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# Automatic Adaptor Generation for Behavioral Mismatches Using Pushdown Model Checking

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## Abstract

Reuse of existing software components as well as web services by composition can save time and cost in application development. However, composition with existing components always encounters errors called mismatches. A promising solution for mismatches is adaptation which introduces a special component that controls interactions of components by exclusively synchronizing with components. Current approaches of adaptation focus on behavioral mismatches using automata modeling. With behavior interfaces of components and specified adaptor contracts designed by developers, adaptors can be automatically generated. Current approaches work well but still have some disadvantages. First, behavioral mismatches of behavioral interfaces may result in the need of an adaptor having non-regular behavior while in current approaches expressing non-regular behavior is not possible. Second, adaptation contracts are manually designed with limited tool support. This leads to difficulties especially in dealing with large scale systems or components need to be dynamically composed such as services in mobile devices.

This thesis analyzes the two disadvantages of current approaches of adaptation and introduces a novel approach of adaptor generation. The approach uses pushdown systems model as protocols of adaptors so that non-regular behavior is able to be expressed. In order to compute and generate adaptors with this new modeling, pushdown model checking is applied to generate suitable traces for further generating adaptors. The idea of generating suitable traces is letting model checking algorithms searching for the negation of necessary properties and generating counterexamples satisfying the properties. The adaptation is called “Coordinator Guided Adaptor Generation” which includes building a over-behavioral system with a special adaptor called Coordinator and generating adaptors from counterexamples returned from pushdown model checking. This way of using pushdown model checking can leave the design of adaptation contracts to algorithms of model checking and therefore achieves fully automatic adaptor generation. Additionally, in order to automatically capture necessary properties, behavior interfaces of components are remodeled with constraints to force the revelation of implicit information. Properties for behavioral-mismatch-free and unbounded messages are especially addressed in this thesis.

The approach is evaluated by experiments on a web service system having ordering behavioral mismatches. A non-regular behavioral adaptor was successfully and automatically generated. The generated adaptor was further implemented in BPEL processes to confirm the feasibility of the approach. The experiments shows the approach successfully performs automatic adaptor generation with non-regular behavior and the modeling using pushdown system can be easily implemented in BPEL processes as an example of platform of software development. For the generality of the approach, some technical issues are discussed. Solutions for signature mismatches and branchings are provided so that the approach is also applicable on general cases of adaptation.

**Key Words:** Behavior Mismatch, Software Adaptation, Pushdown Model Checking