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Unfolding Design Spaces Interactively

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Abstract

Design is an iterative process of specifying problems, finding plausible solutions, judging the validity of solutions relative to problems and reformulating problems and solutions. Computational exploration requires formal mechanisms and human computer interaction models for supporting designing. The theory of design space exploration posits a formal substrate for representing and generating designs. To integrate the user in design space exploration, an interaction model that combines the role of the the designer and the formalism is necessary.

This thesis addresses the problem of interaction between an exploration formalism and the designer through the paradigm of *mixed-initiative*. The thesis develops a mixed-initiative interaction model for design space exploration in three layers, *domain*, *task* and *dialogue*. The domain layer supports the coordination of the designer's view of exploration in terms of problems, solutions, choices and exploration history with the concepts of state, move and structure available in the formal substrate. The dialogue layer supports communication between the designer and the formalism in terms of a shared visual notation for representing and integrating input and output from both modes of exploration. Through the dialogue layer the designer and the formalism can communicate the intermediate results of exploration. The task layer supports interaction with the operators for moving in a design space. Through the task layer the designer and the formalism can acquire, transfer and relinquish control of the exploration process to generate, navigate and synchronise exploration states. The interaction model is implemented as *FOCDS*, or the *Foldability Of Large Design Spaces*. An example from the domain of architectural design, three-dimensional massing configurations, demonstrates the components of *FOCDS*.

The mixed-initiative interaction model developed in the thesis presents a new approach for integrating the role of the designer and a description formalism in computational exploration. The model enables the designer to maintain exploration freedom in terms of formulating and reformulating problems, generating solutions, making choices and navigating the history of exploration. It permits a fine granularity of interaction through incremental turn-taking, allowing the designer and the formalism to communicate, coordinate and control each step in the process of computing exploration.

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