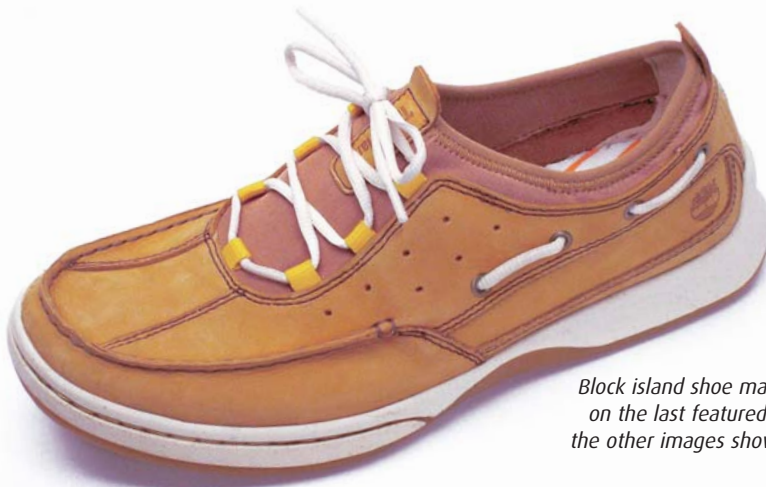


WORLDFOOTWEAR

DSSP opens new horizons



Block island shoe made on the last featured in the other images shown

Timberland has become something of a cultural icon as well as a leading brand. The nickname 'Timbs' frequently appears in hip-hop lyrics and one of the genre's best-selling producers, Timbaland, is named after the company's footwear. Amid all this hype, it is easy to overlook the fact that the company is also something of a manufacturing innovator. It was an early pioneer of injection moulding in the 1960s in order to produce effective water resistant boots. Over the last decade, the product line has expanded from rough-and-ready outdoor boots to a full line of footwear and apparel for men, women and children.

The latest innovation by the company, with its headquarters in Stratham, New Hampshire is taking place behind the scenes with the introduction of DSSP (digital shape sampling and processing) technology from Geomagic for greater footwear customisation, faster time to market, more consistent quality and a reduction in manufacturing waste. While it might not provide further inspiration to rappers, it could well have an influence on how shoes are designed and manufactured for the global market in the future.

LASTS HAVE CHANGED

Shoe lasts were originally made from wood by hand and with no lefts or rights. The 19th century saw the invention of copying lathes which could simultaneously turn both left and right feet. Today, they are generally milled from polypropylene blocks by CNC (computer numerical control) machines.

Timberland currently produces between 100 and 120 lasts per year across its main product lines of Outdoor Performance, Authentic Youth, Industrial-Pro and Casual Gear. Until two years ago, all lasts were created and modified by hand, and then shipped to the company's manufacturing facility in the Dominican Republic or to Asian partners in Thailand, Vietnam and China. Incorrect and outdated lasts were thrown away unless they were newer ones made with polypropylene which could be recycled.

With the new DSSP process, hand-made lasts represent only 10% of those used for design and manufacturing and reworks, a frequent occurrence with hand-made lasts, have been reduced by up to 75%. Timberland says that a last can now be visualised before it is used to make a shoe and a physical prototype created within three-to-four hours for a design and engineering review. Material waste has also been drastically reduced and chemical-based fillers eliminated.

WHAT IS DSSP?

DSSP is essentially a collection of technology components that enables users to quickly create accurate digital models of complex physical objects. It is used by manufacturers worldwide to capture a part with a 3D scanner, reconstruct the

measurement data (point clouds) into highly accurate polygon or NURBS surfaces and use the resulting digital model for applications such as product design, tool and mould design and verification, customised manufacturing, recreating legacy parts, engineering analysis, digital archiving and computer-aided inspection.

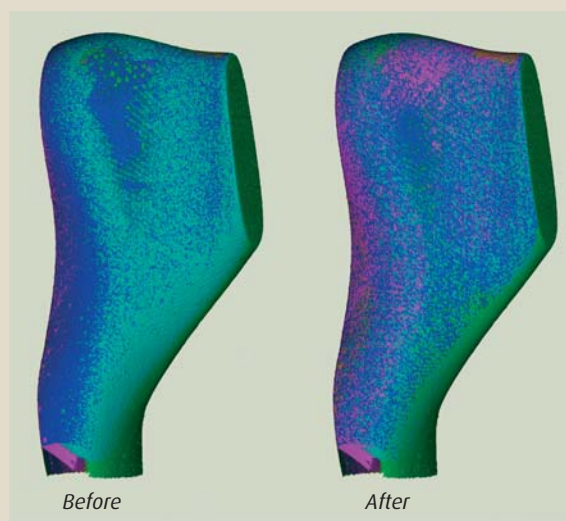
At Timberland, the process of creating a completely new last starts the way it has always done. A concept is specified by the product design team and is usually based on an existing last that has worked well. An in-house last engineer then creates the first interpretation by hand, cutting, filling and adjusting the shape, keeping in mind the balance of key fit points and design aesthetics.

Once complete, the last is scanned with a Konica-Minolta Vivid 9i laser scanner which captures the shape of the last as thousands of 3D points within a resolution up to ± 0.008 millimetres. A turntable controlled by Geomagic software helps to speed up the process of producing multiple scans that capture the complex curves of the last.

FROM PHYSICAL TO DIGITAL

Point-cloud data from the scanner is then brought into Geomagic Studio digital reconstruction software, which automatically aligns the multiple scans. A module called Wrap eliminates time-consuming surface reconstruction work by mathematically 'wrapping' a polygonal surface around the point-cloud data. The software also provides intelligent data filtering to

Automatic global registration is used to align the different scans of the last



DEFINITION

CAD is used to create 3D models from scratch using a *prescriptive* process, i.e. it starts with a blank screen, requiring the user to input dimensions, shapes, curves and surfaces that will define an object.

DSSP offers *descriptive* modelling methods where the software extracts geometry and topology from measurement data and describes them to users for archiving and re-use for multiple purposes. It enables a user to create exact digital models from an archive of existing physical lasts and use them in a new design and manufacturing process without having to make models from scratch in CAD.

preserve features and minimise visual noise from the 3D model. Automated features can be used to fill holes and remove blemishes while maintaining surface curvature and to reconstruct sharp or creased edges lost during scanning. From initial scanning to digital reconstruction, a precise digital replica of a last can be produced in about an hour. A more complex object, such as an entire shoe with many more features and details, can take three or four hours.

Two features that have proved particularly useful are 'select by edge length' and 'select by curvature'. Select by edge length eliminates shadow surfaces created during scanning, where a surface has been formed across what should be a gap. The software automatically identifies these because of longer edge lengths. Selecting and deleting these surfaces manually can be very time consuming. In a similar manner, select by curvature cuts down the amount of time needed in finding and eliminating areas of high curvature from smoothing operations.

ENDLESS POSSIBILITIES

Once basic lasts are captured in digital form, the design, prototyping and manufacturing possibilities appear to be endless. Timberland has found the greatest time savings have come from being able to modify lasts quickly and by digitally transferring 3D last files to overseas factories instead of shipping physical products.

DSSP has also allowed modified versions of existing or historical lasts to be created, based on models from the company's digital archive of more than 500 designs. Design conceptualisation can be done in minutes by making changes to the 3D model and, in cases where a physical prototype is needed, the Geomagic data can be sent to a Z Corp rapid prototyping system, which can produce a realistic physical model for design and engineering review in three to four hours.

The fact that three or four new lasts can be digitally replicated in a day means that many more design options can be explored in order to meet the demands of today's fast changing footwear market. It is also hoped that exchanging 3D digital data with manufacturers will lead to standardised fitting and grading regardless of where a shoe is produced, as there is less chance for error. With new lasts often based on proven ones known to fit well and be suitable for manufacturing, foreparts can be altered for fashion or end-use purposes without altering the heel area that is so critical for fit.

Finally, Timberland has discovered one further extremely useful function—archiving. In the past, this involved considerable

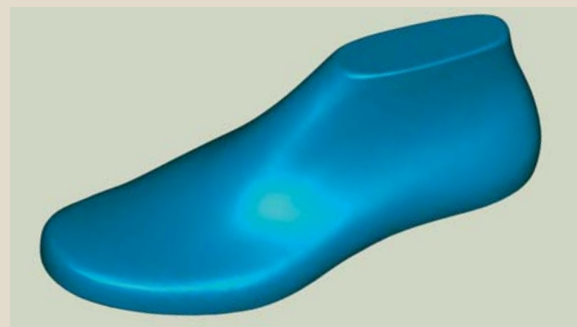
manual labour and physical space to store and retrieve hundreds of historical lasts. Geomagic 3D models of lasts can now be transferred to an electronic library that is managed using 3Shape software. This provides a structured database, search and browsing functions and an archival display of all relevant information. Important data such as development notes, measurements and other information necessary to ensure design and manufacturing accuracy has, therefore, become much easier to trace.

VIRTUAL SHOES AND BEYOND

Timberland has only been using DSSP for two years. It now has plans to use the system for computer-aided inspection for geometry and shape comparison among different types of shoe and to create photorealistic 'virtual shoes' that can be reviewed on screen by designers and manufacturers at any location, anywhere in the world. It is also felt to have the potential to deliver more customised styles to the market in much less time.

Most producers of women's casual footwear introduce new products four to eight times a year. Timberland, on the other hand, typically designs and develops new products only twice a year. Currently, somewhere near 150 styles are produced every six months and the time needed for production and shipping is fairly fixed.

Finished digital last used for Block Island shoe



If tools such as DSSP and rapid prototyping can reduce the design and development segment of the cycle sufficiently, it might be possible to produce 75 to 90 styles every three months. The ability to present fresh new women's casual products four times a year could then increase revenue by as much as 25% as retailers would have more opportunities to place new products in their stores.

The impact of increasingly sophisticated computer software programs never ceases to amaze. Timberland is a serious player in the global industry and, if it has found DSSP technology able to offer so many benefits, it is clearly worthy of consideration. The fact that the company also sees it as a way of moving from its traditional stance to one of being able to offer greater variety and freshness in its ranges at no extra cost has to be another signal of a fundamental change in the way the industry of the future is likely to work. It's no longer a black-and-brown shoe world. 

This article has been created with the assistance of Bob Cramblitt, president of Cramblitt & Company, who writes about technologies that breed positive changes in the way goods and data are designed, managed, engineered and produced.