Handling Crosscutting Constraints in Domain-Specific Modeling

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PROJECT OBJECTIVE
This representation and analysis project is investigating the combination of Model Integrated Computing (MIC) and Aspect-Oriented Programming (AOP) composition technologies. In particular, the concepts of aspect weaving will be applied at a higher level of abstraction - at the modeling level. An additional goal is to develop a framework for building domain-specific weavers. The specific goals of the project are to develop:

- A domain-specific, graphical language that captures the functional and design semantics of real-time embedded systems.
- A process that maps high-level invariant properties and system requirements to design constraints affecting specific implementation aspects.
- A generation process that customizes components and composes real-time embedded systems.

This project will produce domain-specific and even application-specific modeling tools that will enable systems engineers to configure, analyze, and validate complex real-time embedded systems in a more intuitive manner.

BACKGROUND: DOMAIN-SPECIFIC MODELING

Key Characteristics of MIC
- Metamodeling is used to define a domain modeling language and the constraints that bind it.
- The ECL model is a metamodeling environment created by the ECL metacoercer.
- Domain experts work within the generative environment to create specific variants of domain models.
- Domain models can then be interpreted. This can result in an analysis of a model, or even synthesis into an application.

META-WEAVER FRAMEWORK

Domain-Specific Meta-Weaver Framework (DSMWF)

Observation
- A domain-oriented metamodeling paradigm captures the semantic and behavior of a domain.
- Using the GME metamodeling environment, the DSMWF provides a declarative metamodeling environment.

Consequences
- The resulting model is significantly more complex but easier to maintain and extend.

WEB SERVICE INTEGRATION FRAMEWORK (WSIF)

Creating New Weavers
Each specific GME metamodeling paradigm introduces different types of modeling elements, patterns, and semantics. Therefore, different weavers are needed for different paradigms.

- Strategies are used to instantiate the rapid construction of crosscutting-aware weavers. ECL constraints can be statically captured in the specification of these strategies.
- A code generator translates the strategies into C++ code that is then compiled within the weaving framework. Each domain can then be considered as being composed within the weave.

EXAMPLE: PROCESSOR ASSIGNMENT

Given 5 components for a weapons deployment system:
- The first example demonstrates the weaving of constraints that represent the processor assignment for each component. The strategy is based on worst-case execution time (WCET) for each component.