Efficient Modelling and Simulation Methodology for the Design of Heterogeneous Systems-on-Chips

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EDMI Research Day 2009
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Introduction

Heterogeneous System-on-a-Chip (SoC) Design

Issues to be addressed in the SoC design:
• Significant heterogeneity
• Increasing environmental awareness
• Increasing sensitivity to deep sub-micron Si technologies
• Increasing re-use of subsystems

SystemC AMS-Extensions

• Standardisation effort by AMS Working Group (AMSWG) of Open SystemC Initiative (OSCI)
• Based on SystemC-AMS prototype developed at Fraunhofer IIS/EAS, Dresden, Germany;

Modeling a Multi-Domain System: Electromechanical Transducer Linked to a Resonator

1. Domain-Specific Model

Elements with analogous behavior need to be reimplemented for each domain.

2. Equivalent Bond Graph Model

Generic bond graph elements can be parametrized for each domain.

Goal of this work:
• Development of a dedicated bond graph MoC for SystemC-AMS with full support for static dimensional analysis

3. Derived Block Diagram Model

Static dimensional analysis using CG++ template meta programming
• Arbitrary composite units are ordered and reduced at compile time to a set of base units of a boolean system of units raised to rational powers (e.g., [N] = [kg m⁻² s⁻¹]
• Unit II and value V type become integral part of quant(ity,V), typically implementing all arithmetic operations allowing only consistent equations and assignments between compatible units

Example Implementations and Test Bench for the Block Diagram Library for the SDF MoC with Full Support for Dimensional Analysis

Time-Dependent Function Module with two Inputs

SDF Model of the Electromechanical Transducer

Test Bench for the Electromechanical Transducer

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