Abstract

AUTOMATED GENERATION OF CONCURRENT DESIGNS FOR REAL-TIME SOFTWARE

Kevin L. Mills, Ph.D.

George Mason University, 1995

Dissertation Director: Dr. Hassan Gomaa

This dissertation proposes, investigates, and evaluates a method for generating concurrent designs for real-time software, given a flow graph model of system behavior. The proposed method assumes that a designer depicts system behavior through data/control flow diagrams, using the notation defined for Real-Time Structured Analysis, or RTSA. The proposed method encodes knowledge from a behavioral modeling approach, known as Concurrent Object-Based Real-Time Analysis, or COBRA, and from a design method, known as CONcurrent Design Approach for Real-Time Systems, or CODARTS. The encoded knowledge leads directly to an automated assistant for designers of concurrent software.

This dissertation defines a specification meta-model that enables semi-automated identification of semantic concepts from a data/control flow diagram. The specification meta-model consists of a concept hierarchy, a set of classification rules, and a set of concept axioms that extend and formalize the ideas contained in COBRA. The
dissertation also defines a design meta-model that allows the designer to represent and reason about concurrent designs and target environments.

The four central chapters of this dissertation specify expert-system rules that can generate concurrent designs from RTSA data/control flow diagrams. These expert-system rules are derived from design heuristics included within the CODARTS design method. Each of the central chapters corresponds to a design phase within CODARTS.

To investigate the feasibility of the approach proposed in this dissertation, a prototype COncurrent Designer’s Assistant, CODA, implemented directly from the specifications given within this dissertation, is applied to generate various designs for four real-time problems: an automobile cruise control and monitoring system, a robot controller, an elevator control system, and a remote temperature sensor. For each problem, the design produced by CODA is compared against an existing design provided by an experienced designer. The effectiveness of the approach, embodied within CODA, is evaluated and is compared with other approaches to automating the generation of designs.