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NOLE: an AOM Weaver for Aspect Oriented Modeling of Real-Time System

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Abstract

Legacy applications that are already designed and maintained could be reused by adding new features like security, temporal constraints, etc. Aspect oriented approaches are an emerging technique that allow separation between functional and non-functional mechanisms. Separation of concerns, in aspect oriented design, en†hances productivity, reduces development costs and improves time to market delivery.
In this paper, we introduce AOMRTSYS an approach for weaving crosscutting concerns on UML and UML MARTE model. Then we focus on the NOLE weaver used by AOMRTSYS. We detail its operations and present the techniques used to implement it.

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Keywords: Aspect Oriented Modeling, Software development, UML MARTE, Real-Time System, Weaver ;

1. Introduction

Aspect Oriented Modeling (AOM) approaches aim to define transversal concerns separately. These are defined by functional and non-functional requirements. For example, billing or bank transaction systems represent functional

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requirements. However, authentication or data encryption mechanisms are considered as non-functional requirements. Subsequently, every aspect oriented modeling approach comprises these transversal concerns according to its own weaving process. Within the implementation phase, aspects' weaving uses the following notions: "*Joinpoint*", "*Pointcut*", "*Advice*" and "*Aspect*". A *Joinpoint* describes the location where the advice is added. An advice is a fragment of code, which is inserted before, around or after the defined *Pointcuts*. A *Pointcut* consists of a set of *Joinpoints*. An Aspect is a module that defines the advice and their *Pointcuts*.

Nomenclature

AOM	Aspect Oriented Modeling
AOP	Aspect Oriented Programming
AOMRTSYS	Aspect Oriented Modeling of Real-Time SYStem
UML	Unified Modeling Language
MARTE	Modeling and Analysis of Real Time and Embedded systems
R	Weaving rule
Ri	Instance of the Weaving rule
XML	Extensible Markup Language
XMI	XML Metadata Interchange

There is no consensus on the definition of these notions in the context of AOM. All the approaches dealing with this problem define their self-concepts. Usually, the non-functional requirements are defined using complex and elaborated models, which describe the whole process. The benefit of this choice is to reuse the components modeling the non-functional requirements (i.e. non-functional components). Nevertheless, weaving such components is relatively difficult. A component model could contain sub-models, for example, a structural and a behavioral one. Consequently, defining *Joinpoint* is difficult and potentially heterogeneous. Also, if the component provides many services, the weaving process will be more tedious. Aspect Oriented Modeling of Real-Time SYStem[1] (AOMRTSYS) approach addresses the aspect oriented modeling problem using an elementary and incremental way. According to our approach, a non-functional component is formed by many atomic elements. Every element of the language or modeling formalism is a potential atomic element. In addition, the weaving of a complex functional requirement, using the NOLE weaver, will be done in several steps using an incremental way. This proposition permits the simplification of the weaving step. We only weave atomic elements instead of complex models. This proposition is the cornerstone of an aided modeling system.

This paper is structured as follows. A general overview of AOMRTSYS approach is presented in Section 2. In Section 3, details of the NOLE weaver and techniques for its implementation are given. Related works are discussed in Section 4, and the last section draws our conclusion.

2. Overview of AOMRTSYS

Aspect Oriented Modeling of Real-Time System[1] (AOMRTSYS) is an AOM approach intended for the separation of concern in the modeling and design of real-time systems. AOMRTSYS aims at providing new ways of modularization in order to separate non functional requirement from traditional object-oriented units of decomposition during real-time system software development. Separation of real-time constraint has been the subject of many early research efforts[2, 3, 4] proving its possibility. In fact, a real-time application can be decomposed into functional requirements and non-functional ones. Functional requirements define, as any other domain, application core design. However, non-functional requirements is a set real-time constraints like scheduling, timing, concurrency and resource sharing.

According to our approach, a non-functional component is formed by many atomic elements. Every element of the language or modeling formalism is a potential atomic element. In addition, the weaving of a complex functional requirement will be done in several steps using an incremental way. This new proposition simplifies weaving