Creating garment simulations: Effectiveness of traditional textile testing equipment versus KES and FAST Systems

Evrim Buyukaslan, Istanbul Technical University, TURKEY
Fatma Baytar , Cornell University, USA
Fatma Kalaoglu, Istanbul Technical University, TURKEY

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Purpose of the Study. 3D virtual garment simulation software packages offer various fabric alternatives in their fabric libraries to select the most suitable option for creating realistic simulations. However, these libraries are limited in terms of providing their users with particular fabric compositions, structures, and drape properties. When a specific fabric needs to be used for a garment simulation to understand how the end-product would look like, individual fabric mechanical properties must be entered into the software (Magnenat-Thalmann, 2010). For example, in Optitex 3D Product Design Suite (PDS), such fabric properties include stretch, bending, shear, friction, weight, and thickness (Optitex, 2016). In their studies, many scholars used fabric mechanical values measured by either Kawabata Evaluation System (KES), or Fabric Assurance by Simple Testing (FAST) System (Jevsnik, Kalaoglu, & Terliksiz, 2014; Jiang, Cui, & Hu, 2012; Kim, 2011; Power, 2013). Although these systems provide precise measurements, they are very expensive and only few research labs all around the world house them. For example, the price of all KES equipment can reach up to $ 250 K (KATO Tech, 2018) whereas the whole equipment for FAST system is approximately $55 K (ITEC Innovation Ltd., 2018). Therefore, our research questions emerged from the need to use alternative (and cheaper) fabric testing devices, which can be easily accessed, to generate outputs to be used in 3D garment simulation software packages: (1) *Can traditional textile testing equipment be used to measure fabric properties needed to create 3D garment simulations*? and (2) *What is the correlation between simulations generated by using the data obtained from KES, FAST, and traditional test equipment?* The purpose of this study was to collect preliminary data to investigate if traditional textile testing equipment can be used instead of KES or FAST systems to create garment simulations in Optitex PDS 15.

Methods. To measure fabric mechanical properties, three different fabrics were tested by KES, FAST, and traditional textile testing equipment. Traditional test equipment, which can be widely found in most of the textile labs, were selected as a fabric strength tester, a surface friction tester, and a portable fabric thickness gauge. CAD patterns of a knee-length, semi-fitted dress with long sleeves is prepared and graded in Optitex PDS 15 in three sizes: XS, S (fit model's size), and M. Fit model's 3D body scan was obtained by using a Human Solutions Vitus 3D body scanner. Fabric mechanical properties were entered into Optitex PDS 15 one by one to create garment simulations for each size, virtual dresses were draped on the model, and a total of 27 simulations were generated. To make objective comparisons among simulations, rather than using Likert scales, the area between body and dress was measured at certain body parts (i.e., bust, waist, hips, thigh, hem, armhole, bicep, elbow, and wrist). Similarly, the total volume between body and dress was calculated for each simulation. All measurements were taken in Geomagic. Data were analyzed by regression analysis and one-way ANOVA in Microsoft Excel Analysis ToolPak.

Results and Implications. To investigate the first research question, a one-way between subjects ANOVA was conducted to compare the effects of using data from the three different fabric measurement methods on the ease amounts at the identified areas between body scan and dress simulations. No significant effects among KES, FAST, and traditional test equipment were found at the $p < 0.05$ level ($F(2,225) = 0.067$, $p= 0.94$). The same analysis was also conducted to compare the effects of using data from the three different fabric measurement methods on generating volume differences between body scan and dress simulations. No significant effects among KES, FAST, and traditional test equipment data were found at the $p < 0.05$ level for the three conditions ($F(2,24) = 0.114$, $p= 0.89$). Therefore, it can be expected that traditional testing equipment would be efficient to measure required 3D fabric properties to create garment simulations.

In order to examine the second research question, linear regression analyses were used to assess the relationship between (a) FAST and traditional test equipment, and (b) KES and traditional test equipment at the identified body sections for each garment simulations. Significant regression equations were found for both conditions: $F(1, 74) = 47784$, $p < 0.001$ with an $R^2 = 0.998$; and $F(1, 74) = 30375$, $p < 0.001$ with an $R^2 = 0.997$, alternatively.

The results of this study were promising as they indicated that simple test instruments can be used to obtain necessary fabric mechanical properties to create garment simulations. Scholars and industry professionals can follow the measurement procedures conducted in this research and create garments simulations, even though they don't have FAST or KES equipment. In this study only a semi-fitted dress was simulated. Therefore, it is necessary to test other garment types such as loose-fitting dresses or trousers, as well as running the same tests for actual garments.

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