Integrating Product Form Preference into Engineering Design

Abstract

by

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The product form has an important role in the judgment of a product, and increasingly more products within a market segment have similar technology and performance. This has elevated the importance of the appearance of a product, and being the first impression of a product visual, this work presents methods for the integration of the product form preference into the engineering design process. Three experiments were performed with the purpose of designing products that are both functional and aesthetically pleasing; one experiment for prediction models comparisons, and two experiments for form quantification metric development.

In the first experiment, linear models to predict the subject preference of a product form were built with physical dimensions, Gestalt principles, semantic space, and Kansei words as predictors. In the experiment, subjects rated their preference and other perceptual dimensions towards wheel rim designs. The data was used to find the coefficients for the regression models. The models were compared and found to be appropriate for product form preference prediction; however, the Gestalt model was more suitable for design purposes.

Quantifications of the Gestalt principles were developed based on the first experiment since they were found suitable for design, and because no formal quantification existed previously. For each Gestalt principle individual quantifications in the form of equations were developed and validated by applying them to images already recognized in the Gestalt literature as having specific Gestalts.

Then, in a second experiment the relationship between Gestalt principles and aesthetic was investigated. The previously developed quantification of Gestalt principles was used to generate sets of wheel rim designs with low and high Gestalt. Subjects rated these for preference. Prior to the experiment, the aesthetic measurement equation established that if the complexity of the designs was constant the Gestalt would be positively correlated with subject preference (aesthetics). The data was able to support the equation results, and also showed that designs with similar Gestalt levels but different physical dimensions maintained similar preference.

To expand the application of the aesthetic measurement equation, a complexity metric was developed to quantify the complexity in two-dimensional product representations. The metric was validated in the third experiment in which one pool of subjects reported their perceived complexity towards images of house facades. The complexity quantification of the images was in agreement with the subject reported complexity. In the second subject pool of the third experiment, subjects reported their preference towards the house facades. Both quantification metrics, Gestalt and complexity, were calculated for each image to compute the aesthetic of the house
facades images. The aesthetic results and the subjects reported preference were scaled equally, and the comparison demonstrated that the aesthetic measurement equation is a valid representation of subject preference within designs of the same style.

The two quantifications developed in this work, Gestalt and complexity, provide ways to quantify the product form preference that can be used and integrated into the engineering design of a product. This can enable groups of designers to develop aesthetic and functional product designs.