

# **The Management of Design Information: A Decision-Analytic Approach**

Andy Dong

Abstract

Doctoral Dissertation

University of California at Berkeley

1996/97

This dissertation describes the development of an autonomous decision-making system that is situated in dynamic design environments over extended periods of time and entrusted with the task of managing and retrieving design information. The system orchestrates information resource management in collaborative design by employing a design information infrastructure consisting of "smart drawings" and a decision-analytic machinery enriched with a learned model of the design. The system learns an extensional model of the mechanical by processing, over the lifetime of the design cycle, streams of information communicated by the designers in the form of full-text documentation. The analytical machinery of decision-making uses the measure of expected value of perfect information (EVPI) to make design-time decisions about the ideal questions to pose of the system to optimize the retrieval of useful information.

The fundamental proposition of this research program focuses on constructing a formal methodology to learn an approximate textual model of the design and to perform inference over that model to ascertain the functional specification and decomposition of the design. The model permits the agent to engage in an effective dialogue with the designers. To build the model, the general goal is to extract relationships between the features and functions of the design from documents generated by the engineers. Inferring relationships between the features binds together disparate pieces of information comprising the design, into complex design documents called "smart drawings." The system includes: a natural language processing component which parses design documents into keywords or phrases; a clustering algorithm which organizes the keywords or phrases into groups which describe principal features of the design; techniques for applying belief networks to the task of learning the decomposition of the design and inferring the mutual impact of components or functions of the design; and an expected value of perfect information engine to augment retrieval requests by identifying the most valuable search variables.

By learning the content of design documents and assisting engineers in understanding the design through semi-autonomous interpretation of information, the mechanical design language interpreter fits into a part of a larger computer-supported collaborative work enterprise supporting incremental addition of content, interaction with the user and with other tools, and reuse of content according to the preferences of the engineer.