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ARTEC EVA 3D SCANNER IS USED TO DEVELOP ERGONOMIC EXOSKELETONS

Time saver | High accuracy | Precision

R&MM's MIRAD, a powered assistive exoskeleton, equipped with adjustable orthoses

A RESEARCH GROUP IN BELGIUM IS BOOSTING THE CAPABILITIES OF POWERED EXOSKELETONS BY CUSTOMIZING THEIR DESIGN WITH THE HELP OF 3D SCANNING, CAD AND 3D PRINTING

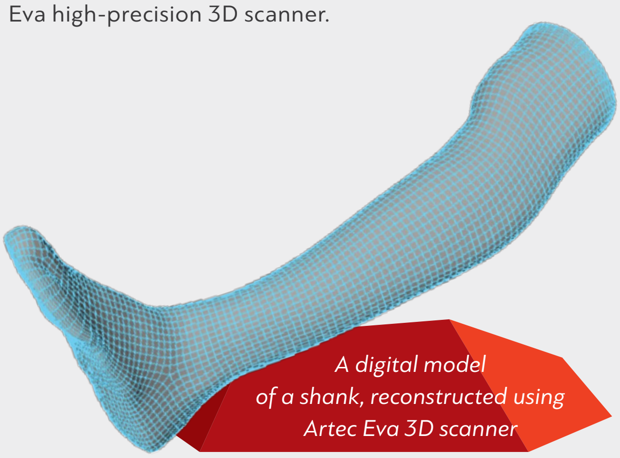
Kevin Langlois, a PhD researcher at Vrije Universiteit Brussel (Free University of Brussels), is a member of the university's Robotics & Multibody Mechanics (R&MM) research group, whose main area of focus is wearable robotics, such as powered exoskeletons. Kevin believes that robotic assistive technology is one of those major technologies that can help to keep healthcare costs under control, because it contributes to keeping people mobile, less dependent on care and decreases the risk of secondary health effects of immobility.

Despite the fact that remarkable progress has been made in this research area, a major problem has yet to be solved: How to achieve perfect interaction between a human being and their robotized exoskeleton? On the mechanical level, this question boils down to how to achieve absolute adhesion between the two entities.

This question is not that easy to answer, given that each person is unique anthropometrically (the dimensions of the limbs and their capabilities) and biomechanically (the way the person walks). This suggests that you need a customized solution for each individual.

Initially, the group started out by purchasing adjustable orthoses for their research that were attached to the body by straps and brackets. These fixtures, however, turned out to get misplaced quite often, resulting in inefficient performance of the exoskeleton.

An alternative solution was then found — using 3D scanning to capture the individual anatomy of the subject and designing an orthosis that would replicate it smoothly. This way you can achieve stiffer adhesion and increase the robustness of the exoskeleton without compromising on the user's comfort. To this end, the group acquired Artec Eva high-precision 3D scanner.



A digital model of a shank, reconstructed using Artec Eva 3D scanner

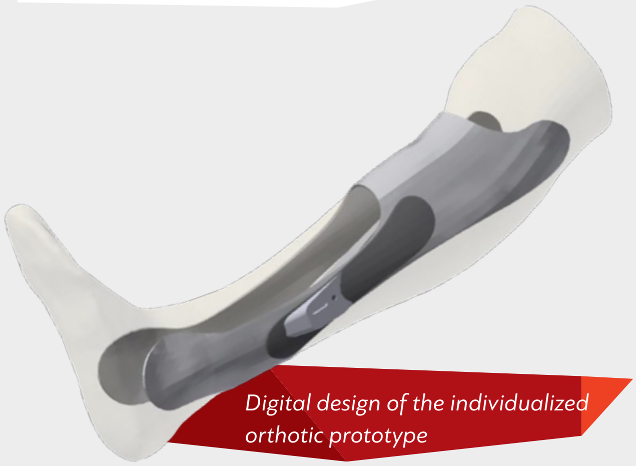
A key feature of the exoskeleton's actuator that transfers the torques, or forces, to the subject's joints (ankle, knee and hip) is the use of a tunable elastic element — a spring with variable pretension — in series with an electric drive. As opposed to conventional "stiff" or "rigid" actuators — like geared drives — this compliant actuator naturally allows deviations from the target position when external forces are applied by the user.

"The Artec Eva 3D scanner allows us to incorporate all these parameters into a compact and ergonomic orthosis," says Kevin.

3D scanning a subject's shank at the R&MM lab

To make a customized orthosis, Kevin first selects the areas that need to be captured, for example, the shank. Then he selects one or more subjects on which the orthosis will be tested. These subjects are scanned, and the data is processed in Artec Studio 3D software.

"The critical point is to gather high-quality scans, to not leave any holes in the model, and to facilitate the alignment of the scans. The Sharp Fusion tool will precisely fuse the scans together and generate the final model. I conclude that the Artec Studio software provides an intuitive interface and powerful tools allowing scientists and engineers to perform research in the area of wearable robotics," says Kevin.



Digital design of the individualized orthotic prototype

After post-processing, the .STL file is exported to CAD software, where a tightly fitting orthotic device is designed. The final step is to produce the orthosis using additive manufacturing. After the orthosis has been 3D printed, it is reinforced with carbon fibers and an epoxy composite.

The use of 3D scanning and 3D printing is especially beneficial, as opposed to using a plaster mold, as it allows for a digital record to be saved on file. Having a digital record provides an advantage from a design perspective, as it allows the subject to fully integrate the human to the design of the robot. It also provides more freedom on the production or manufacturing options of the orthosis, allowing the use of Computer Aided Manufacturing (CAM) techniques, such as 3D printing. This in turn can potentially reduce costs and improve the quality and applicability of the products.