

HARDWOOD SAWYER TRAINER

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INTRODUCTION

It is well understood by now that the initial breakdown of hardwood logs into lumber has a tremendous impact on the total lumber value and conversion efficiency. The focus of this research project is the development of a computer-aided sawing trainer tool for the primary breakdown of hardwood logs.

Maximum lumber recovery is dependent on the proper log orientation as the flitches are removed. The primary breakdown of hardwood logs is a decision-intensive activity that relies on the knowledge, skill, and experience of the sawyer. The latter sawyer attributes are typically the result of many years of sawing experience. There is currently no facility that will allow a beginning sawyer (trainee) to experiment with different log orientations during sawing, or with different breakdown patterns on the same log, and receive immediate feedback on the outcome of sawing decisions as a learning aid. It will be prohibitive to practice on sawlogs in the sawmill, since physical sawing is an irreversible process.

The objective of this research project is to develop a computer-aided sawing trainer that will enable the beginning sawyer to nondestructively experiment with sawing decisions. To be an effective tool, it will need to represent logs and defects in realistic shapes, provide tools for examining the log, enable the repeated sawing of the same log, provide immediate lumber value feedback, store the history of the sawing session of each user for reference, and be user-friendly.

Since it will be difficult to create a sawing trainer tool that will be everything for everyone, it is important to define the parameters for what it is and what it is not. What is it? It is primarily a nondestructive simulator for log breakdown, which can be used as a tool for exploring sawing alternatives, and as a trainer for examining the effects of sawing decisions. Its main contribution will be in the sawing decision process. What is it NOT? It does not replicate a sawyer cab environment (lacks characteristic noise, flying sawdust, etc.); it is not a simulator for headrig operation controls (no joystick, control panel, etc.); nor does it claim to be a substitute for real hands-on headrig experience. It is intended to be an early learning tool for the green (beginning) sawyer, where the impact of different sawing decisions can be nondestructively studied. Ultimately, the trainee has to graduate to the real sawing headrig and networks.

METHODOLOGY

Three steps were involved in the development of the sawing trainer: implementation of solid modeling techniques, generation of hypothetical logs from real logs, and development of the program using ANSI C and Silver C codes.

Solid Modeling: Implementation

The logs and defects were represented as solid models because of several factors: their relative ease of representing visually realistic objects, ranging from wire-frame, hidden-line removal, shading, lighting, and texturing; convenience of performing calculations, such as dimensions, volume, mass, centroid, and surface area; the capability to do transformations, such as translation, rotation, and scaling; and the capability to logically operate on solid models, such as the Boolean operations of intersection, union, and difference.

Log and Defect Generation

The logs and their defects were generated from surface characteristics (and indications of internal defect locations) of real logs collected in the 1960s by the Northeastern Forest Experiment Station. Thus, while the logs and defects are hypothetical (generated as opposed to actual data set), they are representative of real logs from historical data. The generation uses a methodology developed by Chen and Occeña (1996). There are six red oak log models for each log grade in the trainer library, for a total of 18 logs. More logs of different grades or species can be added in the future

Like any solid model, the logs and defects exist as 3-dimensional geometric and topologic representations. To make them look realistic, color, shading, and lighting are added as shown in Figure 1.

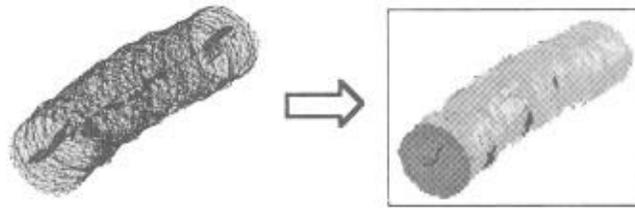


Figure 1. Solid model coloring, shading, and lighting.

Equally important is the object-oriented structuring of the data to represent the original log and its defects prior to sawing, and the subsequent log section, kerf, wane, and lumber board resulting from each sawing pass.

Program Coding

Finally, the program is coded using a combination of SilverC and ANSI C. SilverC is a built-in C compiler of SilverScreen, an integrated CAD program produced by Schroff Development Corporation (Howe 1996). The sawing trainer is primarily built on top of SilverScreen, and calls on several of SilverScreen's functions. At the same time, it calls on several externally written ANSI C programs, for example lumber grading and general system management.

DESIGN AND DEVELOPMENT

There are 26 modules in the sawing trainer program, as listed below. Each module is responsible for a key function of the program. When the application is started, the trainee will be asked to create a user profile that will be used to track the user's progress. A main menu offers six modes, as shown in Figure 2. After selecting the first mode (sawing simulation), the trainee will be presented with a list of the logs in the library. A description for each log is provided. The trainee can choose between a band saw and circular saw, and specify a default board thickness. The trainee can then begin working with the log, with the ability to rotate, zoom, or finally saw. Each sawing operation will show the opened face, and require the trainee to decide whether to continue sawing

Opening	History Load	Read Name	Purge	Zoom
Sawing	Get Position	Edging	Volume	Utility
Edging Position	Wane Manager	Assistance	User Profile	Taper Rotation
Making Kerf	Kerf Manager	Rotation	Corrector	Picture Gallery
Save Undo	Pop-Up Menu	Grading	Exporting	Score-Updating

on the same face, or to turn the log and begin sawing on a different face. The trainee can follow the rules of thumb for log sawing, or try out a new sawing pattern. After either the dogboard or the final cant is reached, the edging and grading process will proceed and present the trainee with the resulting grade and value yield, as in Figure 3.

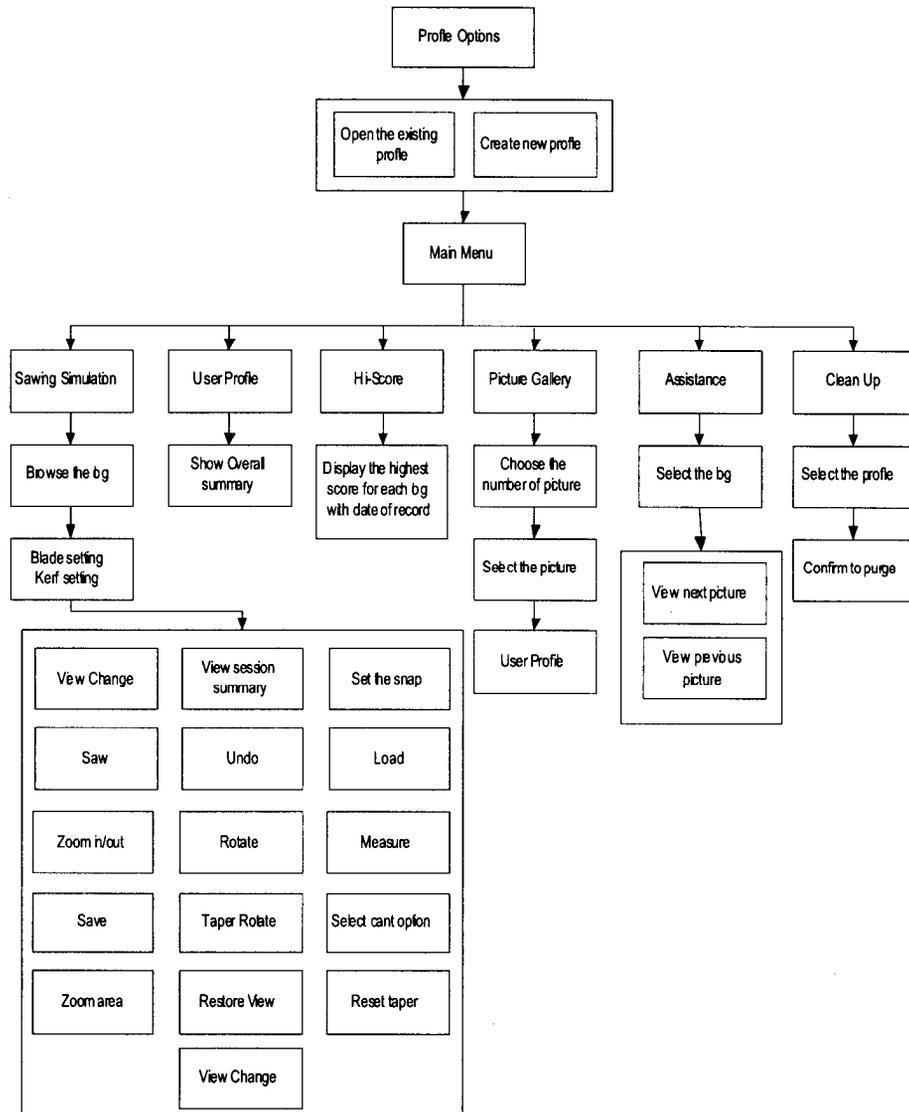
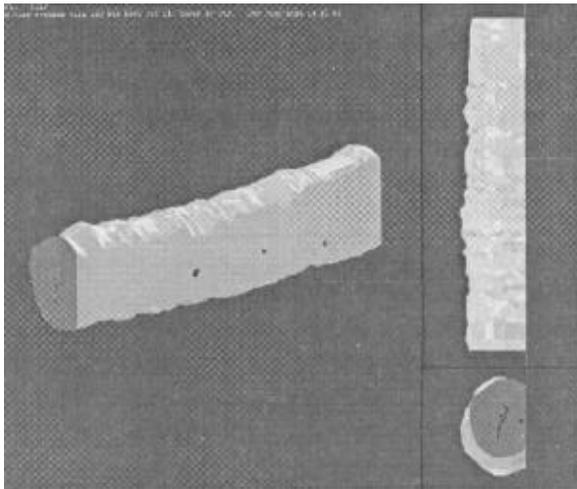
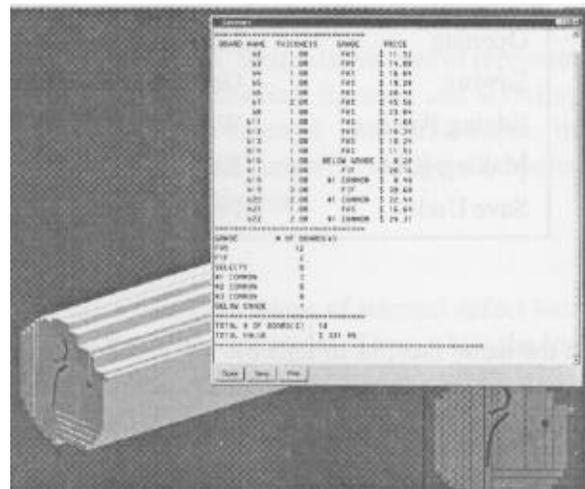


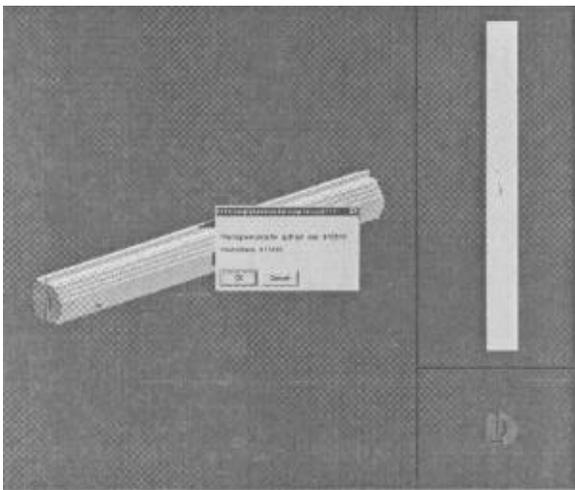
Figure 2. Hierarchical Map of Functions.



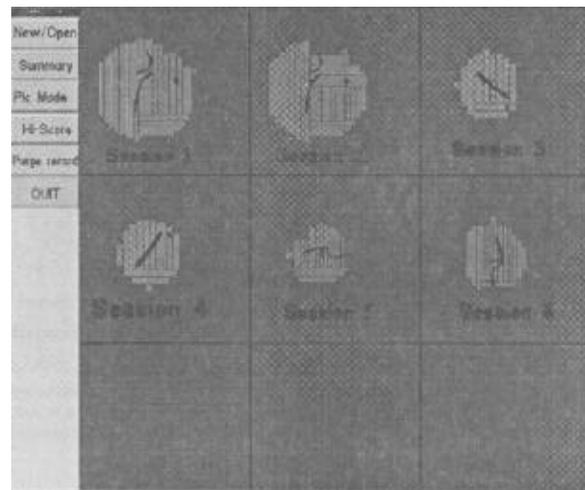
Opening face.



Grade and value results.



Recognition of best sawing result for a log.



Comparison of various sawing trials on same log.

Figure 3. Sample sawing trainer images.

After the sawing is completed, the program will retain a snapshot of the sawing pattern with a label prescribed by the trainee. The User Profile mode gives a summary of the trainee's sawing results. The Hi-Score mode view previous sawing patterns in the user profile. The Assistance mode shows a sample high-scoring breakdown session for each log in the library. Finally, the Clean Up mode enables the trainee to purge unwanted profiles to save disk space.

CONCLUSION

The sawing trainer program is a nondestructive training tool on hardwood log breakdown for beginning sawyers. On the same log, the trainee can explore the effects of different sawing patterns, log orientations, and

sawing rules of thumb. Upon completion of a sawing session, the trainee receives immediate feedback on value and volume recovery. A history of the session is retained for future reference and comparison.

The sawing trainer program was commissioned by the National Hardwood Lumber Association through the presented at the NHLA Annual Meeting in San Diego, CA, last September 1999, and at the NHLA Research Symposium in Canaan Valley, WV, last May 2000. The two-year project will end on July 1, 2000. The program to cover packaging, shipping and handling.

Until the NHLA assigns a formal name for the program, we have temporarily called it LogCAST (which stands (PC), with at least 64 Mb RAM. As mentioned earlier, LogCAST runs on top of the SilverScreen program. members to obtain a complimentary copy of SilverScreen for the exclusive purpose of running LogCAST.

To ensure that LogCAST is used productively by the NHLA membership, a follow-up proposal has been submitted training workshops on the proper use of LogCAST, an assessment study of the effectiveness of LogCAST as a

ACKNOWLEDGMENTS

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