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Towards Aspectual Component-Based Real-Time System Development

by

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Abstract

Increasing complexity of real-time systems and demands for enabling their configurability and tailorability are strong motivations for applying new software engineering principles such as aspect-oriented and component-based software development. The integration of these two techniques into real-time systems development would enable: (i) efficient system configuration from the components in the component library based on the system requirements, (ii) easy tailoring of components and/or a system for a specific application by changing the behavior (code) of the component by aspect weaving, and (iii) enhanced flexibility of the real-time and embedded software through the notion of system configurability and components tailorability.

In this thesis we focus on applying aspect-oriented and component-based software development to real-time system development. We propose a novel concept of aspectual component-based real-time system development (ACCORD). ACCORD introduces the following into real-time system development: (i) a design method that assumes the decomposition of the real-time system into a set of components and a set of aspects, (ii) a real-time component model denoted RTCOM that supports aspect weaving while enforcing information hiding, (iii) a method and a tool for performing worst-case execution time analysis of different configurations of aspects and components, and (iv) a new approach to modeling of real-time policies as aspects.

We present a case study of the development of a configurable real-time database system, called COMET, using ACCORD principles. In the COMET example we show that applying ACCORD does have an impact on the real-time system development in providing efficient configuration of the real-time system. Thus, it could be a way for improved reusability and flexibility of real-time software, and modularization of crosscutting concerns.

In connection with development of ACCORD, we identify criteria that a design method for component-based real-time systems needs to address. The criteria include a well-defined component model for real-time systems, aspect separation, support for system configuration, and analysis of the composed real-time system. Using the identified set of criteria we provide an evaluation of ACCORD. In comparison with other approaches, ACCORD provides a distinct classification of crosscutting concerns in the real-time domain into different types of aspects, and provides a real-time component model that supports weaving of aspects into the code of a component, as well as a tool for temporal analysis of the weaved system.

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