Quantifying and Maximizing Aesthetic Preference

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Brief abstract: One of the greatest challenges in new product development is the creating of a product form that is attractive to an intended market audience. Just as choice-based conjoint has been successfully utilized to explore product features, we have developed methods that enable and support conjoint analysis to explore consumer preferences within a continuous parametric range of visual aesthetics (physical product forms). We apply our work to vehicle design, where our application can facilitate vehicle design by providing a time and cost efficient method to obtain market research on aesthetic preferences for vehicle design. In general, this methodology will allow product developers to incorporate rich preference feedback from the market about product form, where market preferences can be collected extremely early in the development of the product concept.

Slightly longer abstract:

One of the greatest challenges in new product development is the creating of a product form that is attractive to an intended market audience. Choice-based conjoint has been successfully utilized to explore product features, but there is currently no analogous quantitative tool for aesthetic preferences. Current methods typically ask respondents to associate a discrete set of product forms with abstract semantics such as “strong” or “sexy,” while we use utility-maximization over the space of product forms (aesthetics), completely avoiding semantics.

The purpose of this work is to quantify aesthetic preference into a concise, objective form that can then be used for generation of product designs. Our implementation is a set of algorithms that generates visual product designs (physical form) based on initial parameters (such as initial preference information), gathers additional preference information through discrete choice experiments, and iteratively updates the product designs to incorporate additional preference information. This methodology will allow product developers to incorporate rich marketplace preference feedback on visual product forms, where market preferences can be collected extremely early in the development of the product concept.

For the purpose of quantifying aesthetic preference, we use utility functions (von Neumann and Morgenstern, 1944) in a choice-based conjoint, principal component analysis (Johnson and Wichern, 1982) to reduce data dimensionality, software agents to explore the design spaces (Campbell, Cagan, and Kotovsky, 1999 and 2003), and shape grammars (Stiny, 1980) to represent the design language within the design space.

From a managerial viewpoint, our work develops new methods which will greatly facilitate market research of visual aspects of products. Our application, for example, can facilitate vehicle design by providing a time and cost efficient method for market research to ascertain preference for vehicle design. Put another way, imagine the following scenario: a market research analyst scans in one or a few pictures of coffee makers. A software tool automatically generates new coffee maker pictures, implements the coffee makers into a conjoint study, and generates new product designs that maximize the reported aesthetic preferences of the respondent. This scenario is one that we are working to realize.

This presentation will span multiple research papers, two of which are attached to this proposal.

The choice model implementation currently is work in progress; we already have completed and documented some preliminary results.

Accompanying Papers:
I have attached two papers (both from *Research in Engineering Design*) in which we developed some of the supporting algorithms for this work.

Papers cited above:
Campbell, M.I., J. Cagan, and K. Kotovsky (1999), "A-Design: An Agent-Based Approach to Conceptual Design in a Dynamic Environment," Research in Engineering Design, 11(3) 173-192.

Campbell, M.I., J. Cagan, and K. Kotovsky (1999), "The A-Design Approach to Managing Automated Design Synthesis" Research in Engineering Design, 14(1) 12-24.

Johnson, R.A. and D.W. Wichern (1982) Applied Multivariate Statistical Analysis, Prentice-Hall, Englewood Cliffs, NJ.

Stiny, G. (1980), "Introduction to Shape and Shape Grammars," Environment and Planning B, 7 (3), 343-351.

von Neumann, J. and O. Morgenstern (1944), Theory of Games and Economic Behavior, Princeton University Press, Princeton, NJ.