Critical Pre and Post Processes for Quick and Accurate Extraction of Foot Measurements for Custom Prostheses and Orthoses

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Abstract

Getting accurate measurements extracted from a foot scan quickly and reliably is always challenging. While our tendency is to focus on optimizing the measurement extraction processes and algorithms, we at 3D Measure Up (www.3dmeasureup.com) have found some pre-processes and post-processes which go a long way in helping with the goal. In this paper we discuss 3D scan preprocessing viz. Alignment and positioning, mesh cleaning, unit extraction etc. and post processing such as sanity checks and validations, nomenclature etc. and evaluate their impact on measurement extraction speed and accuracy.

Keywords: Prosthetics, Orthotics, 3D foot scan, measurement, alignment, anthropometry, optimize, reliability, accurate, mesh cleaning.

Prostheses (artificial legs and hands) and orthoses (braces and splints) enable people with physical impairments or functional limitations to live healthy, productive, independent, dignified lives and to participate in education, the labour market and social life. WHO estimates that, today, only 1 in 10 people in need has access to assistive products, including prostheses and orthoses, because of their high cost and because of lack of awareness, availability, trained personnel, policy and financing[1]. According to a report, up to 15% of the North American market could benefit from a custom-fit orthotic product. New custom fitting takes patient evaluation away from pressure plates because 3-D printing can provide a more accurate insole that can be used with current footwear choices (Ergo Research). Custom orthotics cost the most in the industry, with an entry-level price of about $300. (American Orthopaedic Foot and Ankle Society)[2]

Large number of scanning technologies, both hardware and software, are emerging to capture the users' foot scan. While this is definitely encouraging, it has also led to a huge challenge in terms of the quality of the avatar being produced for effective downstream usage esp. extracting the measurements.

In this paper, we will discuss some of the major issues with the input foot scan and challenges that we faced in identifying and extracting body measurements from these. We will also discuss the approaches and methods that we used to overcome these problems. And showcase the impact of these problems on the accuracy of landmark detection and measurements and effectiveness of our solution on the same.

Forward Motion (https://fdmotion.com/about/) , established in 2002, is an industry leader in manufacturing of custom orthotics. Using ProtoTech's 3D Measure Up measurement solution, they managed to reduce the time spent on extracting foot measurements from 30 mins to 30 secs effectively reducing 98% of the time spent. Not just that, they also increased the accuracy of the measurements[3]. Since we use Machine Learning in tandem with Computational and Geometric algorithms, the challenge for us is to identify and isolate the cases where we might have missed our landmarks or when we may not have gotten accurate results.

To overcome this, we came across some post-processing methods to quickly do a high-level quality check on our results and weed out the inaccurate outcomes. We will discuss these as well.

Conclusion

We discussed the common problems with foot scan data, it's impact on measure extraction and remedies. We also discussed methods to improve reliability of the measurement extraction outcomes.

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