Abstract

Software-intensive systems offer unprecedented functionality, efficiency, and flexibility, but we require enhanced methodologies for managing the complexity of future systems that adapt and optimize their own behavior. Model-Driven Engineering improves quality and efficiency by means of modeling and code generation. The multi-agent system paradigm promises a more intuitive understanding of complex systems. In this thesis, we fuse these concepts into a model-driven approach to multi-agent system design. This allows us to combine CURCUMA, an innovative approach for designing complex coordination architectures, with a solid theoretical and technical foundation that enables formal verification and experimental validation. CURCUMA is based on two principles: Dynamic agent organizations that are responsible for solving specific problems by adhering to a set of shared conventions, and the prominent use of the agents' environment as the frame of reference that such conventions require. For their specification, we extend the UML with a family of visual constraint languages: *Story Decision Diagrams* provide a first-order logic for object-oriented systems, whereas *Timed Story Scenario Diagrams* describe their structural evolution. We provide formal semantics based on graph grammars, which enables the application of formal verification techniques. Moreover, we support an iterative development process relying on code generation, simulation, and monitoring, based on Fujaba4Eclipse.