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Generative Algorithmic Fashion Design

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Abstract

The generative algorithmic design methodology and its current industrial applications have been discussed briefly. The relevance and application of the methodology for fashion design have been demonstrated by way of an example. The presented example of a cuff bracelet watch focuses on the design variants for the bracelet component created by generative computer-aided design based on a range of shape, material, weight and various other constraints. The two main categories of generated design variants featuring structural versus aesthetic options separately are reviewed and discussed. It is concluded that fashion designer intervention is still required to select the optimal design solution from rather infinite number of generated variants.

Keywords: Computer-aided design; Generative computer-aided design; Generative algorithmic design; Algorithmic fashion design; Generative fashion design.

Introduction and Background

In the general context of product design, fashion design similarly relies on computer-aided design (CAD) for production and presentation purposes. Currently, there are a large variety of fashion-specific software products available for specifying product detail, creating photo-realistic rendering, processing product images, facilitating direct design-to-manufacturing and a large number of other use cases. [1-4] However, in all these cases, the computing power within application is used exclusively as a basic utility and a substitute for comparable manual efficacy. Although evolutionary in nature, these software products still have provided significant improvements over the related state of the art manual protocols and practices in terms of cost, quality and turnaround time. Complex manual design and presentation tasks which required considerable degree of skill and a high level of effort can now be managed and completed rapidly and accurately by a practitioner of ordinary skill in the art. Recently, the above capabilities have been extended to include generative computer-aided design (GCAD) by incorporating the computation capability into the fashion design process [5]. This concept relies on algorithmic logic to create design solutions within the boundaries of input for design requirements, material specification and manufacturing restrictions.

The GCAD techniques have been heavily utilized in practice in mechanical engineering design, industrial design, architectural design and a wide range of other design applications. Benefiting from the unique integration of artificial intelligence with cloud computing, this approach has provided designers a complete and comprehensive set of solutions to their design task at hand. The special advantage of the concept lies in the fact that any and all combinations of the solution components, which meet the overall design requirements are generated and presented via the GCAD application software. The designer's main tasks are to specify range of input values for design parameters, select optimal materials and the related fabrication/construction technique. The GCAD application software utilizes the above input to generate any and all design solutions meeting the specified design requirements. While these solutions mainly entail the structural and technical aspects of design, the aesthetic attributes can also be considered and generated as part of the overall solution through algorithmic logic principles. An example of such use case was presented previously [5], in which the coloring attributes of a footwear design were combined with its structural features to produce an even larger set of variants using the GCAD application software. In such use cases, the aesthetic attributes will be considered as contextual parameters and the GCAD input and output will be converted accordingly.

Case Study

Objectives and Methodology

In order to demonstrate the relevance of GCAD to, and its utility for fashion design, the highlights of a fashion jewelry design project involving a cuff style bracelet smart watch is reviewed and discussed here. The project focused on GCAD utilization for producing design solutions which represented a wide range of variants featuring both the structural and aesthetic attributes as contextual design parameters. Figure 1 shows a preliminary prototype of the cuff bracelet attached to a test smart watch. The prototype consists of two sterling silver cuff halves each attached to the watch frame in a fixed configuration using a set of fine screws and cuff plate counterbores in this particular design variant. The project's objectives were twofold and included:

1. Minimize the cuff bracelet's weight without compromising its structural integrity; and

2. Generate the widest range of design variants featuring aesthetic

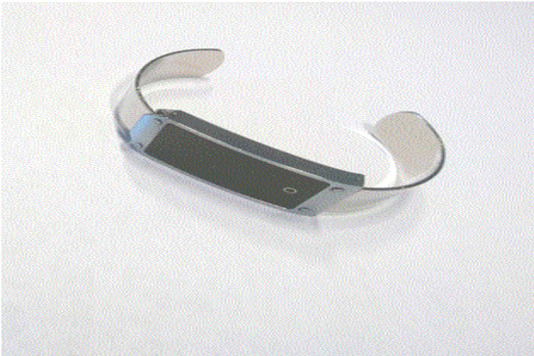

Figure 1: Cuff bracelet prototype attached to a test smart watch frame.

attributes.

The above objectives were to be achieved with the following constraints and options:

a. Preserve the cuff bracelet's peripheral and outer physical boundaries;

b. Comply with fabrication restrictions;

c. Consider the generated geometry as an aesthetic factor; and

d. Evaluate various materials and coloring scheme as aesthetic factors.

The combination of above objectives, constraints and options had to be examined and assessed in order to establish an optimal framework for the project. Essentially, the project required maintaining the sterling silver cuff bracelet's edge and surface boundaries while minimizing its weight, and without compromising its structural integrity while in use by the wearer. Furthermore, it required to be in compliance with the manufacturing constraints applicable to fabrication of the cuff bracelet components. Interestingly, the structural design variants created through GCAD were also to be considered as an integral part of the aesthetic design set. However, it was also recommended to assess various materials and coloring scheme as additional aesthetic factors.

An overall review of the requirements for GCAD creation of optimal design solutions concluded that algorithmic logic was anticipated to incorporate perforations of various size and geometries at different positions within the cuff bracelet's plate. Within this framework, the mechanical engineering principles governing the structural integrity of the bracelet while meeting the wearer's expected ergonomic requirements had to be identified and studied. Figure 2 shows schematically the shear force distribution (SFD) and bending moment distribution (BMD) diagrams within a cuff bracelet half (CBH), while subject to the maximum anticipated force (MAF) applied at its open end by the wearer. This force will be exerted while the piece is put on or taken off by the wearer. As can be seen from these diagrams, due

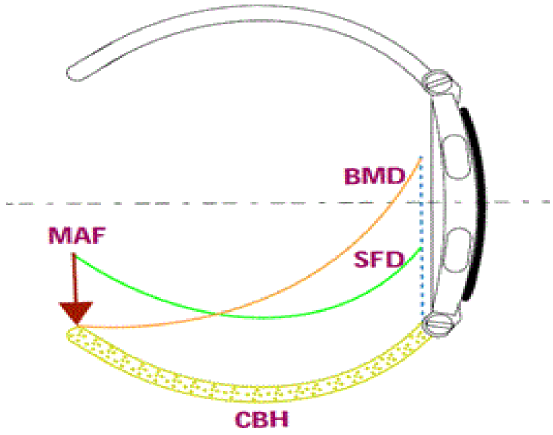

Figure 2: Shear force and bending moment distribution diagrams.

to the fact that CBH is rigidly attached at its closed end to the watch frame, its plate transverse must be able to withstand the shear force and bending moment at any point along its entire length. As can be seen as well, while the shear force magnitude remains constant along the cuff's entire crescent, the bending moment progressively increases in magnitude, starting at zero at its open end and ending at its maximum at the CBH fixed end. These solid mechanics requirements will dictate to the algorithmic logic as to how any perforation pattern can be incorporated into the CBH design without compromising its structural integrity. Meeting these requirements will ensure no damage to the CBH set while being worn by the wearer of this cuff bracelet smart watch piece of fashion jewelry.

Structural Design Variants

As discussed previously, the generative algorithmic fashion design is comprised of structural variants and aesthetic variants; however, the generated geometry itself can be, and was considered an aesthetic factor in this project. In this section, the design variants generated solely based on solid mechanics requirements of Section A are presented and discussed. Basically, the design parameters according to the project's specified constraints and options were used as input for the GCAD application and the generated design variants were sorted and labeled for review. Figure 3 shows a select set of these variants in drawing and rendering versions. As expected, the GCAD application incorporated perforations of different size and geometry into the CBH sterling silver plates to reduce their overall weight without compromising their structural integrity. As can be seen, the shape, size and distribution of the perforations within the cuff plates appear consistent with the specified solid mechanics requirements. Essentially, the perforated plates' transverse increases in total surface area progressively from the open end toward the fixed end consistent with the BMD distribution as discussed in Section A. As predicted by the BMD diagram, this

Figure 3: Select set of GCAD structural variants in drawing and rendering versions.

trend indicates an increasing resistance to the bending moment necessary to preserve the cuff plate's structural integrity further away from the CBH open end and toward its fixed end.

Figure 4: Select set of GCAD aesthetic variants featuring color and texture variations.

Summary and Conclusions

Generative CAD was utilized for creating extensive matrices of structural and aesthetic designs for a cuff style bracelet smart watch as a piece of fashion jewelry. It was shown that solid mechanics solutions meeting the structural design requirements of the jewelry also played a role as elements of aesthetic design. However, the GCAD application also featured the capability to experiment with various textures and coloring schemes to enhance and/or add to the existing aesthetic attributes. Overall, it was demonstrated that generative algorithmic fashion design, as an extension of generative design methodologies currently in use in various other industries, can effectively and efficiently expand the design tool set for practitioners in fashion industry.

References

1. CLO Simulation Engine for Fashion. CLO Virtual Fashion LLC. 2020.
2. Roman CAD Fashion Design Software, Strategies la Compagnie.2020.
3. Marvelous Designer Virtual Clothing Design Software, CLO Virtual Fashion, Inc.2020.
4. Browzwear Fashion Design Solutions, Browzwear Solutions Pte Ltd.2020.
5. Fredrick S. Generative Computer-aided Design for Fashion. Curr Trends Fashion Technol Textile Eng. 2020; 6(3): 555693. doi: 10.19080/CTFTTE.2020.06.555693