Design Tools Session

MULTICUBE: Multi-Objective Design Space Exploration of Multiprocessor Architectures for Embedded Multimedia Applications

C. Silvano[1], G. Palermo[1], V. Zaccaria[1], W. Fornaciari[1], R. Zafalon[2], S. Bocchio[2], M. Martinez[3], M. Wouters[4], G. Vanmeerbeeck[4], P. Avasare[4], L. Onesti[5], C. Kavka[5], U. Bondi[6], G. Mariani[6], E. Villar[7], H. Posadas[7], C. Y. Q. Wu[8], F. Dongrui[9], Z. Hao[9].

[1]*Politecnico di Milano, ITALY - {silvano, gpalermo, zaccaria, fornacia}@elet.polimi.it*
[2]*STMicroelectronics, ITALY - {roberto.zafalon, sara.bocchio}@st.com*
[3]*DS2, SPAIN - marcos.martinez@ds2.es*
[4]*IMEC, BELGIUM - {woutersm, vanmeerb, avasare}@imec.be*
[5]*ESTECO, ITALY - {luca.onesti, carlos.kavka}@esteco.com*
[6]*ALaRI - Università della Svizzera Italiana, SWITZERLAND - {bondi, marianig}@alari.ch*
[7]*University of Cantabria, SPAIN - {villar, posadash}@teisa.unican.es*
[8]*STMicroelectronics, CHINA - chris.wu@st.com*
[9]*Institute of Computing Technology - Chinese Accademy of Science, CHINA - {fandr, zhanghao}@ict.ac.cn*

Abstract

Many point tools exist to optimize particular aspects of embedded systems. However, an overall design space exploration framework is needed to combine all the decisions into a global search space, and a common interface to the optimization and evaluation tools. The MULTICUBE project (www.multicube.eu) focuses on the definition of an automatic multi-objective Design Space Exploration (DSE) framework to be used to tune the System-on-Chip architecture for the target application evaluating a set of metrics (e.g. energy, latency, throughput, bandwidth, QoS, etc.) for the next generation of embedded multimedia platforms. This overall objective is two-fold.

From one side, the MULTICUBE project will define an automatic multi-objective DSE framework to find design alternatives that best meet system constraints and cost criteria, strongly dependent on the target application, but also to restrict the search space to crucial parameters to enable an efficient exploration. In the developed DSE framework, a set of heuristic optimization algorithms must be defined to reduce the overall exploration time by computing an approximated Pareto set of configurations with respect to the selected figures of merit. Once the approximated Pareto set has been built, the designer can quickly select the best system configuration satisfying the constraints.

From the other side, the MULTICUBE project will define a run-time DSE framework based on the applications of the results of the static multi-objective design exploration to optimize the run-time allocation and scheduling of different application tasks. The design space exploration flow results in a Pareto-optimal set of design alternatives with different speed, energy, memory and communication bandwidth parameters. This information can be used at run-time by the operation system to make an informed decision about how the resources should be distributed over different tasks running on the multi-processor system on-chip. This resource distribution cannot be performed during the design exploration itself, since it depends on which tasks are active at a particular point in time.