

Seeking a good fit

IAN PARIS

"Why is it that after 150 years of shoemaking, we still have to fit-test even the most basic woman's court shoe?" So said Tony Darvill, Clarks Shoes Engineer and inventor of the Shoemaster CAD/CAM system in 1975. In this, the first of two articles, Ian Paris, CTO of ATOMLab Bristol, provides a general outline on why it is difficult to manufacture shoes to fit all customers. Everyone knows that this is a complicated problem for which there is no simple answer. A new approach to research could produce valuable information to assist manufacturers in improving their rates of success when fitting shoes.

LAST MODELS AND FITTING TESTS

At the core of shoe making is the last; this provides the foundation from which all parts of the shoe are derived. For many years, ever since the invention of last turning lathes, the focus has been to produce a model size last that can then be turned into a set of graded lasts in different sizes and, possibly, width fittings. It is therefore vitally important to ensure that this model last has good fitting properties. For this we rely on a 'master last maker' who, through skill and years of experience, can create new last shapes that adhere to the measurement standards of a given shoe manufacturer, as well as provide an aesthetically pleasing shape around which to form

the shoe. The process typically involves using standard back-parts and grafting foreparts on to these to produce lasts that are then adapted in shape using manual wood-working skills.

However, even when a model last has been produced to these exacting standards, it is still necessary to fit-test shoes that are made on that last. This is because the fitting properties of shoes are also affected by other factors such as construction and style, the number and type of pieces in the upper and the softness of materials used. To fit test shoes, a manufacturer will select several of their employees to be fitting models. These firstly have a model size foot and

secondly are 'judged' by the fitting services manager to have a typical foot shape. It is vitally important that the shapes of the feet of these people are representative of the customer population. In reality, it is almost impossible for a shoe company to know if this is absolutely true, so they rely on their experience and skill as shoemakers to make the correct judgement.

Once a shoe has passed a fit-test, then additional sizes (and possibly widths) are created by proportionally grading the model shoe last. The gross assumption of this process is that all customers, no matter what size/width, have feet that are in proportion to the



Creating lasts with good fitting characteristics relies on the skill of a master craftsman.

CREDIT: MONKEY BUSINESS/SHUTTERSTOCK



The feet of a number of employees are checked to find those with a typical foot shape.

CREDIT: MONKEY BUSINESS/SHUTTERWORK

last grading rules. This is a point for discussion. Ultimately, a successfully fitting shoe is one that a customer feels comfortable wearing. This introduces a whole range of subjective factors concerning personal choice. Some people prefer soft light shoes, others hard heavy ones. Some prefer a tight fit, others a more relaxed/loose fit and so forth. However, the important point is that although subjective concepts of comfort are a factor, these are less likely to be achieved if the technical fit does not provide a good correlation between the size and shape of the foot with that of the shoe.

The foot should fit the shoe shape in static conditions. The position of the foot within the shoe should also allow them to function in harmony when walking. For example, the foot should bend in the same region as the shoe is designed to bend. If technical fit is not achieved (even if a consumer has the impression that the shoes are comfortable) then shoes will distort in shape over time and will appear to deteriorate more quickly than expected. Whereas the lasting process is what should determine the shape of the shoe, a bad technical fit combined with warm, humid conditions inside

shoes can result in the lasting process effectively continuing after purchase. This often results in them changing into a shape that was not envisaged by the designer or expected by the customer. Consumers can be unaware that shoes have a bad technical fit and assume that this deterioration of shape is due to the shoes being of a lower quality than they expected. It is therefore vital that manufacturers produce shoes in shapes that fit the foot shapes of their customers.

SHOE AND FOOT SIZES

Over many years, consumers of footwear have been educated to believe that a shoe size and width is an accurate guide that will point them to the exact shoes that are suitable for them to wear. In reality, this should only be used as an approximation to the selection of shoe sizes and types they should try on. A shoe sizing system has limitations. To observe these, let us compare the sizing systems of shoes with those of paper. Sheets of paper are also defined by length and width with imperial and metric sizing systems also used. However, this is where the similarities of sizing systems stop. The paper sizing system is a 100% representation of the product, whereas feet and shoes being 3D objects can only be represented in a simple way if solely relying on length and width.

Problems arise when using these sizing systems as feet with the "same size and width" can be very different shapes to each other and will therefore have different fitting characteristics. It is also true that shoes that are the same size can vary significantly in shape and that shoes available in a size 10 from one company can be a different size to a size 10 from another. It is hardly surprising that anyone buying footwear hits the problem that shoes that are marked as their size and width, do not always fit. It is clear that the size and width labelling system can never be effective as the only one to put the correctly fitting shoes on an individual's foot. Traditionally, it is recommended to use the skills of an experienced shoe fitter within a shop. These are not always available, however and with the increase in Internet shopping, alternative methods other than using an expert need to be considered. Technology can offer some supportive



Using size and width as a definitive label is ideal for paper but not for feet – or shoes.

CREDITS: IUNEWIND/SHUTTERWORK & MACROVECTOR/SHUTTERWORK

systems to the traditional shoe making expertise that can help improve the fitting success rates with customers.

FINDING SHOES THAT FIT

Recent studies in the UK have shown that more than 40% of men in the UK are buying shoes that are one or even two sizes too big in order to get sufficient width. This, however results in shoes that are technically incorrect in other aspects, such as the shoe flexing in the wrong position (*World Footwear* November/December 2018). Typically, Internet shoppers purchase up to three pairs of shoes in different sizes as they lack confidence in the sizing systems currently used. This involves the return of at least two and possibly all three pairs. In any business model, this has to be viewed as inefficient and costly. It is also common knowledge that consumers tend to migrate to manufacturers that provide the shape of shoes that better fit their feet.

There have been many studies into shoe fitting and the relationship between feet, lasts and shoes. Predominantly these have focussed their attention on measurements and the correlation between these measurements when taken on feet, lasts and shoes. This type of approach has been driven by limitations in the manual measuring systems that have been available. Now, with the proliferation of available foot scanners as well as 3D CAD data of lasts and shoes, the quality and quantity of data

that can be analysed has greatly improved. The obvious conclusion with this step change in technology is that more measurements can be accurately recorded and compared. This is true, but it misses a key advantage that the new scanning technology provides in that it can capture not only measurements but also shape. A new research team has been set up at Bristol in the UK that is focused on the 'Science of Shoes' and evaluation of the effect shape has on fit.

ATOMLab RESEARCH

ATOM s.p.a, a world leading supplier of cutting systems, has shown its commitment to research and innovation by setting up a new corporate innovation division comprising three research centres collectively known as ATOMLab. These are found in three different locations but still closely collaborate on innovation projects. Each centre has an area of specialisation; Milan in Italy for AI, Cloud Platforms and Innovative Software Architecture, Vigevano also in Italy for Machine, Processes and Automation and Bristol in the UK for Science of Shoes and Footwear Innovation. The Bristol-based team has its origins within Clarks Shoes and subsequently Shoemaster International, developers of the Shoemaster 3D shoe design and manufacture CAD system. This provides a wealth of knowledge concerning shoemaking and shoe related technology.

Initial research is in progress at Bristol to study the effect of foot shape on the shape and, subsequently, the fitting of shoes.

This is a new approach to put shape as the primary characteristic ahead of dimensions/measures. The initial approach is to better understand and quantify the shape of feet. If you are trying to produce a shoe to be worn, then you must understand the shapes and sizes of your potential customers feet. In particular, the target for the research is to improve product design and processes so that shoe brands and manufacturers can:

- Produce ranges of shoes that better fit a higher percentage of their customer base
- Direct individual customers to shoes that would better suit their shape of foot
- Provide simple adjustments to shoe shapes for individuals that require something different to the readily available shoe shapes

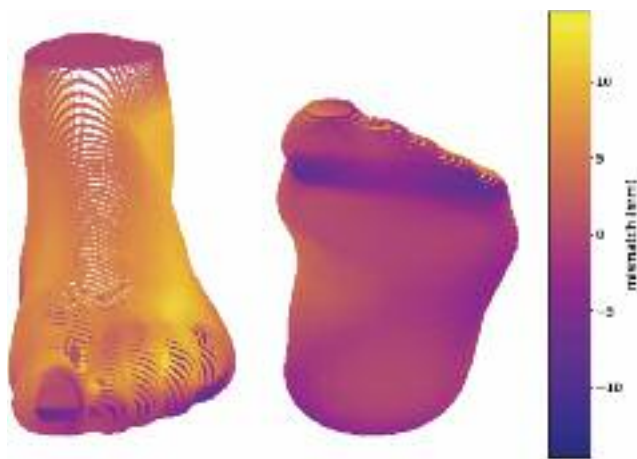
Foot shape studies are now in progress using new software tools developed in ATOMLab-Bristol. These allow us to analyse foot shape and quantitatively determine from a particular population, who has the 'most average' foot. In addition to selecting this person, it is also possible to mathematically calculate a shape that is the absolute average of that population. These average shaped feet would appear to be a good starting point to improve shoe fitting processes. Certainly, comparisons are being made with the fitting models of shoe companies in order to quantify if these people are a good representation of their customer base.

Other avenues of investigation are to evaluate the foot shapes in sub-populations. A particular example could be to determine if there are differences in the shapes of feet of people of different ages. If shoes are targeted at certain age groups, should last shapes be adjusted accordingly? Standard back-parts for lasts were developed many years ago; are the shapes of these back-parts suitable for the foot shapes of today's 20- to 30-year-old? Previous foot surveys have tended understandably to concentrate on the general population, bearing in mind the difficulty of collecting data. However, it is now easier to collect foot scan data including foot shape information, so that we can focus research on the customers of individual companies. After all, it is



Innovative software tools allow foot shapes to be compared for feet of different sizes.

CREDIT: M. ISKANDAROV/SHUTTERWORK



Heat maps can evaluate how close a foot matches the average foot shape of a population.

CREDIT: ATOM S.P.A.

very important to understand the foot shapes of your customers.

In addition, specific surveys are planned to look at comparing foot shapes of customers who buy shoes with potential customers that try on shoes but subsequently do not buy them. A report on the first wave of research is planned to be published in a future issue of *World Footwear*. We certainly do not expect to be able to provide a magic answer to what everyone knows is a very difficult problem. However, by approaching the problem from a different direction and using the latest technology partnered with

some innovative new software tools, we expect to be able to provide shoe manufacturers with services that can allow them to improve the fitting properties of their products and put more customers into good fitting shoes.

RESEARCH PARTNERS

ATOMLAB-Bristol is based in the Engine Shed, Bristol, a collaboration between Bristol City Council, the University of Bristol and the West of England Local Enterprise Partnership (LEP). Engine Shed is a hub where businesses, entrepreneurs, academics, social innovators and corporates collaborate. It showcases the strengths and innovations of the South West UK region by providing space, creating encounters, and running projects that inspire, enable, and challenge everyone.

Within this eco-system we have established strong ties with Bristol University, Bath University, the University of the West of England and Bristol Robotics Lab. Collaborative projects have been run at undergraduate, MSc and PhD levels. This provides the universities with their objective to run real-world projects linked with local industry and allows us set up small pockets of research while gaining access to the latest in academic research. In addition, we are collaborating with industrial partners including shoe makers who are looking to understand more about their existing and potential customers, and particularly looking to improve the fitting qualities of their shoes by using the results of joint investigations. Other industrial partners will be added to the project throughout the year. 📌

Perfect fit of your shoes

We feel the responsibility

Fagus

Highest precision and accuracy
Everything under one roof:

- Development and fabrication of shoelasts for normal production, direct injection molding and automation
- Sole design and molds

Leading shoelast partner
for automation



www.fagus.com

