Comparison of Actual and Virtual Pressure of Athletic Clothing in Active Poses

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Introduction: In contemporary fashion, the design process follows a circular path moving from 2D sketching and patternmaking to 3D prototypes, with iterative phases of design and making (Gully, 2010). This progression from 2D to 3D is facilitated by virtual prototyping and garment simulation tools, which are powerful tools for fashion designers. Avatars in active poses can add value to the use of these 3D tools, providing valuable information for design and fit evaluation of activewear. Virtual pressure representations on the avatars provide information about garment fit and comfort that is particularly important for active wear. Stress/tension/pressure maps are used for observation and analysis of dimensional correspondence between body and product (Olaru et al., 2014). With currently available technologies, it is not possible to conduct sensory evaluations of apparel in virtual reality (Cheng et al., 2020), however, this issue can be investigated further by addressing the relationships between the actual pressure values from humans and virtual pressure maps on avatars made from body scans. In this research, we explore the issues of virtual fit with tight fitting cycling wear on avatars obtained by 3D body scanning of athletes in active poses. We compare them to the actual pressure values obtained from the participants of different sizes in several poses wearing two garment types.

Methods/Procedures: For the research project, four cyclists representing size S, M, L and XL were selected for pressure tests. A size set of tight fitting bicycle shorts and bib-shorts were manufactured as test garments using industrial techniques. Pressure values were measured with a clothing pressure measurement device (Ami3037-10, Ami Co., Ltd.) with airpack sensors on predefined locations on the body. Pressure measurements were conducted in the standing position, and in the cycling pose with two different leg positions. In parallel, participants were scanned with a Vitus Smart XXL 3D Body Scanner, both in the standing and cycling positions. 3D virtual bodies of the participants from their scan data were reconstructed using digital tools to create watertight digital avatars. Fabric parameters were physically measured and transferred to the 3D software for virtual fit simulation. Using the locations for pressure measurement from the human participant tests, pressure measurement tests were conducted on the avatars.

Results/Discussion: Various simulation and 3D properties were modified in the software to create the virtual representations, required due to the specific poses and garment types. A comparison was then made of seamline, waistline and hemline placement on the actual and virtual garments. Similar fit results were achieved visually in both the standing and cycling poses (Figure 1).

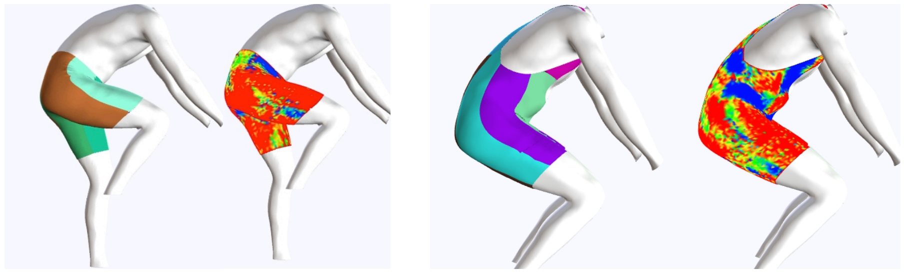

Figure 1. Avatars in cycling pose with shorts and bibshorts in two different leg positions

Pressure data from the participants and the avatars were compared for the different research parameters: the participant size, clothing type, and pose. Results showed very low or no correlation between the pressure data from the avatars and the human participants. Of the 32 cases representing different combinations of the parameters of this research (4 sizes, 2 garment types, 4 body poses), all cases recorded higher values for human participants. The main finding from the investigations was the randomness of the variations, with no clear tendencies based on size or position.

In order to investigate the repeatability of our pressure measurement setting on human participants, approximately 720 pressure measurements were obtained for one participant in six different sessions. The intraclass correlation coefficient (ICC) was calculated as 0.969, indicating an excellent correlation among the pressure data from each session (Koo and Li, 2014). Therefore, our settings and procedures can be considered as reliable in terms of the pressure values obtained. The same reliability procedures can be conducted for the avatar data, a process planned for further phases of this research. The initial results from this research work can also be expanded by conducting similar tests with a range of cutting edge commercial software.

Dissimilarities of the compressive properties of the human body and the avatar, differences between the virtual and real bicycle shorts materials (crotch padding and elastics in the actual shorts were not duplicated in the virtual shorts), and choices made for the simulation parameters for the development of the virtual shorts can possibly explain some of the differences in results from the actual and virtual data. Difficulties in selecting identical measurement locations for the participants and the avatars (especially in active poses) may also result in differences in data.

Conclusions: This research presents a practice-based approach, investigating the user perspective and application context of a commercial virtual fit software. It is suggested that, rather than providing a direct correlation with pressure values on the body, the avatar data offer comparative visual support for fit evaluation of different garments within the virtual fit technology. Future developments of virtual fit, including valid pressure values, will provide useful input for the product development phases of active wear design.

References

Cheng, Z., Kuzmichev, V., & Adolphe, D. (2020), A digital replica of male compression underwear. *Textile Research Journal*, *90*(7–8), 877–895. https://doi.org/10.1177/0040517519883058

Gully, R. (2010). Cognition and process vs. design artifact in fashion design pedagogy, *Cumulus Working Papers*, *Cumulus Conference, Melbourne, Australia,* 40-45.

Koo, T.K. & Li, M. Y. (2016). A Guideline of selecting and reporting intraclass correlation coefficients for reliability research. *Journal of Chiropractic Medicine*, 15, 155–163. http://dx.doi.org/10.1016/j.jcm.2016.02.012

Olaru, S., Spânachi, E., Filipescu E. & Salistean, A. (2014). Virtual fitting – Innovative technology for customize clothing design, *Procedia Engineering*, 69, 555–564. https://doi.org/10.1016/j.proeng.2014.03.026.