Interactive design galleries: A general approach to interacting with design alternatives

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Designers work by exploring alternatives. While extant parametric modelers theoretically define alternatives, their interfaces generally provide access to designs serially. Our goal is to change this near-universal feature of parametric interfaces to support exploration using multiple alternatives. We built a prototype gallery system on a web browser that supports saving alternatives from three graph-based parametric modeling tools. Users can retrieve alternatives from the gallery, share them with others, and combine them to generate more alternatives. We evaluated this system qualitatively in a workshop with ten expert designers working on their own design problems. We learnt that users prefer the gallery to their accustomed workarounds. The study produced several directions for new user interface designs.
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Design tasks are, by nature, both *under-* and *ill-defined* (Reitman, 1964, chap. 15; Rittel & Webber, 1973; Simon, 1973). Under-definition means that there are typically multiple solutions to a given design situation. Ill-definition means that the design problem being solved itself develops as design progresses. Further, criteria in design may remain *tacit* throughout. In the face of tacit criteria, designers typically rely on design proposals to understand the design problem to hand (Archea, 1987). The set of possible responses to a design situation is Vast (in Dennett's terms) (Woodbury & Burrow, 2006b), and both designer knowledge and time are finite resources. All of the above mean that designers *satisfice* (Simon, 1975): they aim to arrive at one or more solutions that adequately address a design situation rather than seeking any form of optimality. In fact, there is evidence that designers treat optimized solutions as starting points for further exploration Bradner, Iorio, and Davis (2014). Typically, designers

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consider several alternatives and compare the relative benefits across these. Designers tend to work along a front of choices, seldom a single one. Indeed, working with a single alternative is a hallmark of the novice designer. Hence, creating multiple alternatives lends itself to comparative reasoning among options and what-if explorations of possible scenarios (Hartmann, Yu, Allison, Yang, & Klemmer, 2008; Lunzer & Hornbæk, 2008a), which lead to better design choices. Current digital design media constrain this normal mode of work. Terry and Mynatt (2002) define this as the Single-State document model—which requires a document to be in one, and only one, state at any particular time, thereby imposing a serial, linear progression through a task that is at odds with the messy, highly iterative creative process. Lunzer and Hornbæk (2008a) argue that single-state models make working with alternatives an arduous task that imposes greater demands on cognitive abilities. They distinguish interfaces that support exploration of alternative scenarios from single-state models, and define them as *subjunctive interfaces*, which support parallel setup, viewing and control of alternative scenarios. From their studies, they formulated three key design principles for subjunctive interfaces: 1) setting up concurrent, multiple and independent scenarios 2) side by side viewing of the scenarios; and 3) the ability to make changes to several scenarios simultaneously. The advantages of subjunctive interfaces are that they allow for comparison and reasoning within choices (Hartmann et al., 2008) and enable exploration (Hartmann et al., 2008; Terry & Mynatt, 2002). Even if there is no explicit requirement for having choices, exploring multiple scenarios may result in a wider variety of results (Lunzer & Hornbæk, 2008a). Although popular parametric modelers theoretically define such alternatives, by letting users change parameters and explore what-if alternatives in real time, they only allow access to one state at a time. We aim to devise, implement and evaluate new interactions supporting design exploration with parametric dependency models, so that systems support subjunctive interfaces, that is, enable designers to work with multiple alternatives.

1 *Parametric modeling*

As in (Woodbury, 2010; chap 2), parametric models are directed graphs with arcs denoting the use of one property by another. This representation enables simple, compact and declarative representation of alternatives, state transitions based on differences and efficient state update algorithms, while only slightly restricting generality. Typically, common names identify nodes across models. This simple convention enables simultaneous updates as change to a named node can be applied across an entire collection. Parametric models are widely used in computer-aided design, are the basis for multiple visual programming languages, and are the fundamental representation underlying tools such as spreadsheets.

Theoretically, parametric models admit multiple alternatives, each achieved by editing one ore more parameters in the model. Thus, shown in Figure 1,

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