Workflow Analysis to Understand Ease of Importing, Stitching and Dressing Existing N95 Mask Patterns with Current 3D Apparel Modeling Software Programs for Sizing and Fit

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In the field of apparel design, digital tools have been created to develop true-to-life samples that remove productivity barriers, speed-up time to market, and enhance sustainability (Browzwear, 2021). This concept abstract uncovers the challenges of importing, stitching, and dressing existing N95 mask patterns with current 3D apparel modeling software programs (Browzwear and CLO), for mask sizing and fit analysis. The work was inspired through a connection with a local hospital that experienced issues sizing and fitting women and minorities into N95 masks during the Coronavirus pandemic. These issues have also been identified by researchers Zhuang, Bradtmiller & Shaffer (2007) and Regli, Sommerfield & von Ungern-Sternberg (2021). The discovery presented are sub-findings from a study that used CAESAR North American 3D scan data (2002), to investigate through machine learning how 3D data and digital modeling tools could inform future N95 mask sizing and fit (Searcy & Sokolowski, 2021).

The N95 masks studied were selected and provided by the local hospital to the PI (Fig. 1.) They were back engineered to capture patterns which were then scanned and digitized in Adobe Illustrator. An example of a back engineered pattern for the 3M 9502^{+} is presented in Fig. 2.

Halyard Respirator & Surgical Mask	3M Aura Respirator & Surgical Mask	Isolator Plus N95 Surgical Respirator	3M 9502^{+} N95 Respirator

Fig. 1. Masks evaluated for the study.

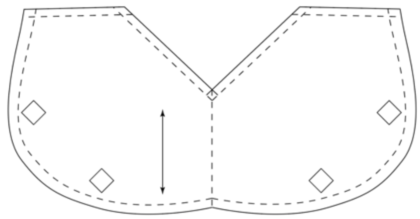
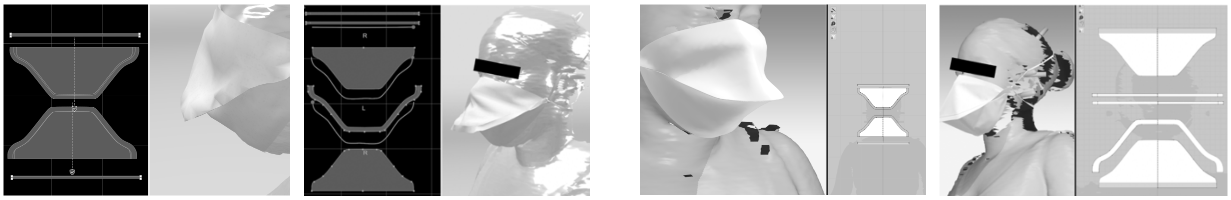


Fig. 2. Example of the back-engineered 3M 9502^{+} N95 respirator mask pattern.

The digital patterns were then imported into the 3D apparel modeling software programs (Browzwear and CLO), for mask sizing and fit analysis. Three major workflow challenges were uncovered. The first was related to material physics. Because N95 masks are not made from “fashion” materials, neither programs had the required physics to drape the patterns. The research team worked with Browzwear to have the non-woven mask materials tested, but when the physics were received – they outputted a digital material that appeared too drapey, which made the modeling exercise invalid (Fig. 3). With CLO, the office that tests materials was closed due to the COVID pandemic, so the researchers resolved to using the physics sliders to obtain an appearance model and are still awaiting data to model sizing/fit. The physics sliders in Browzwear were unable to achieve the drape and appearance of the mask non-woven materials. Issues also emerged with the size of materials samples needed for physics testing (7” x 2”), as there was no inventory of N95 mask material yardage, so the researchers had to cut-up the few reference samples provided by the hospital, and in some cases the test samples were not big enough. Without accurate material physics, realistic sizing and fit analysis to date is not possible with the two 3D programs.

Fig. 3. Results of material physics with Halyard mask (left, Browzwear & right, CLO).

The second challenge involved stitching the mask patterns. As there were no presets for external welded/RF seams, extra pattern pieces/parts needed to be created to establish crisp/rigid edges and internal “wires” for the nose clips in both programs (Fig. 4). Complex pleats (e.g., Isolator mask in Fig. 1) were not possible to model in Browzwear, but feasible in CLO.



Regular Stitching w/ Extra Edge Patterns Regular Stitching w/ Extra Edge Patterns

Fig. 4. Stitching results with Halyard mask (left, Browzwear & right, CLO).

The reason 3D tools were used for this project, were for their ability to examine the fit of products on individual 3D scans. However, challenges arose with dressing the scans, where the auto dressing functions did not work and masks needed to be "styled" to properly cover the face. Given the simple nature of N95 mask patterns, this was a surprising finding (Fig. 5).

Auto Dressed Styled Auto Dressed Styled

Fig. 5. Dressing and styling results with 3M Aura mask (left, Browzwear & right, CLO).

The results of this work demonstrated the 3D technology barriers to improving the size and fit of N95 masks. In this study, the CLO 3D program was more capable of modeling the masks, but to-date the research team does not have the appropriate material physics – so it is unknown if the masks can be fully and accurately modeled in this software. It is hoped these findings could start a conversation between researchers and technology developers to work together to improve industry important tools for better efficiency and accuracy to improve PPE sizing, fit and safety.

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