ABSTRACT

The thesis is an analytical and critical study of the visual and formal processes of design, as employed in computation. The study reviews current information about the state of the processes utilised in design especially in shape grammars. The study contrasts the visual and intuitive methods applied in design, with the formal processes of the shape grammar formalism. The research examines the context of visual processes that affect design. The study looks at shape recognition of U_{22} objects and outlines algorithmic approaches for solutions to the subshape problem, also extendable to U_{33}. An examination of shape grammar interpreters is used to test how design could be made machine-implementable, as a precursor to the development of rule-based methods in design. The adoption of differing shape algebraic methods that hold promise in the development of practical methodologies for design is explored, especially the use of *nonstandard* algebras. Such methods could be similar to intuitive processes in design, and further developed for practicality, especially to overcome the drawbacks of applying shapes in a design setting. Nonstandard algebras also provide the means for developing interactive design interfaces, both for shape grammars and for ordinary design. It enhances the potential for practical design by the adoption of the differing shape interactions using the Boolean functions. To overcome the restrictions of regular shape definitions, a *geometry bifurcation* model is proposed as a means to allow *nonformal* models of design to be implemented as *shape* models. By using a *pointset* definition, and a shape model for all shape types, these become amenable to design editing, rule application and shape operations. Further, the bifurcation model is employed to preserve *model integrity* within a shape grammatical mode. A validation process compares the proposed model against base cases of solid modelling and normal shape grammars; it shows how the projected representation is advantageous. Typical applications are shown, and further possibilities are discussed. The study basically explores how to overcome restrictions within the formal computational methods, and brings them closer to the visual processes which are most utilised in design.

Keywords: *shape grammar, visual and design thinking, formal methods, nonstandard shape algebras*