Diagrammatic Reasoning in Interdisciplinary Communication

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Diagrams play an important role in the reasoning process of design team members and the communication of goals and concepts across disciplines. Our research interest is aimed at exploring the use and power of visual reasoning in the interdisciplinary communication context of conceptual design of a building. More specifically we will attempt to bridge the gap between two members of the design team, the structural engineer and the architect, by developing the necessary tools to support interdisciplinary communication. As the design of a building evolves, each of the design team members creates and transmits the alternative solutions in terms of the conventional representations of his/her field. In doing so, she/he often disregards the fact that for a person from a different field some of the information is hard to understand or irrelevant, even though decisions made based on such transmitted information in the conceptual design phase strongly influence the later design process. Resulting miscommunication is likely to affect the quality of the final building. We believe that the use of diagrams is an important means to address the communication problem. Furthermore, we conjecture that a capability to reason with diagrams will help to convey the design intent in a specific domain to professionals from other domains. The goal of our project is to develop a model for interdisciplinary communication of conceptual design information.

The input to the system will be represented by preliminary descriptions of a building in the two domains:

- an architectural model in the form of block diagram (in terms of functional spaces and dimensions) and circulation specification (in terms of doors and windows), and
- a small number of structural models in the form of alternative structural topologies that correspond to the architectural model.

The reasoning tasks will be accomplished by symbolic and diagrammatic reasoning modules. The symbolic reasoning module will include knowledge bases of structural engineering and architectural knowledge, as well as a qualitative reasoning mechanism to use the knowledge. The diagrammatic reasoning module will include capabilities to represent, manipulate, and zoom in on diagrammatic information of the structure, function, and behavior related to buildings in the two domains. These capabilities will attempt to emulate the manipulation and focusing actions taken by the different design team members while generating conceptual designs and conveying their design intents. The diagrammatic reasoning module will also enable visualization of the effects of interdisciplinary constraints and interactions.

The objective of the study is to understand *what* and *how* design information should be communicated across disciplines, and to explore the role of diagrammatic reasoning in supporting the interaction among design team members.

Once a prototype is implemented, we plan to test it by observing how an architect and a structural engineer use it to generate and discuss a conceptual design of a building in a cooperative manner. These findings will give us a better understanding of the requirements for future systems.