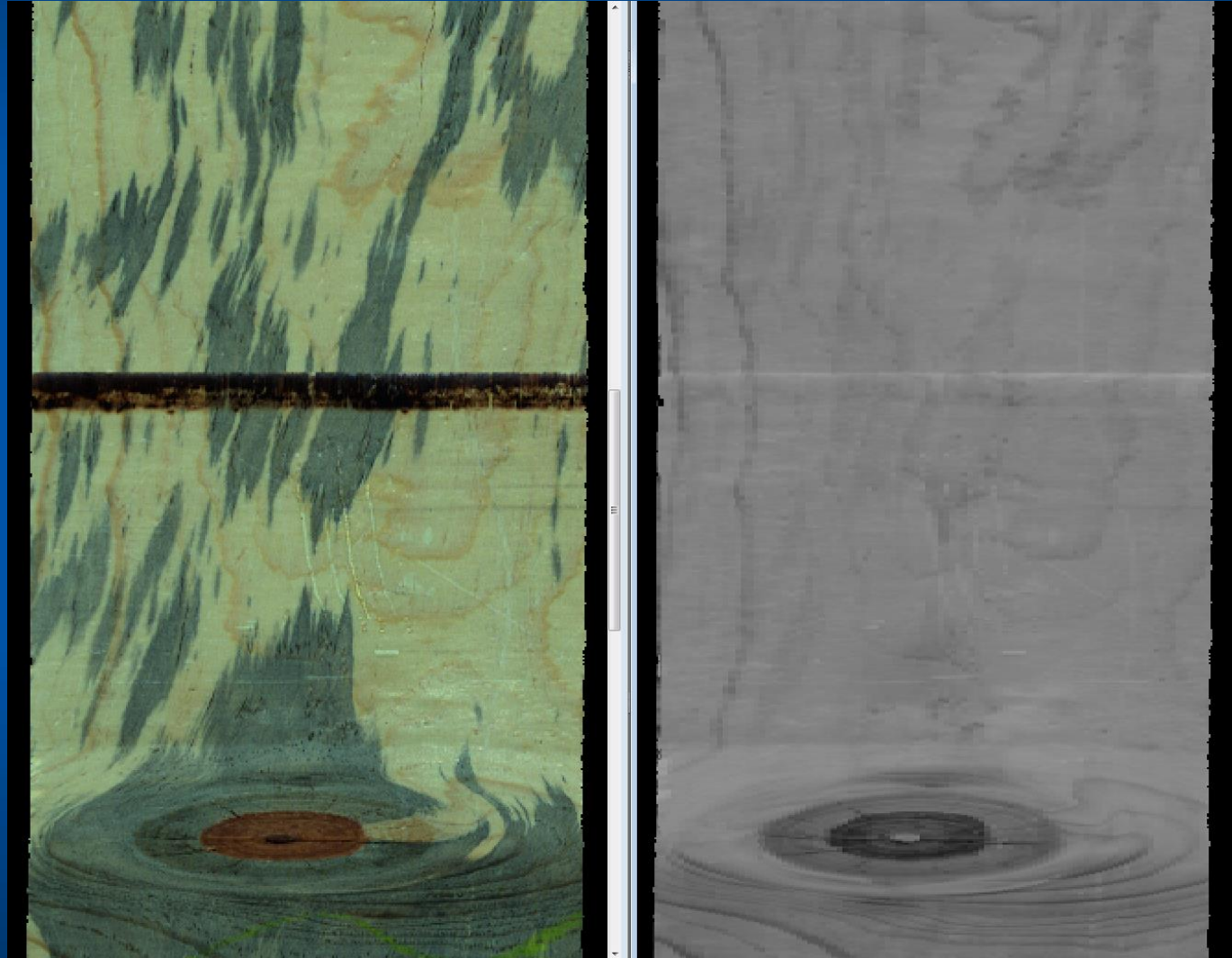
Geometric Sensor

Color/Tracheid Sensors



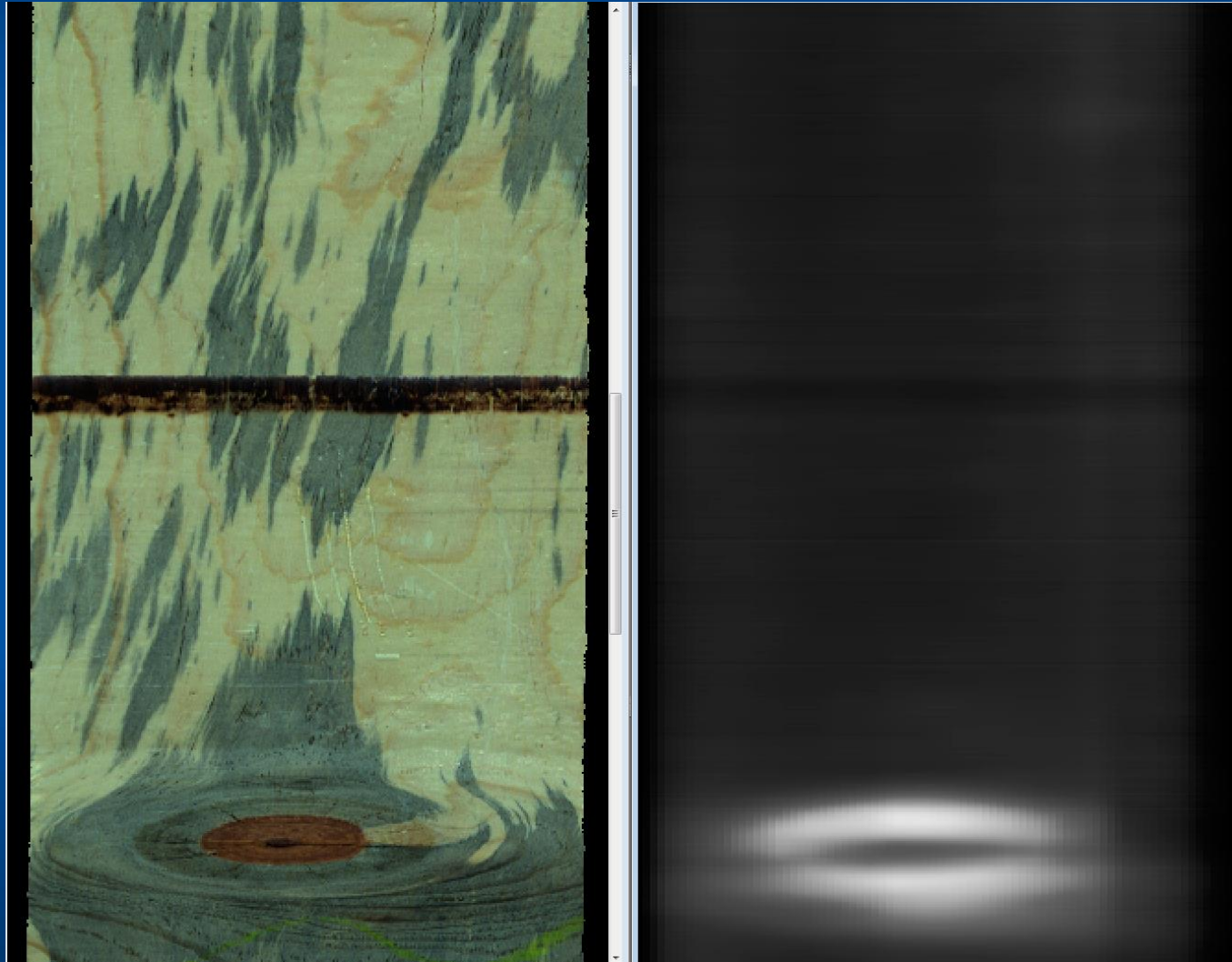
T3 Sensor

*T3 Sensor
“sees” through
natural and
manufactured
stains. Can see
annular rings
and other
defects
otherwise hidden*

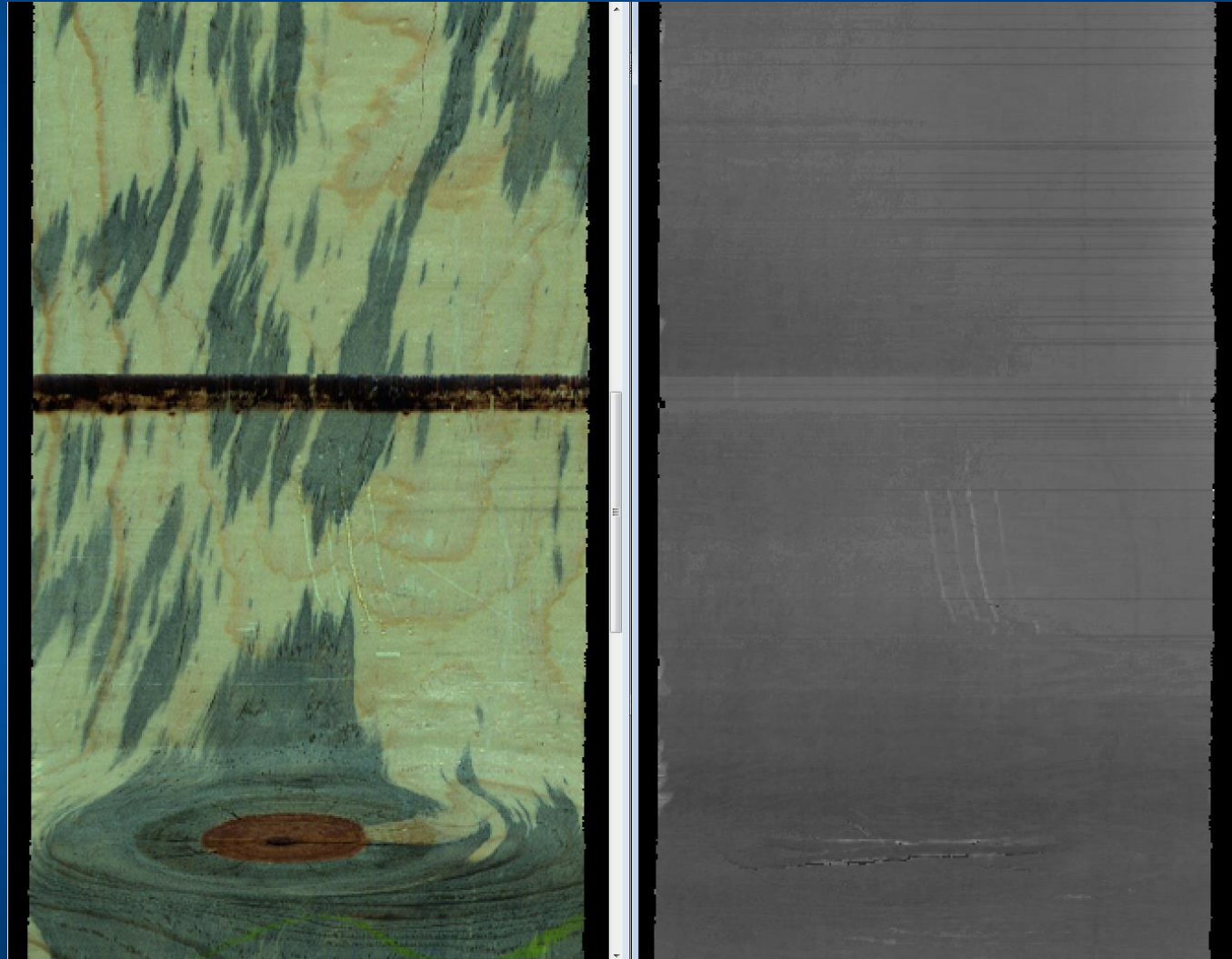


ThroughBoard Sensor

- *Detects density differences.*
- *Similar to X-ray, but with radio waves instead*
- *Two images, top and bottom*



Geometric Sensor, Grayscale View



Current 50+ Class Net Outputs (more to come!):

KnotRed

KnotDead

KnotBlond

KnotDecayed

KnotBarkEncasement

KnotSlough

CrossGrain

PocketPitch

PocketBark

StainBlue

StainKiln

Clear

CompressionWood

ShakePitch

ShakeTimberBreak

CheckSeason

Pith

Skip

SkipStained

BirdseyeBlonde

BirdseyeDark

WhiteSpeck

UnsoundWood

IncipientDecay

LeafScar

BrownStain

PlanerBurn

PlanerKnifeMark

SawCuts

PitchMass

PitchBlack

AntEatenPith

WormEatenPitch

WormHole

BeetleHole

Wane

WaneSmoothBark

Shake

HoneyComb

TornGrain

ManHole

ManHoleCrushed

Burl

FireScar

KnotDistortion

MineralPocket

MineralStreak

Heartwood

Sapwood

StainSpauld

Current Species Trained to Date (more to come!):

SYP

Ponderosa Pine

KD Douglas Fir

White Fir

Green Hemlock

Redwood

Cedar

Radiata Pine

Eastern White Pine

Green Douglas Fir

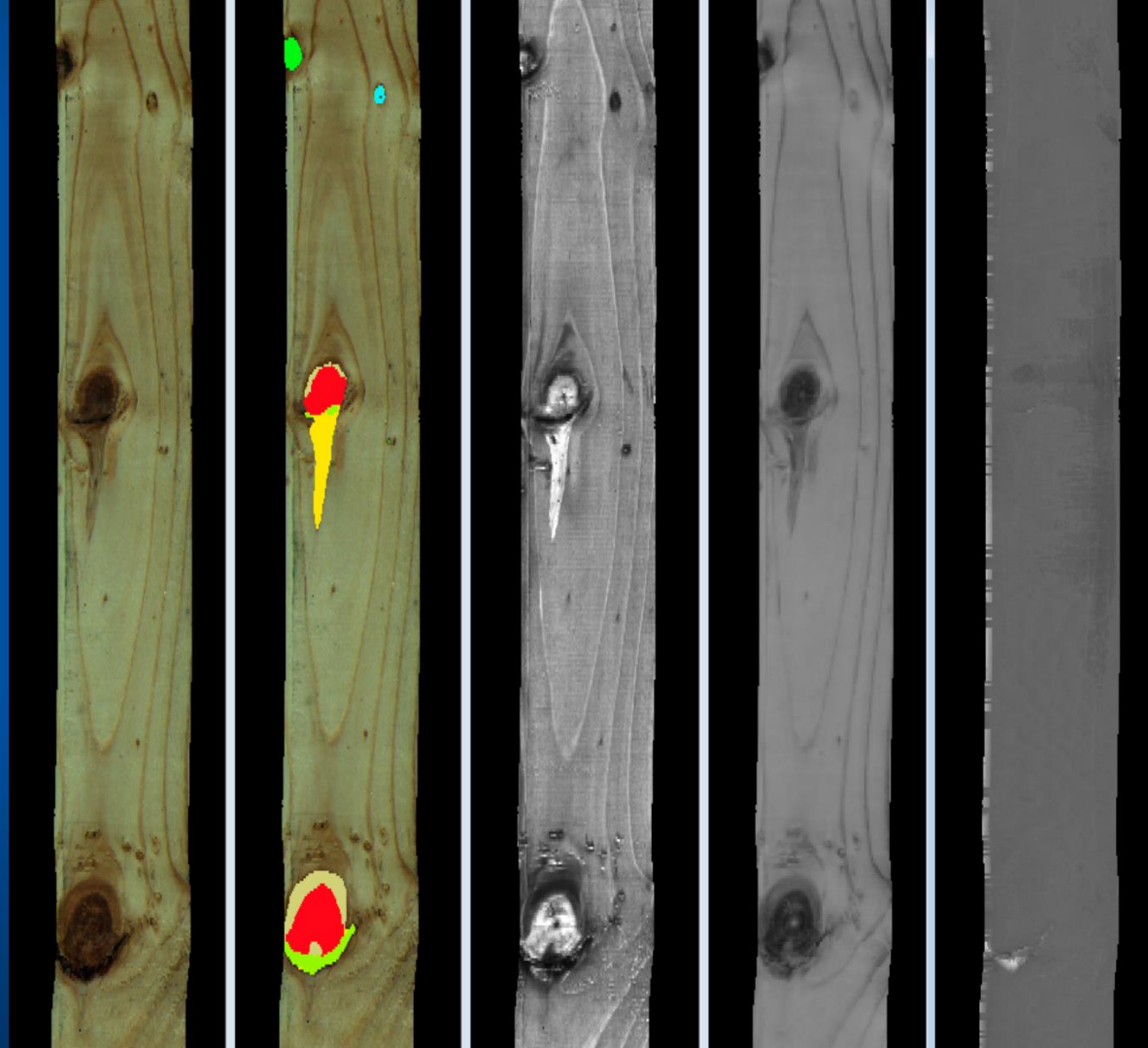
Hemlock

Green Rough Hemlock

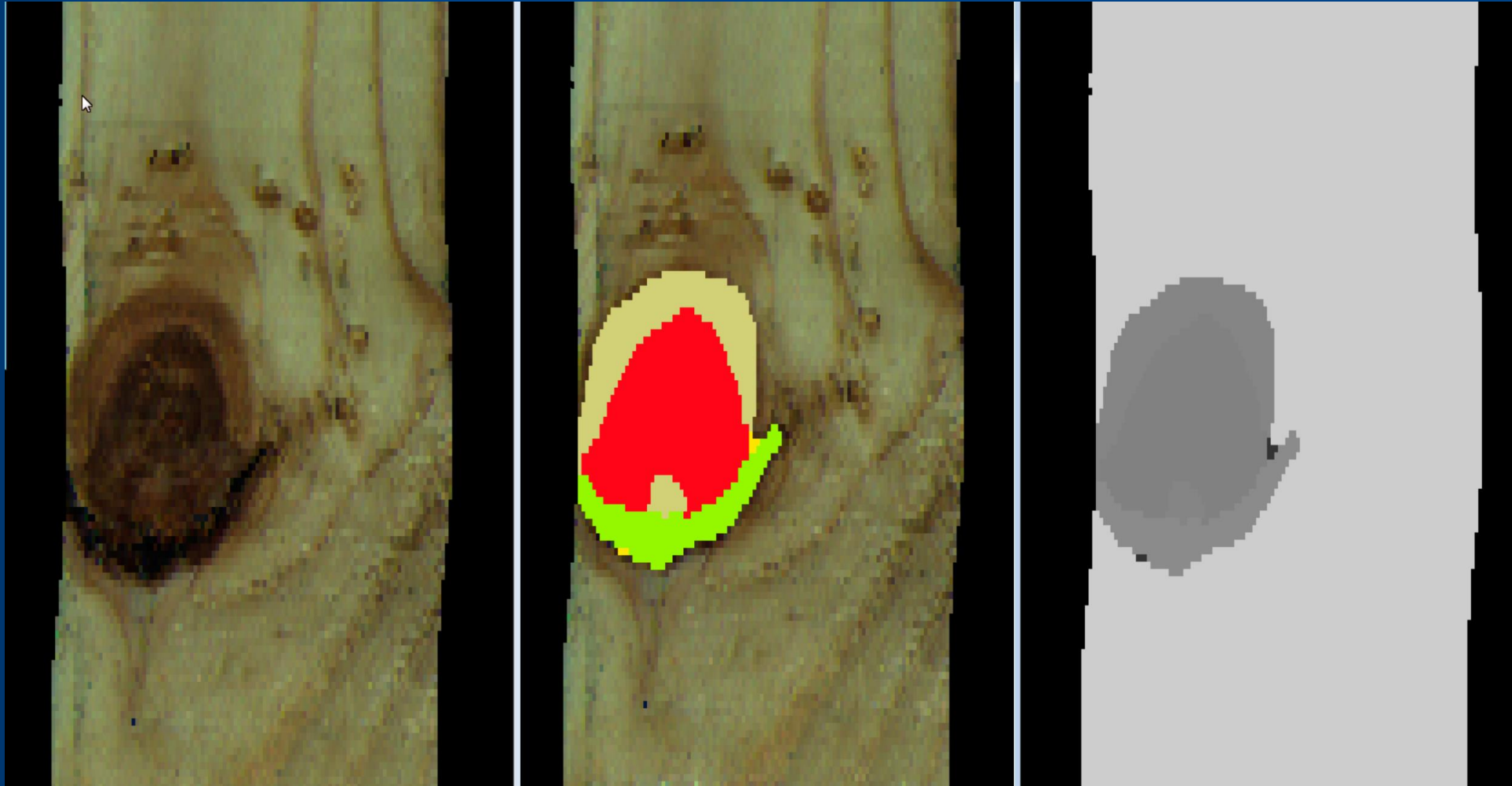
Alder

SPF

Classifying different parts of knots into Blond/Red/Bark Encasement:

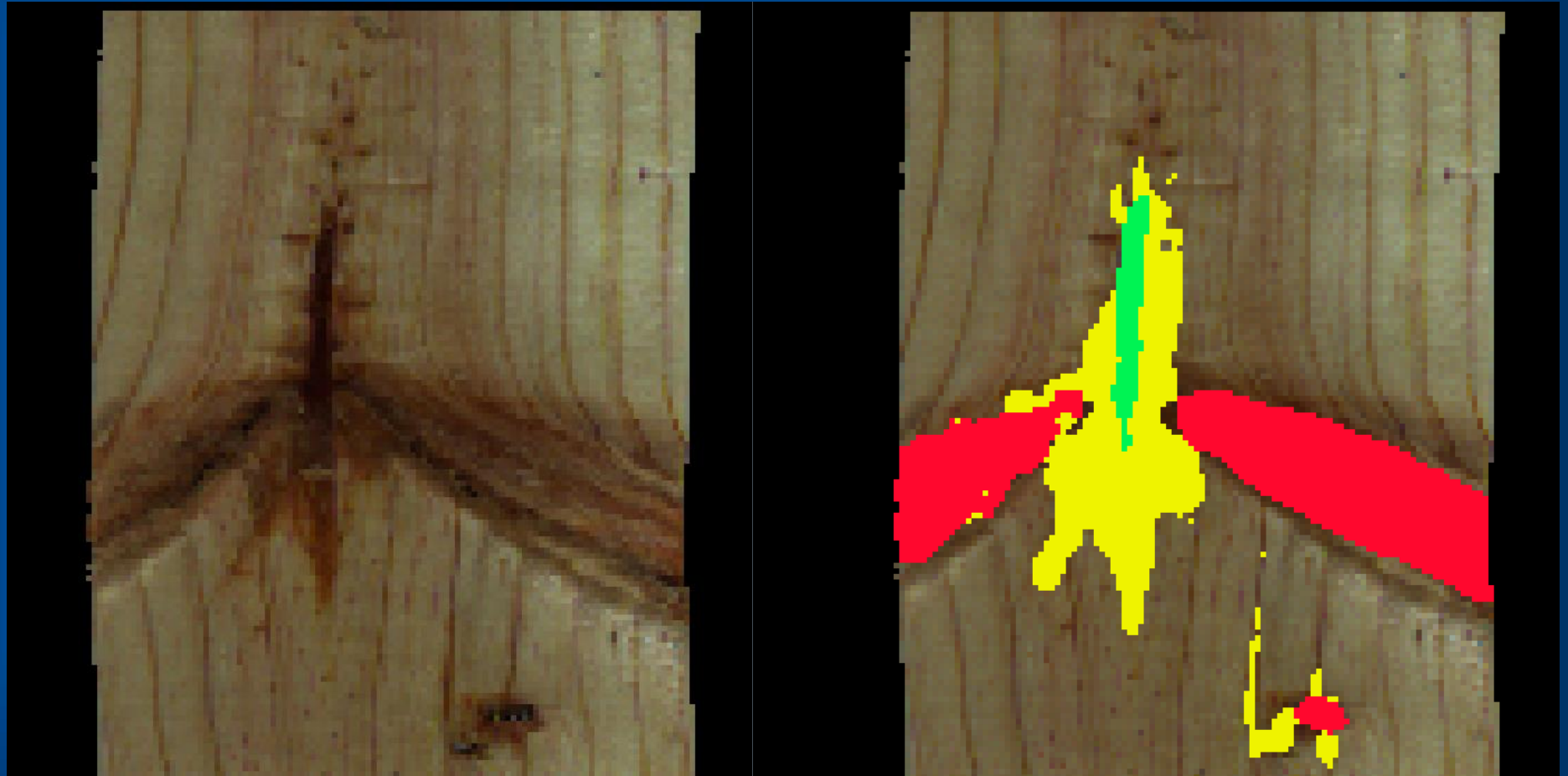


Detail of Blond-Ringed Knot with Encasement:

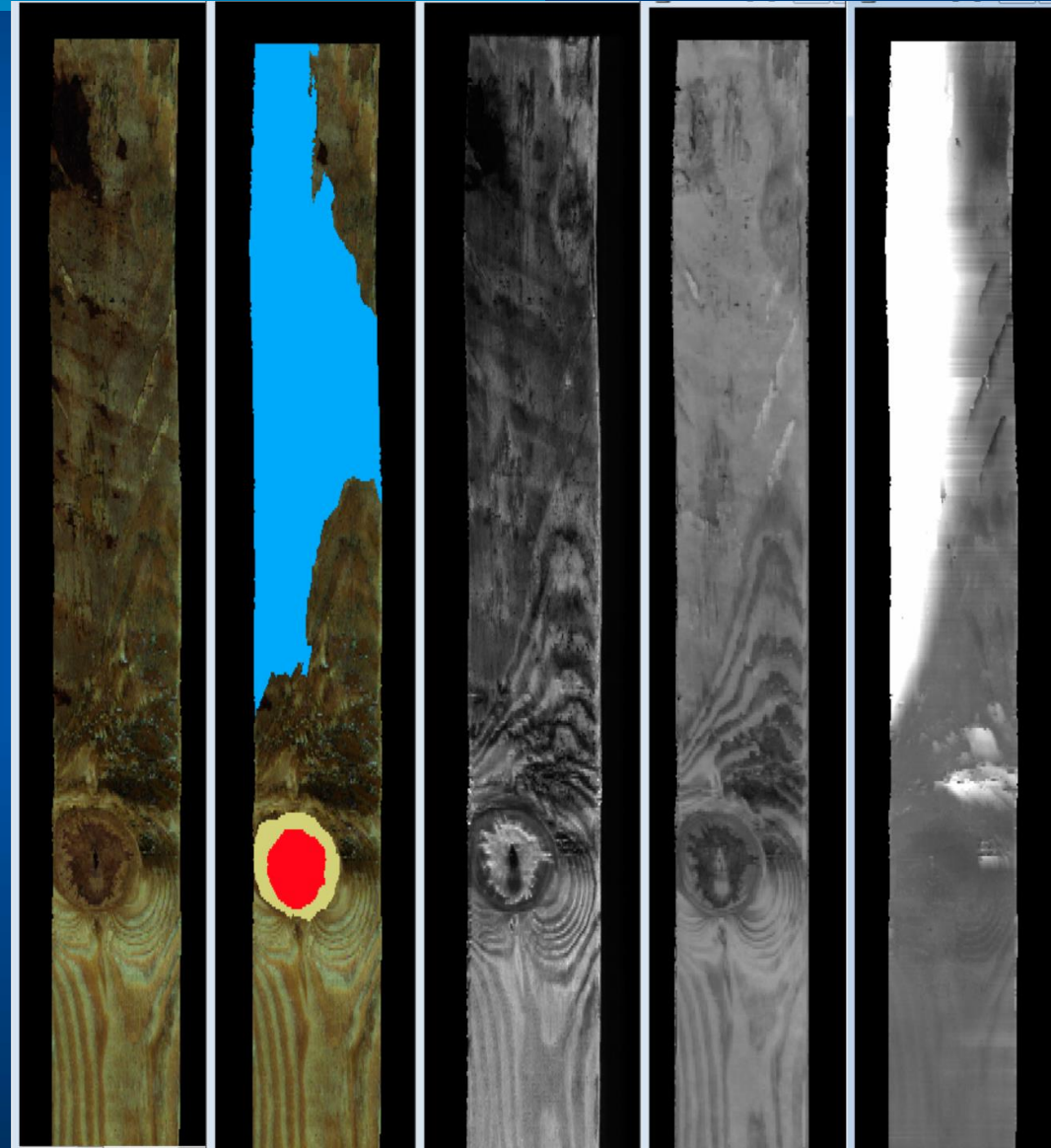


Pattern recognition –

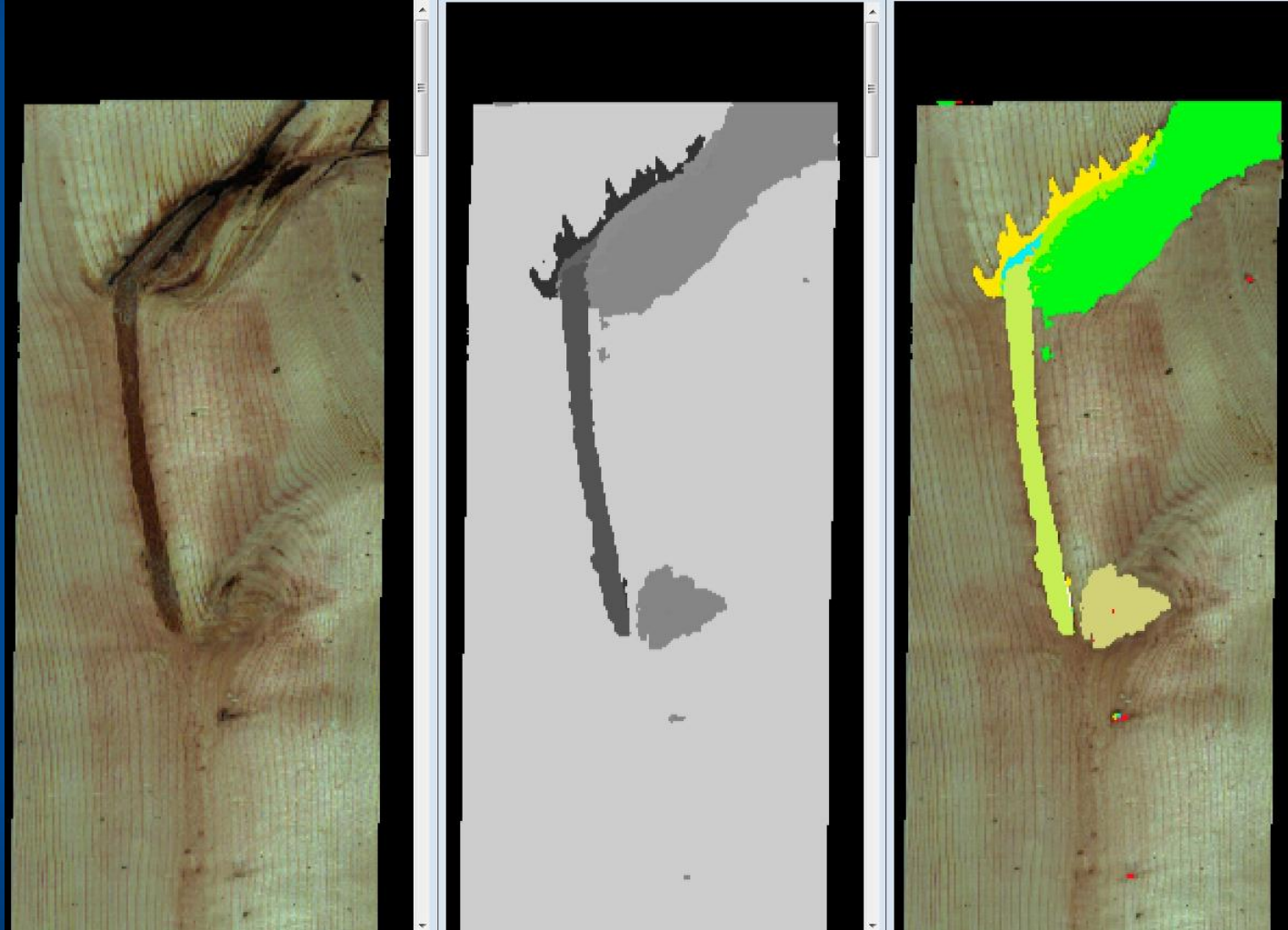
*learn the
“spike/pith/spike”
pattern and don’t
connect the
knots to each
other*



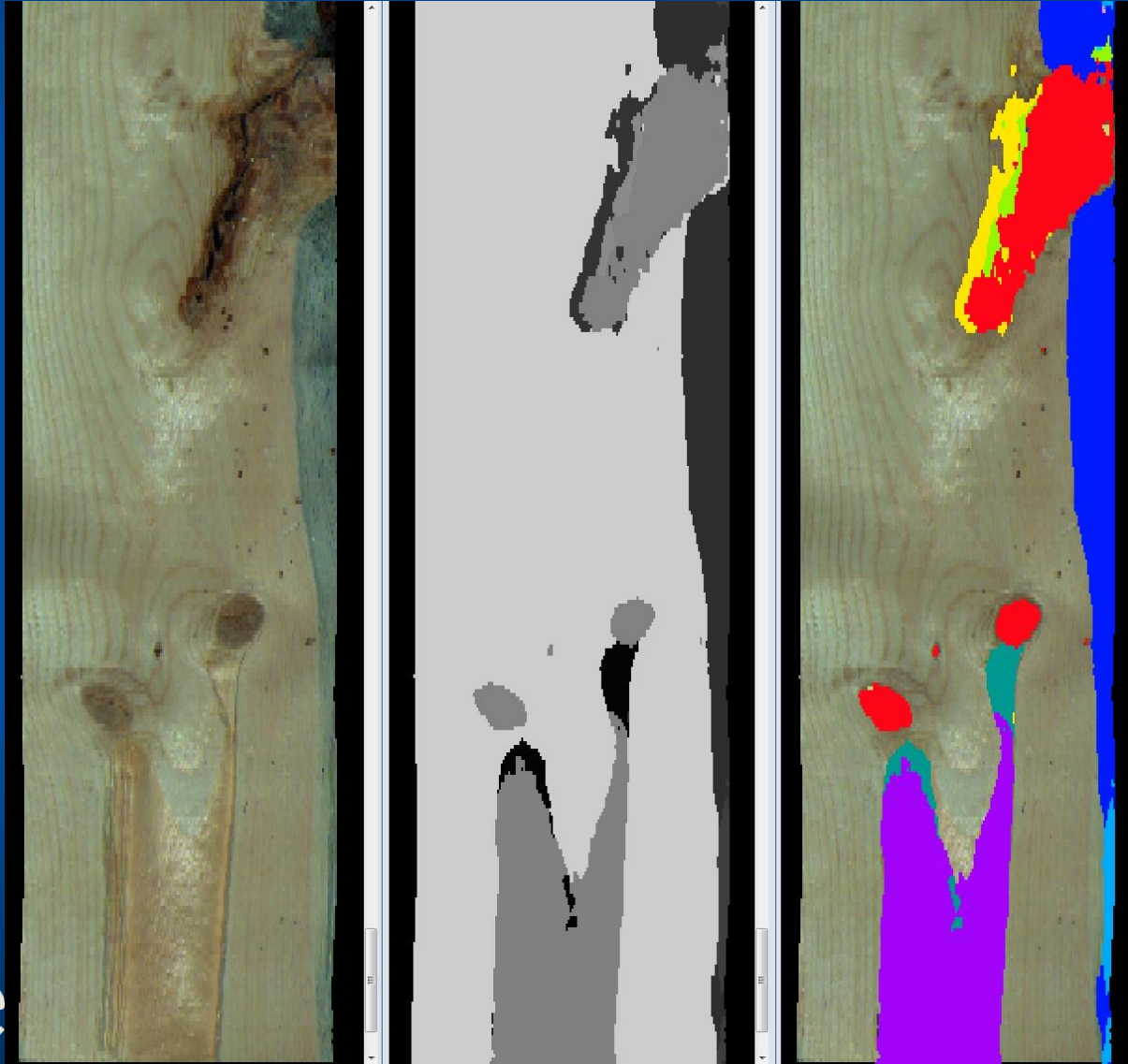
Separating Wane and Heavily Kiln-Stained Skip:



Defect Example: Decayed Spike to Pith (SPF)



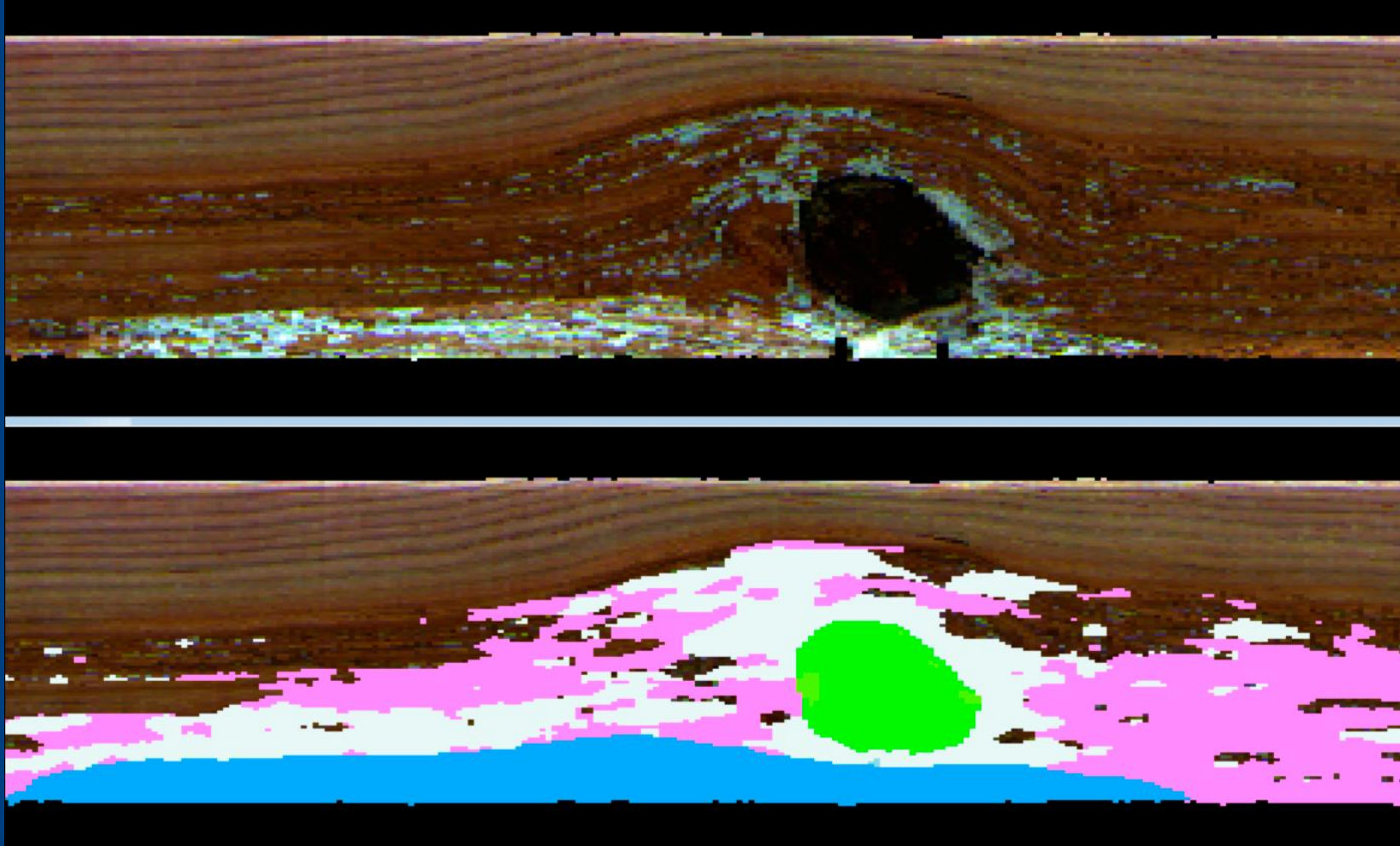
Defect Example: Manufactured Hole, Blue Stain (SPF)



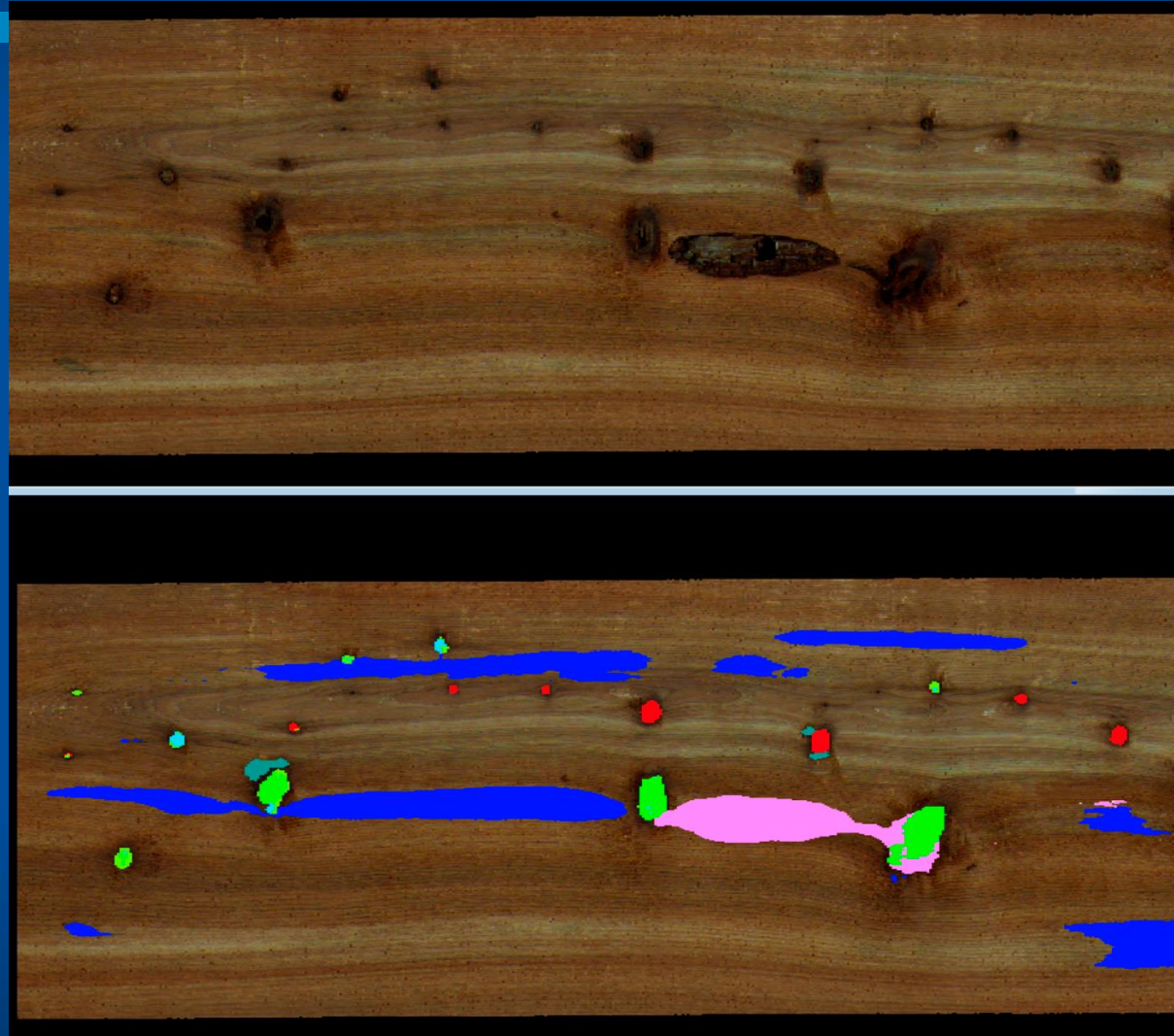
Unsound Wood and Incipient Decay (SPF)



Unsound Wood and White Spec (Green DF)



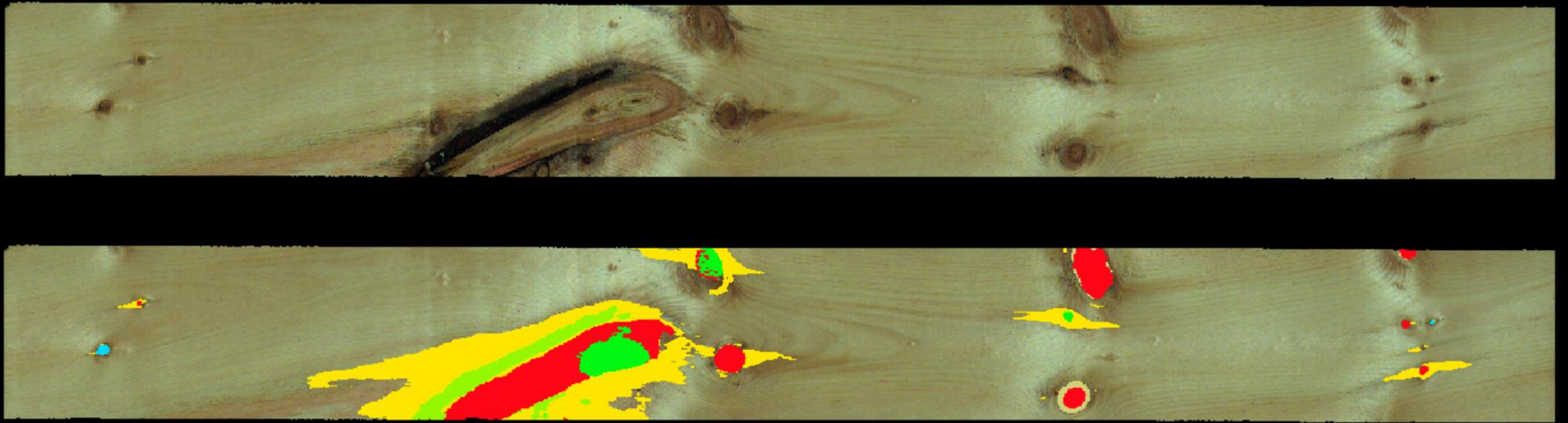
Peck (Cedar)



Manufactured Holes/Crushed

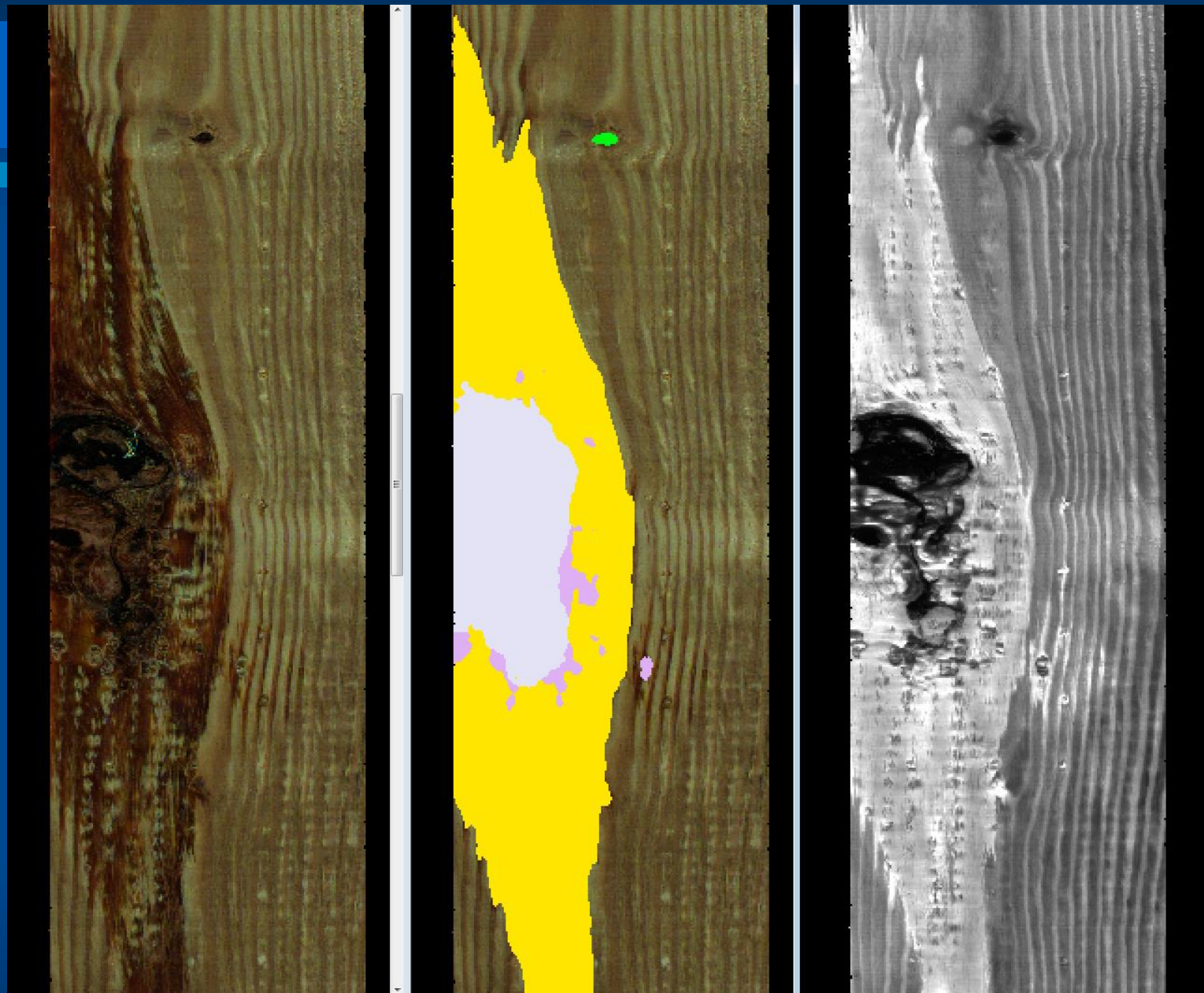


“Sucker” Knot With Encasement

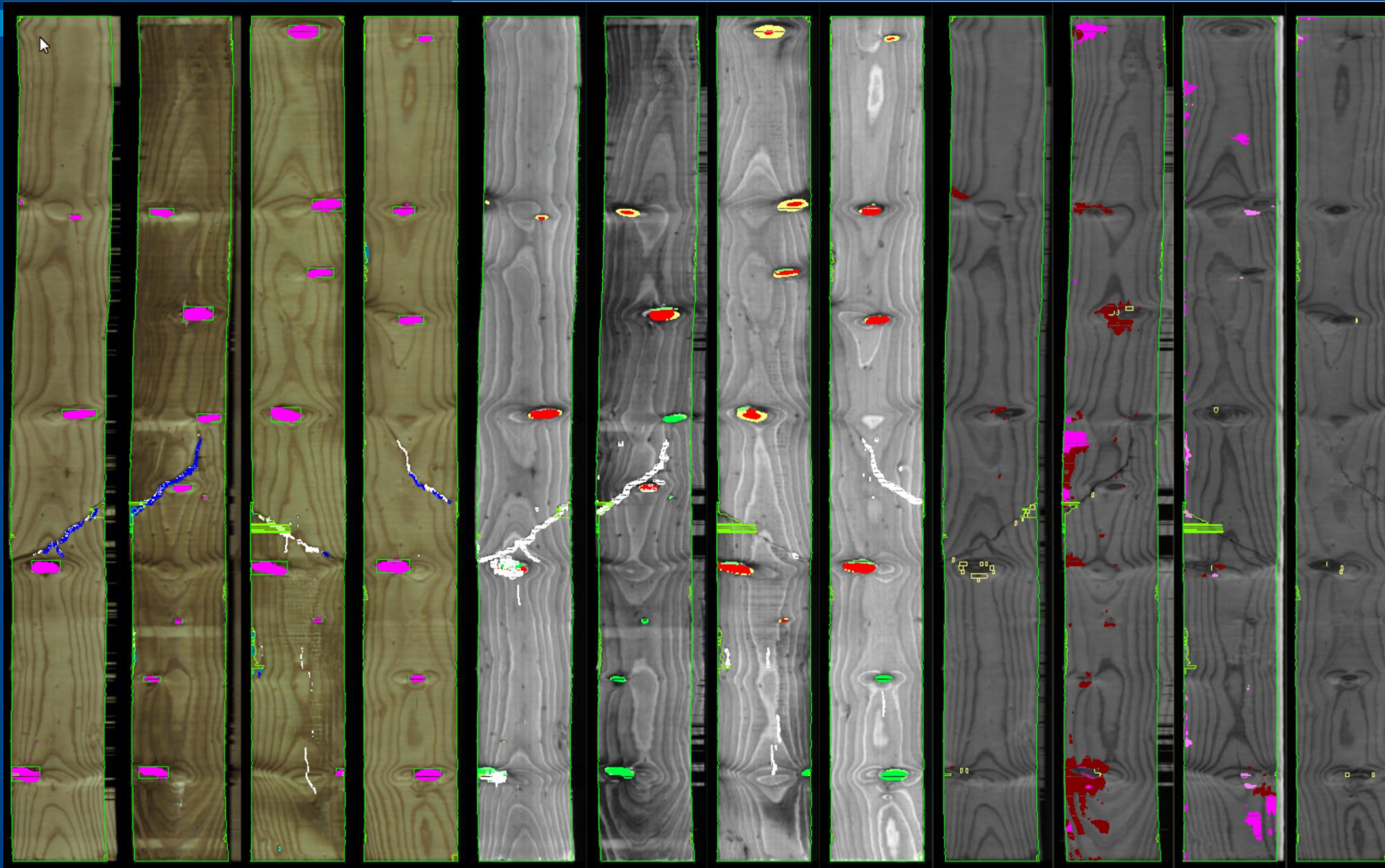


Burl/WEP

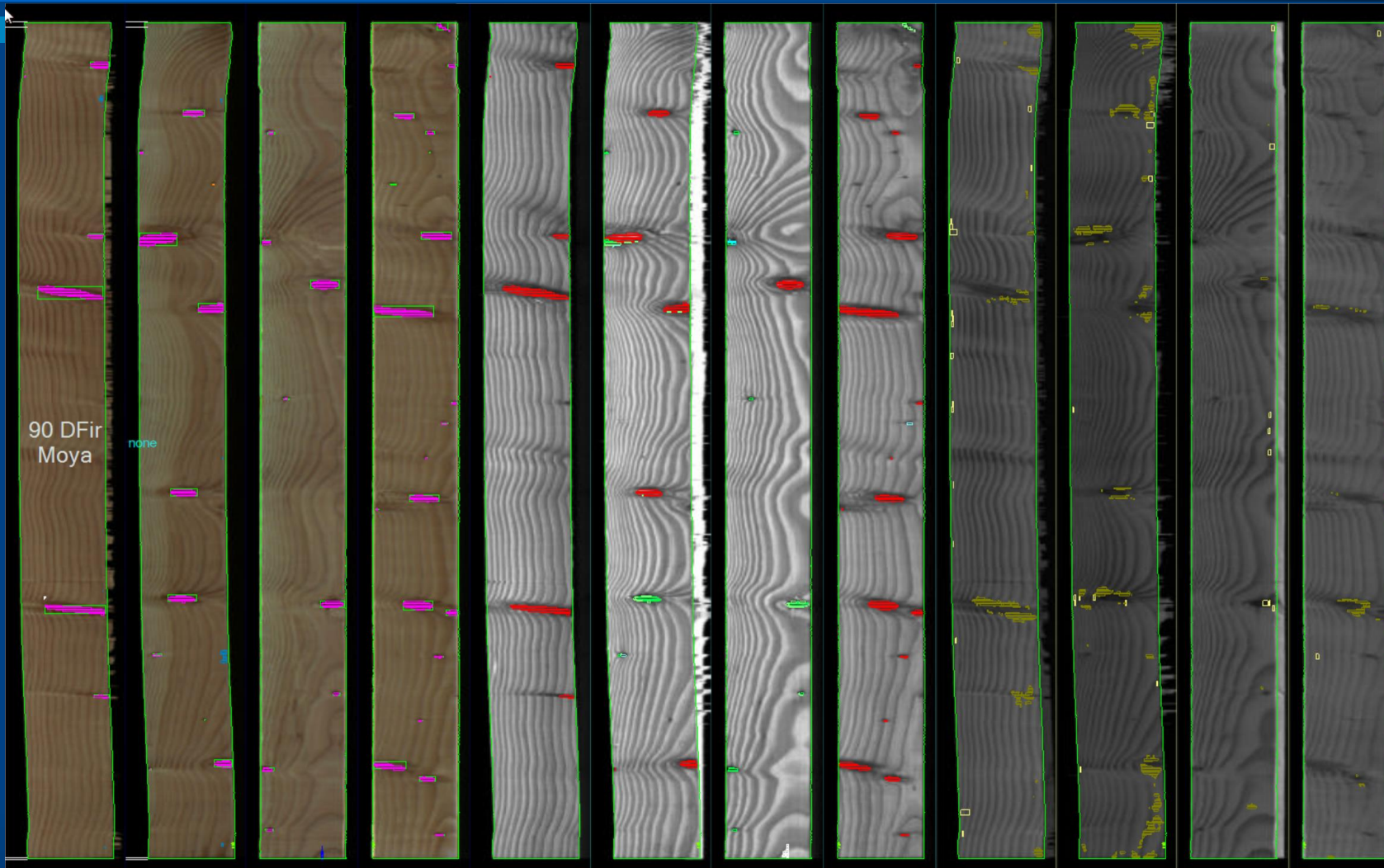
- *Burl (Canker)*
- *WEP (Worm Eaten Pitch)*
- *Note how worm holes are separated from similar manufactured patterns*



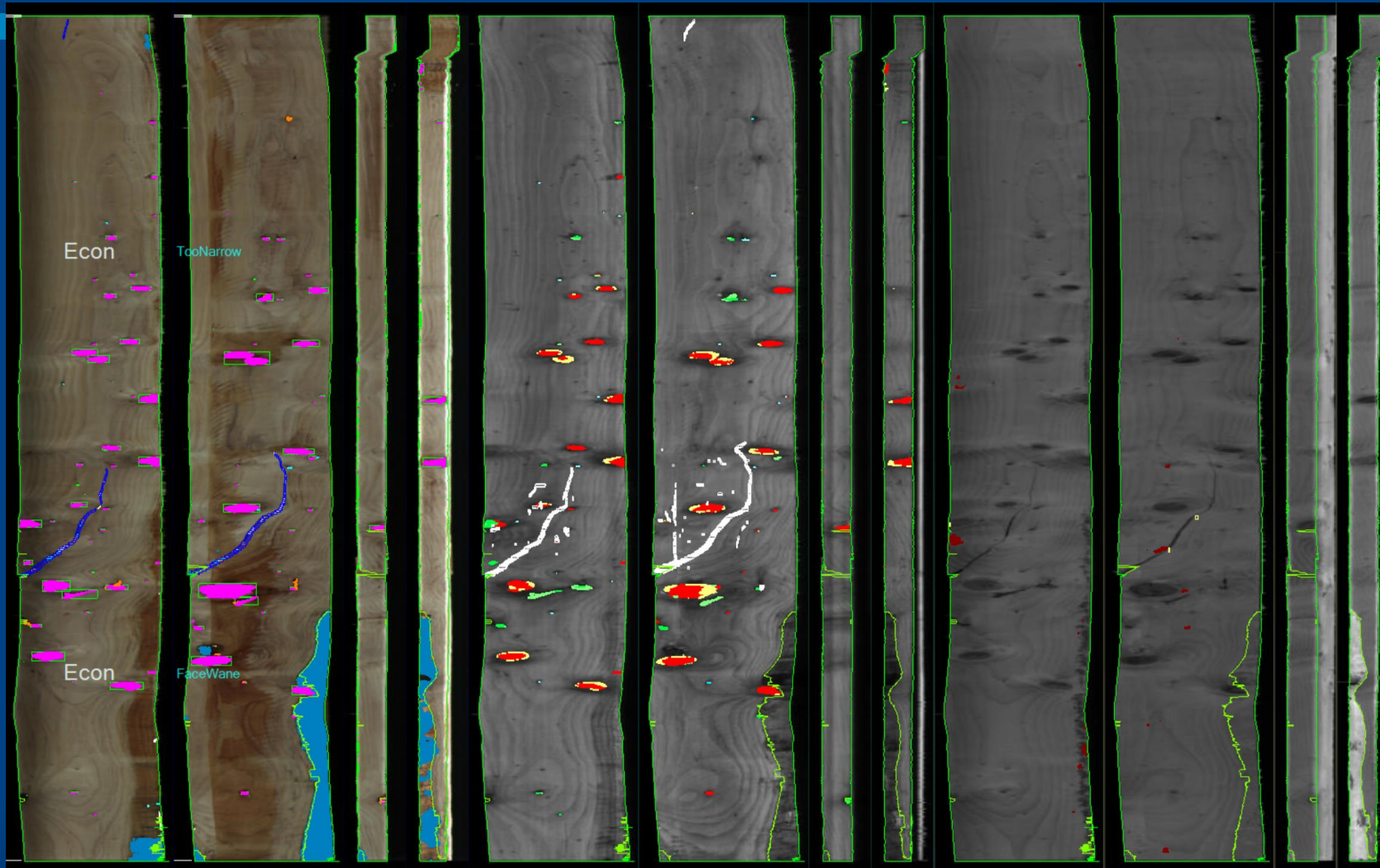
Sample “Thumbnail” Output, SYP



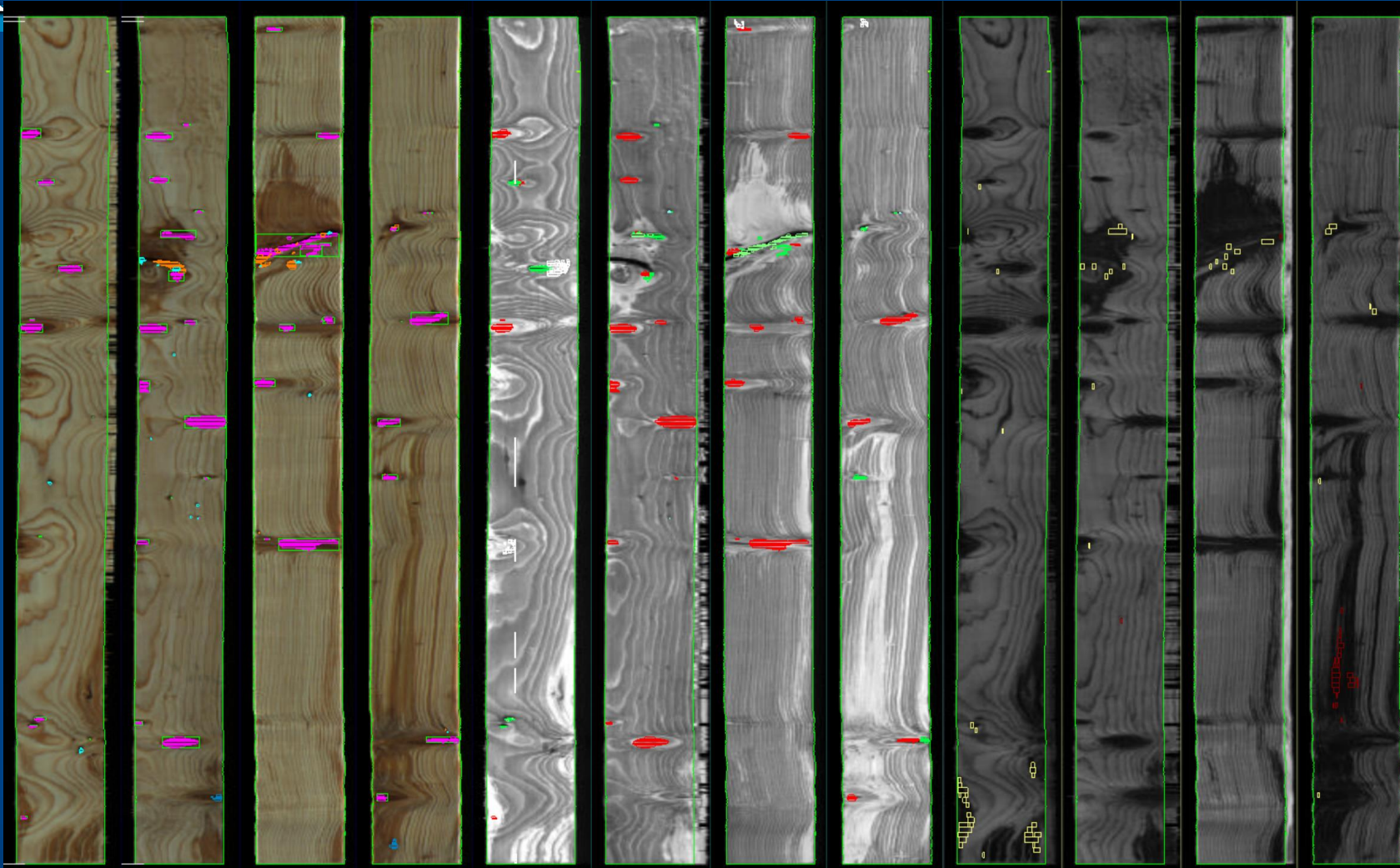
Sample “Thumbnail” Output, KDDF



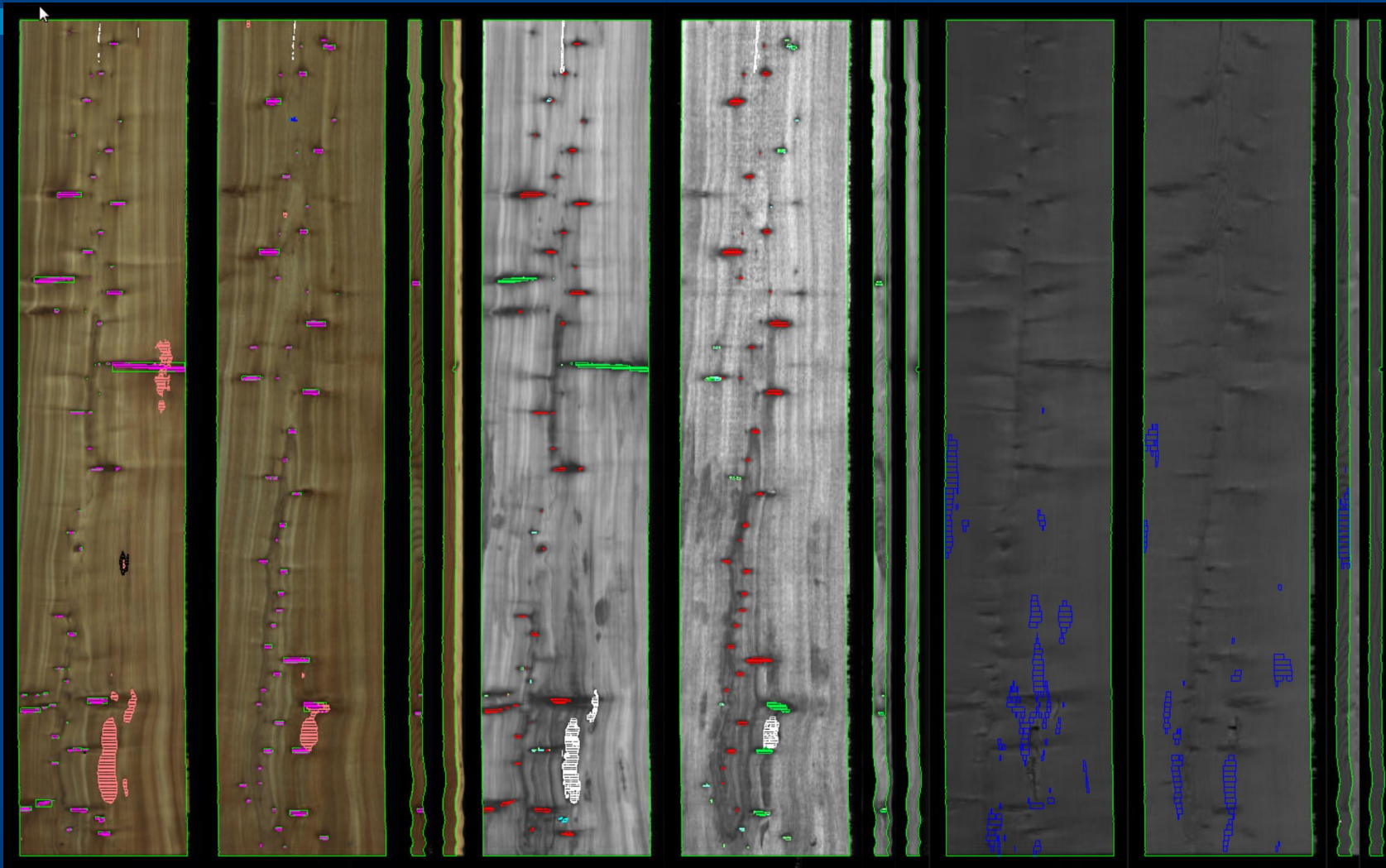
Sample “Thumbnail” Output, Hemlock



Sample “Thumbnail” Output, Rough Green Hemlock

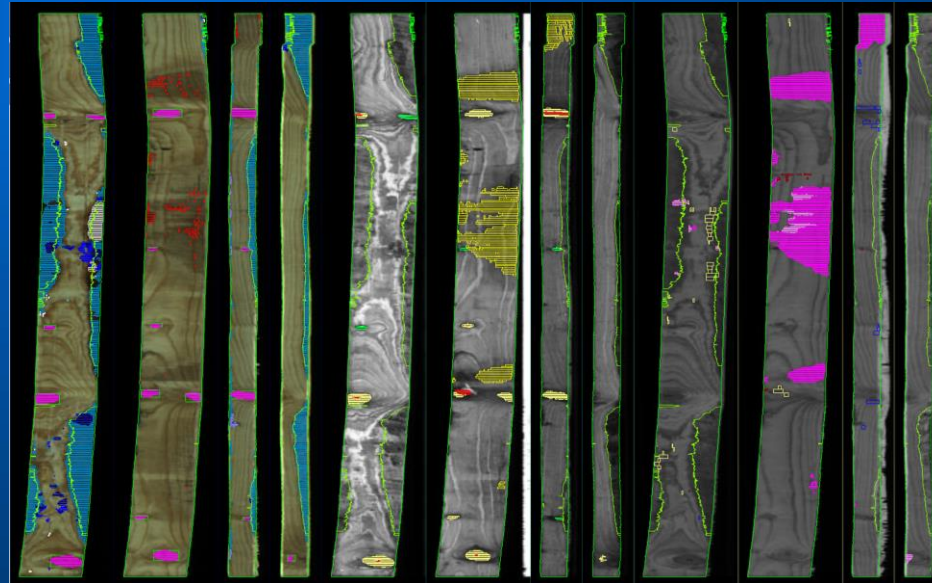


Sample “Thumbnail” Output, Cedar



Perceptive Sight™ Rollout:

- First Installation, March 2017
- Roughly one new Perceptive Sight Install/Upgrade per month
- Roughly one new species per month



Field Results – QCAssist™ Dashboard

QC Assist

Species: Product: Start: 5/12/2018 End: 5/29/2018

Pack Name	Total Boards	Package L...	AG (pcs)	BG (pcs)	AG	BG	Length	Pack Date	Request Ac...
2x6 SYP No. 2 QC 120 ALL BOARDS ON GRADE	128	744	0	0	0 %	0 %	14'	05/21/2018	<input type="checkbox"/>
2x6 SYP No. 4 QC 119	128	743	3	0	2 %	0 %	12'	05/21/2018	<input type="checkbox"/>
2x6 SYP No. 2 QC 118	128	742	1	0	1 %	0 %	12'	05/21/2018	<input type="checkbox"/>
2x4 SYP No. 1 QC 117	208	726	0	5	0 %	2 %	12'	05/17/2018	<input type="checkbox"/>
2x4 SYP No. 4 QC 116	208	725	3	0	1 %	0 %	10'	05/17/2018	<input type="checkbox"/>
2x4 SYP No. 3 QC 115	208	724	2	7	1 %	3 %	12'	05/17/2018	<input type="checkbox"/>
2x4 SYP No. 2 QC 114	208	720	1	0	0 %	0 %	12'	05/17/2018	<input checked="" type="checkbox"/>

QC Assist

Species: Product: Start: 5/12/2018 End: 5/29/2018

Pack Name	Total Boards	Package L...	AG (pcs)	BG (pcs)	AG	BG	Length	Pack Date	Request Ac...
2x04 KD HF Econ QC 193 rs	294	732	3	0	1 %	0 %	8'	05/16/2018	<input type="checkbox"/>
2x04 KD HF Econ QC 192	208	731	0	0	0 %	0 %	12'	05/16/2018	<input type="checkbox"/>
2x04 KD HF 2NBtr QC 191	294	717	0	2	0 %	1 %	12'	05/16/2018	<input type="checkbox"/>
2x04 KD HF Econ QC 190 rs	294	713	1	0	0 %	0 %	10'	05/15/2018	<input type="checkbox"/>
2x04 KD HF 2NBtr QC 189 rs	294	712	0	4	0 %	1 %	16'	05/15/2018	<input type="checkbox"/>

Call Lucidyne to
Learn More!

541-753-5111

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