A SIMPLIFIED HARDWOOD LOG-SAWING PROGRAM FOR THREE-DIMENSIONAL PROFILE DATA

R. Edward Thomas[1]

ABSTRACT

Current laser scanning systems in sawmills collect low-resolution three-dimensional (3D) profiles of logs. However, these scanners are capable of much more. As a demonstration, the U.S. Forest Service, Forestry Sciences Laboratory in Princeton, WV, constructed a 3D laser log scanner using off-the-shelf industrial scanning components. The scanner is composed of three laser scan heads positioned at 120° intervals around the log. Each log is held on steel supports as the scanner mechanism traverses the length of the log. The scanner collects a high-resolution 3D dot cloud map of exterior log surfaces. Each log scan is composed of a series of scan lines around the circumference of the log. The distance between scan lines is 1/16 (0.0625) inch and each line is composed of approximately 300 to 600 points, depending on log size.

Recent advances in image processing have resulted in methods capable of detecting external degrade log defects in the 3D laser data cloud (Thomas and others 2006). With the automated defect detection results or manually recorded log defect information, internal defect shape and position can be inferred using internal defect prediction models (Thomas 2008, Thomas 2009). Combining these three data formats yields a complete 3D view of the log, complete with external and internal defect data.

A computer program was developed using ray-tracing methods to process the 3D log data. Ray-tracing is a computer graphic and mathematical method that simulates the path of a light ray emanating from a source and records the points at which rays intersect and reflect off of objects. If you imagine the saw blade as a ray of light, you can use this method to detect where the saw intersects with the log and and surface or internal defect. The virtual saw blade travels along the log in a line and we record the points where the blade intersects the log or defects. By default, the sawing line travels parallel to the geometric center of the log. If taper sawing is desired, simply adjust the line such that it is parallel to the log surface. Similarly, it is possible to also enable curve sawing by having the saw follow the log profile.

The sawing program takes user-defined sawing patterns, applies it to the set of log data, and generates a set of lumber for each log processed. The sawing program does not perform any optimization. That is, it will saw only the sawing pattern specified. The virtual boards can be graded and a maximum value or yield calculated using the Ultimate Grading and Remanufacturing System (Moody and others 1998) or other lumber grading or processing programs. Repeating the process for different sawing patterns and rotations allows different sawing scenarios to be examined quickly and easily in the office. For example, sawing an 18-inch diameter log into 19 boards takes approximately 45 seconds on an average desktop computer.

[1]Research Scientist, U.S. Forest Service, Forestry Sciences Laboratory, 241 Mercer Springs Road, Princeton, WV 24740. To contact, call (304) 431-2324 or email at ethomas@fs.fed.us.

LITERATURE CITED

Angel, E. 1997. **Interactive computer graphics.** Boston, MA: Addison Wesley Longman, Inc. 521 p.

Moody, J.; Gatchell, C.J.; Walker, E.S.; Klinkhachorn, P. 1998. **User's guide to UGRS: the ultimate grading and remanufacturing system (version 5.0).** Gen. Tech. Rep. NE-254. Radnor PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 40 p.

Thomas, L.; Milli, L.; Thomas, R.E.; Shaffer, C.A. 2006. **Defect detection on hardwood logs using laser scanning.** Wood & Fiber Science. 38(4): 682-695.

Thomas, R.E. 2008. **Predicting internal yellow-poplar log defect features using surface indicators.** Wood & Fiber Science. 40(1): 14-22.

Thomas, R.E. 2009. **Modeling the relationships among internal defect features and external Appalachian hardwood log defect indicators.** Silva Fennica. 43(3): 447-456.