Hardware/Software Codesign Overview

RASSP E&F Module Number: 14

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**Abstract:** The Hardware/SoftwareCodesign Overview module is intended to introduce the hardware/software codesign to the practicing design, software, and systems engineers, and to the senior undergraduate or first year graduate student. The module provides key codesign concepts and attempts to show the benefits of the codesign approach over the current design process.

The module consists of eight sections. The topic is introduced by defining codesign, illustrating its usefulness, and introducing example systems that require this new methodology. Also included is a discussion about the components that make up an ideal codesign environment. The following sections are then dedicated to discussing some of these components in more detail.

The second describes the unified representation for hardware and software that is one of the components for an ideal codesign environment. Several candidate description methods are discussed in some detail. The third section describes techniques used to partition a system into hardware and software components. An automated partitioning algorithm is the ideal way to go, but this is a difficult enough problem that many codesign environments still leave this problem up to the expertise of the user. The fourth section describes the integrated modeling substrate that forms a component of an ideal codesign environment. This modeling substrate allows the complete hardware/software system model to be simulated at any point in the design process, which allows some degree of validation to be performed. The fifth section briefly covers methodologies for hardware and software synthesis from abstract system descriptions.

Finally, sixth section covers industrial approaches to hardware/software codesign, specifically covering the Lockheed Saunders and Lockheed Martin ATL approaches, and the seventh section gives a brief introduction into several codesign systems being developed by universities. Example systems included are Chinook, COSYMA, Ptolemy and POLIS.

**Module Objectives:**

To educate the hardware, software, and system designer on the fundamentals of hardware/software codesign in a manner that will assist him/her in understanding and employing cooperative hardware/software design techniques for the construction of complex systems, particularly embedded systems.

**Specific Objectives:**

Provide information on:

1) Introduction of Hardware/Software Codesign
2) Design Issues, Trends, and Considerations
3) Current Hardware/Software Design Process
4) Issues and Directions in Hardware/Software Codesign
5) Hardware/Software Modeling Concepts
6) Hardware/Software Partitioning
7) Hardware/Software Synthesis
8) Hardware/Software Codesign Systems

Prerequisites:

Prerequisite Modules: None

Prerequisite Knowledge:
Fundamentals digital logic design, both combinational and sequential
Software engineering fundamentals

Syllabus:

1) Introduction (25 Slides)
   a) Codesign Definition
   b) Motivation for Codesign
   c) Categories of Systems and the Codesign Problem
   d) Embedded Systems
   e) Components of the Current Codesign Process
   f) Components of the Ideal Codesign Process

2) Unified Hardware/Software Representations (12 Slides)

3) HW/SW Partitioning Techniques (26 Slides)
   a) Partitioning Algorithms
   b) Cost Metrics
   c) Issues in Partitioning

4) Integrated HW/SW Modeling Methodologies (7 Slides)

5) HW/SW Synthesis Methodologies (16 Slides)
   a) Hardware Synthesis
   b) Software Synthesis
   c) Interface Synthesis
   d) Cosynthesis

6) Industry Approaches to HW/SW Codesign (4 Slides)

7) Hardware/Software Codesign Research (30 Slides)
   a) Major Codesign Research Efforts
   b) Chinook
   c) COSYMA
   d) Ptolemy
e) POLIS

9) Module Summary (1 Slide)