Using Automation to Understand Sustainable Design Trade-offs and to Promote Environmental Sustainability in the Early Design Phase

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Abstract

Sustainable product design is becoming an important component of the development of consumer products. Currently there are limited design resources to aid in the creation of environmentally sustainable products. The purpose of this research is to theorize a new method for integrating sustainable design knowledge into the early design phase of new products and processes. A novel organized search tree—consisting of sustainable product design guidelines, empirical design knowledge, international design regulations and preliminary consumer preference information—is constructed to enable application of sustainable design knowledge before and during concept generation. To further facilitate its application, this search tree is embedded in an easy-to-use web-based application called the GREEn Quiz (Guidelines and Regulations for Early design for the Environment). The quiz provides users with weighted questions pertaining to the design or redesign of a product concept, with a list of possible pre-generated responses to choose from. As a designer progresses through the quiz, user responses are compiled and weighted, and a final report that displays the top ten design attributes contributing to the eventual environmental impact of the product are provided to the user. Accompanied by the top ten list, is a list of design decisions that can be used to better help inform the designer to make improvements that can make the product more sustainable. To further assist designers in understanding the impact of their design decisions, a preliminary investigation into life cycle estimation is conducted by training an artificial neural network on 37 different consumer products. The results of this work found that the design method facilitates designers of varied experience to increase the number of environmentally conscience design decisions made in the concept generation process. It was also found that a neural network can be used to learn valuable correlations between product attributes and life cycle data (which is promising for life cycle impact estimation), but further work into increasing the capability of the neural network approach is required before this data can be used to inform the weights used in the GREEn Quiz.

Thursday, May 26, 2016
2:00 pm, Kelley Engineering Center (KEC) 1001