Chapter III

The Management of Evolving Engineering Design Constraints

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Abstract

This chapter presents research aimed at determining the requirements of a database software tool that supports integrity validation of versioned-design artefacts through effective management of evolving constraints. It has resulted in the design and development of a constraint management model, which allows constraint evolution through representing constraints within versioned objects called Constraint Versions Objects (CVOs). This model operates around a version model that uses a well-defined configuration management strategy to manage the versions of complex artefacts. Internal and inter-dependency constraints are modelled in CVOs. The combination of our versioning, configuration management, and constraint management approaches has produced a unique model which has been implemented in a prototype database tool with an intuitive user interface. The user interface

allows designers to manage design constraints without the need to program. The innovative concepts developed in this chapter are introduced using an ongoing example of a simple bicycle design.

Introduction

Artefacts in engineering design are structurally complex and may be represented in software as recursively composite objects. In all but the most trivial of projects, it is impossible for a single designer to perform all of the design effort alone, and therefore engineering design requires teamwork within a cooperative design environment. Due to the evolutionary nature of the design process, design constraints evolve and the design solution of each complex artefact and its components progress through a series of versions. To produce consistent versions, versioning software systems should be augmented with an integrity validation management system. While working within a software environment in which there are evolving constraints which are applied to complex structural artefacts, designers require designer-friendly features to enable them to effectively deal with the design task, without the necessity to program the software.

This chapter presents research aimed at developing a database software tool that supports integrity validation of versioned-design artefacts through effective management of evolving constraints. It has resulted in the design and development of a constraint management model, which allows constraint evolution through representing constraints within versioned objects called Constraint Versions Objects (CVOs). This model operates around a version model that uses a well-defined configuration management strategy to manage the versions of complex artefacts. Internal and inter-dependency constraints are modelled in CVOs. Inter-dependency constraints are used to express the consistency semantics necessary to combine the validated component versions into useful configurations. The combination of our versioning, configuration management and constraint management approaches has produced a unique model which has been implemented in a prototype database tool. This model utilises object-oriented technology and operates in a cooperative and distributed design environment. The innovative concepts developed in this paper are introduced using an ongoing example of a simple bicycle design. The prototype is evaluated using this design which demonstrates the feasibility and viability of our approach.

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