EUREKA AUGUST 2002 FEATURE STORY

Touch wood for something more than luck

An IT-based revolution is poised to transform a traditional material into something capable of challenging plastics in low-cost consumer products. By Tom Shelley

Wood could soon replace plastic in many products courtesy of a new computer-based characterisation and manufacturing techniques.

A European Union-funded project in Germany, Austria and Sweden has demonstrated that it is possible to assess automatically individual planks in some detail while a small company in Switzerland is pioneering new mass production wood component finishing tools and robotic machining techniques that will accommodate natural variations. While still lacking the skills of experienced woodworking craft workers computer-based methods can imitate many of the traditional processes - selecting the wood, deciding which pieces to use for which purpose and adapting the manufacturing process.

Wood is, of course, an amazing composite material that has evolved to perfection over many millions of years. And provided forest sources are properly managed, it is a low cost and everlasting resource. It is, however, highly variable, not only between different species but also between different trees and even different parts of the same tree. So, in order to make better use of wood, especially in the relatively high wage environment we enjoy in Western Europe, the EU has set up a project called IntelliWood. This is being co-ordinated by Sensotech GmbH in Graz, Austria, with the objective of new automatic and low-cost, non-destructive ways of determining the stiffness and strength of individual pieces.

One of the participants is the Bavarian Research Center for Knowledge-Based Systems at the University of Passau in Germany, which is working in conjunction with another university institute, Lignum Research in Graz, Austria. Michael Kellner, one of the Passau researchers, showed Eureka how the properties of wood can be determined by running planks beneath a video camera installed one metre away and working in grey scale and using a computer to follow the grain and compute overall visual properties. Formulae are being researched by Lignum to permit the automatic determination of strength and elasticity, based on knowledge of the species and the origin of the particular wood being examined.

The process is already sufficiently developed to be able to flag up knots, even when these are on the side of the plank opposite to that being observed by the camera. But the eventual goal is a commercially viable product for use in wood-based manufacturing facilities.

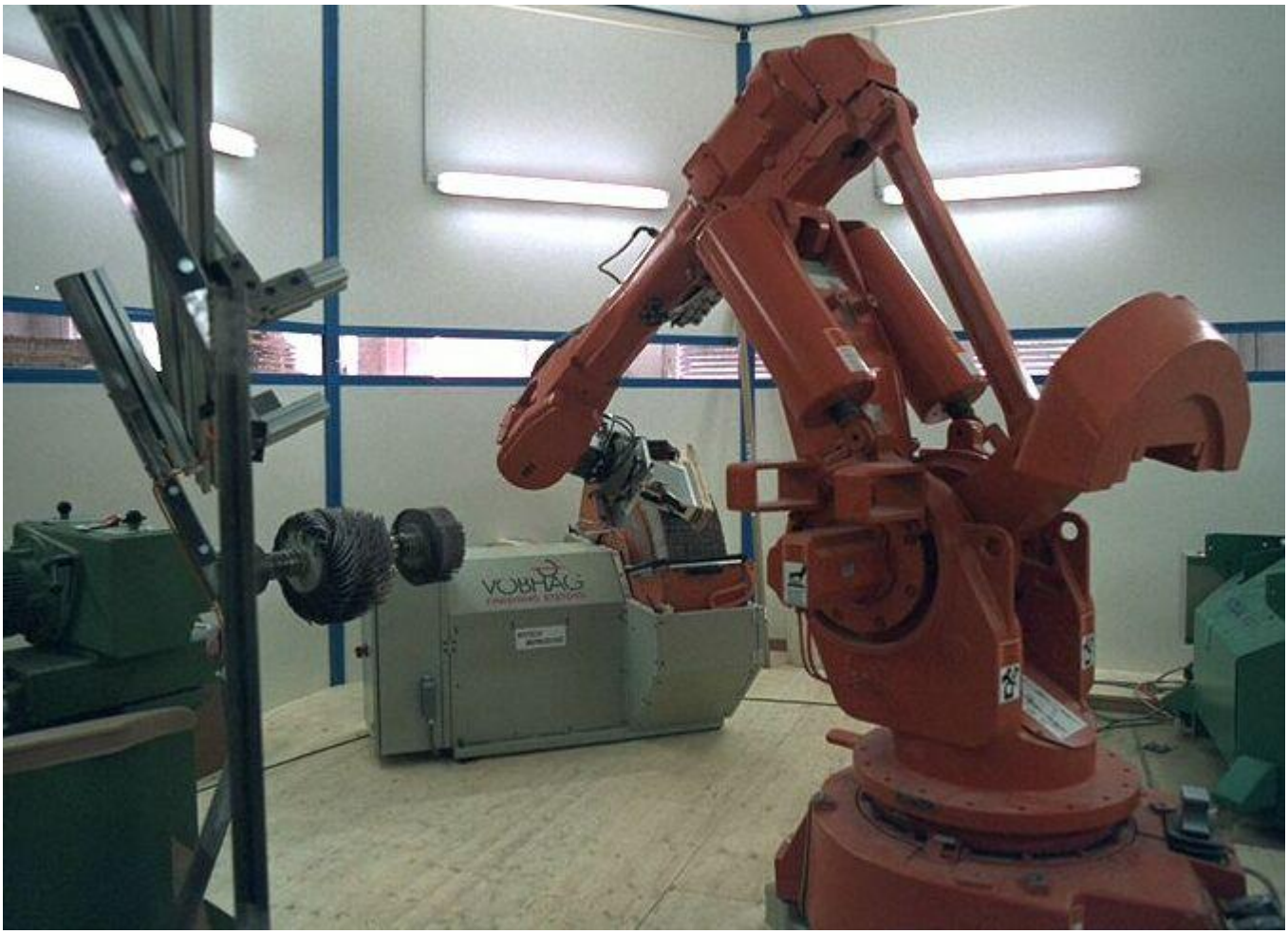
Such a technology, even without the ability to predict accurately strength and stiffness, would be invaluable in a fully-automated manufacturing environment. Processing speed is currently 5 frames per second via a 1,200MHz processor using the Linux operating system. In this way an entire plank one metre long can be examined in less than a second.

Electronically characterising wood is the ideal complement to the robotic wood manufacturing and finishing techniques being developed by Wood Unlimited, a small company based in Biel-Bienne, Switzerland. This is a start-up enterprise spun out of the Swiss School of Engineering for the Wood Industry (SWOOD). Its two main breakthroughs are a new sanding tool that always remains sharp and robotic finishing software.

The tool comprises a large number of strips of sandpaper attached at one end to a rotating hub with the other end thrust outwards by centrifugal force. Between each sandpaper layer is a layer of foam, which allows the tool to deform when a workpiece is pressed against it, exerting a roughly constant pressure irrespective of precise relative positions. Furthermore, unlike traditional sanding tools, which according to the company's Daniel Berchtold, only last for a few workpieces, the new tool lasts for "hundred of pieces and always remains sharp." This happens because the strips wear away at their ends, constantly exposing new backing with unworn sand, unlike a traditional tool where the sand grains are steadily worn away and removed from the backing, which remains.

The workpieces are held against the sanding wheels by a robot using sophisticated and novel software. This allows immediate changes to control instructions, according to which type of component is being sanded, while the robot detects the force between workpiece and tool and modifies its program accordingly.

This accommodates several problems peculiar to the wood industry. To begin with, the average small Swiss factory producing high class furniture will make, perhaps, 100 different parts to fulfil customer orders for different items of furniture, with production runs often only in a few tens. Furthermore, each piece of wood is liable to possess slightly different mechanical properties from every other and, as a result, may vary slightly in dimensions after coming out of previous manufacturing processes.



Wood Unlimited currently markets its technology in the guise of three distinct products. Wood profeel 100 is a production cell specifically designed to sand flat shaped furniture parts with profiles on the surface and on the edges. Wood contour 200, on the other hand, routes the contours out of the raw shapes made of moulded plywood as well as sanding them. And Wood-solid 3D 300 produces complicated solid wood parts. Depending on the loading system, the production cell is able to work independently for up to ten or more hours at a time. These products have been developed mainly for the furniture markets but the intention is to extend the technology to other areas.

At the top end of the engineering spectrum, the objective of the computer-based characterisation project is to pick out wooden planks of guaranteed and consistent strength and quality with a view to their being used in engineering constructions with an assurance as to their performance. Large buildings have been, and often still are, built largely of wooden parts, and plywood proved itself a highly successful material for making military aircraft during both world wars.

At the other end of the spectrum, Eureka recently found itself in possession of what appeared to be a German-made wooden ballpoint pen. It is interesting to compare this precisely manufactured and beautifully finished machine-made wooden product with its much cruder counterparts hand-made in India by craftsmen undoubtedly paid only pitiful amounts. But, in either case, the wooden pens look nicer than their plastic equivalents and have proved to be more durable.
(More information at www.forswiss.uni-passau.de and www.wood-unlimited.com)

Pointers

• Wood can now be characterised automatically by a vision system working at 1m/s

• Robotic manufacturing is able to accommodate variations between individual wooden parts

• Wood has the potential to replace plastic in low-cost consumer products