

Robots Poised to put a Spring in the Step of the Footwear Industry

THERE are typically 28 separate operations needed to make an average shoe. All are highly skilled, manual tasks. This could be set to change. ROBOFOOT is a consortium formed last year that is seeking ways to overcome the complexity inherent within an industry so dependent on handcrafted production.

Gian Paolo Gerio, performance engineering manager at Comau S.p.A., said: "We share a dream that one day it will be possible to simply go into a shop, have your foot scanned and have the style you choose made for you there and then using the last most appropriate to your foot shape."

Europe is the global leader in the footwear industry for high value added shoes, with production centred on Italy and Spain. Fashion dictates that the footwear industry has some of the shortest production runs in almost any industry, so any automation would have to be extremely flexible in order to cope with small production batches. ROBOFOOT recognises that it will have to modify current production layouts and facilities in order to introduce advanced flexibility.

The robotic cell will lie at the heart of the demonstrator being developed by the ROBOFOOT consortium and all the various operations will be managed by Comau's C4G Open controller. Comau, which is owned by Fiat and is one of Europe's leading automation companies, is also acting as ROBOFOOT's system integrator. "A project this ambitious has to be a team effort", explained Gerio. "The Consortium needs companies like Robotnik, who specialise in flexible grippers capable of handling supple leather, just as much as it needs the end users, like Pikolinos and Rotta."

The ROBOFOOT Consortium is comprised of research institutions in the field of footwear, various technology providers and end users. They are Spanish research organisations, Tekniker (ROBOFOOT Co-ordinator) and INESCOP, Italian technology centre, CNR-ITIA, German technology centre, DFKI-RIC, robotics companies Comau, Robotnik automation, technology integrators, QDesign and AYCEN and end users, Pikolinos and Rotta. ROBOFOOT is an EU Framework 7 project and is expected to run for three years.

Fabrizio Romanelli, R&D Control Engineering at Comau, explains how the system will work: "Within the robot cell, an intelligent vision system will scan the scene and work in conjunction with a force sensor to recognise the objects within the cell and identify the components, such as the lasts, the various shoe parts and the packaging. The robot will then be able to use its sensors to locate the best positions to manipulate the shoe components and grasp the final packaging."

The Consortium is focussed on developing grasping and handling algorithms and devices so that the robot can manipulate shoes of different shapes, sizes and material properties, firmly and reliably whilst avoiding surface damage. Critical to this being successfully managed is the development of an off-line, automatic robot program that can be generated from CAD data. Feeding into this program will be a continuous stream of positional information from end effectors and sensors. "Acting as a hub, the Comau open source controller will be the platform into which CAD/CAM software, the vision system, the scanner and the force sensors will be integrated. For this to happen, new C4G Open control modalities will need to be developed in order to support the technology partners in the use of sensor-based programming and control at higher abstraction level. This open control will then provide the robot with instructions to perform the various processes", explained Romanelli.

The ROBOFOOT Consortium is busy working towards finishing the second of seven work packages to develop concepts of how best to redesign the manufacturing process for automation. "At this stage we are choosing which shoe making processes would be best suited for automation", explained Gerio. "Currently we are focussing on assembly and have already decided that finishing would be too

complicated for a robot, because not only do you need to see faults in the leather, but you also have to be able to decide what to do to rectify them. These tasks would be highly complex, comprising multiple, small, dexterous re-working operations. Even at this early stage, it is clear that introducing robotics into shoe manufacture will require a great deal of creative thinking to revise the various processes, especially the heat setting, the last clamping and the packaging. At Comau, we are more used to building cars, so getting our heads around the arcane intricacies of shoe production is a real challenge!”

It is the open source element of Comau’s C4G controller that makes it ideal for collaborative programmes like ROBOFOOT and, in fact, it was specifically designed to act as a bridge between pure research and industry. It achieves its open source thanks to real-time communication between an external PC and the robot’s servo system, supported by an Ethernet network. The standard control processes can interact by additional control algorithms and novel trajectory generation methods hosted on the PC. C4G’s modular architecture has three different hierarchical levels – SMP+ Control Board, MPC Control Board and DSP Control Board. In addition, many operative modalities are supported, so that modality switching does not lead to the robot stopping.

EUnited Robotics, European Robotics Association, was founded in 2004 by major European robot manufacturers. EUnited Robotics serves as a platform for manufacturers, component suppliers, and system integrators of robotics in Europe, creating a network of industry leaders. EUnited Robotics is the robotics industries’ voice in Europe representing the robot suppliers’ view on industry issues and R&D policies. The association is also a cooperation platform among all robotics stakeholders – from research institutes to national associations and customers.

Members: ABB (Sweden), COMAU (Italy), Güdel (Switzerland), ISRA Vision (Germany), KUKA Roboter (Germany), Reis Robotics (Germany), Schunk (Germany), Spinea (Slovakia) and SUMITOMO (Germany)

Cooperation partners: DLR German Aerospace Centre (Germany), Fraunhofer IPA (Germany), and Technische Universität München (Germany).

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