3D Methodology for Leg Prosthesis Modelling

F. Carpinteiro [1], P. Costa[1], F. Magalhães[1,2] and H. P. Oliveira[1,2]
(The presenting authors had similar contributions to the development of the work)
[1] BioStar, Faculty of Engineering, University of Porto, Portugal.
[2] INESC-TEC (formerly INESC-Porto)

A system for (three-dimensional) 3D modeling of the leg prosthesis and posterior limb-prosthesis fitting measurement is being developed. The lack of adaptation between the stub and the prosthesis is a well-known identified problem which needs to be solved in order to diminish the associated complications, such as pain, injuries, different pressure distribution along the limb, thus causing discomfort and prosthesis substitution after some time [1,2]. Prosthetic design is mainly manufactured using plaster bandages, therefore the production is imprecise. Its accuracy depends on the used instruments, the operators' skills, on mechanical properties of the plaster at the measurement time and on the status of the patients' limb [2]. Even routine consultations are based on the subjective evaluation of the fitting.

The approach will consist on the projection of a red circumference with a laser on the inner surface of a conventional prosthesis, and its recording with an EyeToy® camera. Image processing techniques can be used to calculate the prosthesis dimensions for the construction of a 3D model. The segmentation of a laser line projected on the inner surface of the prosthesis and the detection of the geometric center of the prosthesis recorded image was tested. Also, a simulated scanning of the prosthesis was performed. The segmentation algorithm was used to detect red artificial circumferences, whose diameter increased with the height of the prosthesis, drawn over a prosthesis recorded image.

The segmented line had 1 pixel width (Figure 1b), with no distortion and the center detection was adequate (Figure 1c). Red artificial circumferences detection and 3D representation was successful (Figure 1d) and had a conic form.

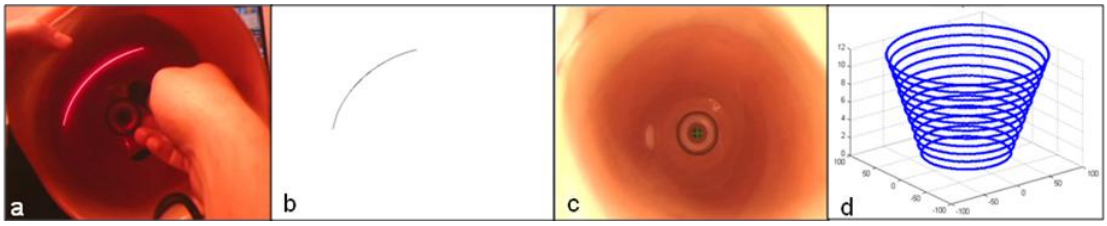

Figure 1. Obtained results. In a) the original recorded image is displayed, b) presents the segmentated laser line, c) presents the geometric center detection and d) presents the result of the simulated scanning along the prosthesis' height.

This system would fill a gap in the existent technology as it would allow prosthetists and doctors to do a more accurate and faster design of the prosthetic devices. As it will be possible to quantify the adaptation, the comfort to the amputee will be increased.

References:

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