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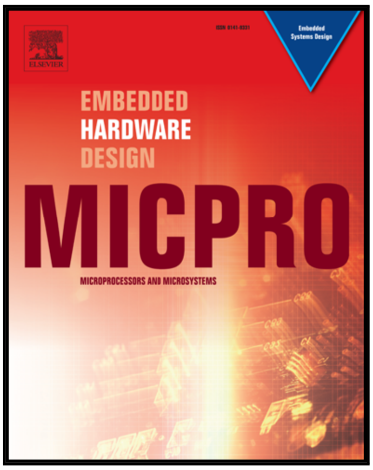

Heterogeneity of abstractions in EDA tools: reviewing models of computation for many-core systems targeting intensive signal processing applications

Manel Ammar, Mohamed Abid

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Heterogeneity of abstractions in EDA tools: reviewing models of computation for many-core systems targeting intensive signal processing applications

Manel Ammar and Mohamed Abid

CES Laboratory, National Engineering School of Sfax, Sfax, Tunisia

Abstract

Designing many-core systems for intensive signal processing applications necessitates refreshing common practices in the design of Electronic Design Automation (EDA) tools. This should change the focus of the EDA community from old-fashioned foundations including heavy implementations and time-consuming simulations, to recent engineering practices promoting rapid design and acceptable accuracy. Hence, the challenge of the EDA community comes to define a design process for many-core systems which enables four goals: modeling conciseness, estimation accuracy, design rapidity, and exploration flexibility. In this scenario, the modeling task can be defined as a delicate design phase that requires choosing the adequate Model of Computation (MoC) at each step of the design process. Design models at each level of abstraction provide the basis for applying analysis, synthesis or verification techniques. Since modeling concepts and techniques can have a large influence on the quality, accuracy and rapidity of results, models and corresponding abstraction levels should be well-defined with clear and unambiguous semantics. In this paper, we aim to provide an analysis and comparative overview of common MoCs used in the specification and performance analysis of intensive signal processing applications and many-core architectures. After identifying conventional classifications, we propose a new taxonomy of MoCs based on their purpose in the design flow. The heterogeneity of MoCs in EDA tools is also discussed and various tools are reviewed and compared.

Keywords: Model of Computation, many-core, Signal processing, Electronic Design Automation, Model of performance, Model of specification

1. Introduction

At the beginning of this new century, the exponential information growth rate goes beyond Moores Law evolution [1]. Accordingly, massive data including signals is making big pressure on the digital signal processing field leading to the emergence of a new discipline: intensive signal processing. In 2012, authors in [2] listed big data techniques involving intensive signal processing discipline in Top 10 Critical Technology Trends For The Next Five Years. Intensive signal processing denotes the manipulation of a considerable amount of data and the accomplishment of numerous complex computations [3]. An intensive signal processing application is then an application that explores, inquires, examines, pictures and in general deals with very large scale data streams.

Intensive signal processing applications share many common charactestics which are mainly: the high complexity of the data structures, the intensive parallelism available in the application functionalities, and the high data storage and computational requirements. Targeting intensive signal processing applications requires using hardware architectures that are:

- Fast: meet demanding processing requirements
- Flexible: easy to program to reach the market on time
- Scalable: easy to upgrade with the intention of providing a different functionality

The needs for time-predictability, energy-efficiency, and flexibility, coming along with Moore's law