Title: *Reconfigurable Systems and their Influence on Mobile and Multimedia Applications*

Abstract: With the advent of field programmable logic devices it became possible to design and implement digital systems without the need for the technological steps dealing with silicon. Tremendous progress in this area has made it possible to advance configurable microchips from programmable logic arrays - PLA (early 1970s) and further simple gate arrays, that appeared on the market in the mid-1980s, to platform field programmable gate arrays (FPGA) containing more than 10 million system gates and incorporating complex heterogeneous structures, such as PowerPC processors. Recent research results show that future programmable logic might achieve 100 billion devices per square centimeter, which permits to argue that cheap molecular-scale reconfiguration is likely to become the predominant digital technology in a decade hence. The impact of FPGAs on different development directions in computer science, electrical and computer engineering is growing continuously. Today, advanced research is being intensively performed in the areas of system-on-chip and network-on-chip supported by the extensive use of computer-aided design (CAD) systems. Traditionally, FPGA-targeted CAD systems are based on schematic and hardware description language design flows involving model-specific tools and core generators. Recently, system level specification languages (such as Handel-C and SystemC) have been developed and are now frequently used. This clearly demonstrates that the domain of reconfigurable systems design is very dynamic and many-sided. The rapid evolution of FPGA technology and relevant CAD systems requires a large number of well-prepared engineers in these areas. Hence an ongoing review of the corresponding curricula is necessary to incorporate the recent advances. Consequently the impact of reconfigurable systems on contemporary engineering education is also growing continuously.

This tutorial is intended to cover the majority of hot topics related to reconfigurable systems with a profound analysis and comparison of alternative approaches, such as hardware/software versus *configware*. It demonstrates advantages of reconfigurable systems in terms of technical characteristics and economic aspects and shows their significant influence on mobile computing and multimedia applications. The tutorial also includes a profound discussion of a novel methodology that has been used for teaching reconfigurable systems.

Outline

1. **Evolution of reconfigurable systems**
1.1. PLA and PAL;
1.2. Gate arrays;
1.3. Field Programmable Gate Arrays - FPGA;
1.4. Platform FPGA.
1.5. System-on-chip;
1.6. Network-on-chip;
1.7. Reconfigurable systems for mobile computing;
1.8. Reconfigurable systems for multimedia applications.

2. **Generations of FPGA. Impact of FPGA on mobile computing and multimedia applications**
2.1. From gate arrays to system-on-chip;
2.2. Configuration and reconfiguration techniques;
2.3. FPGA architectures;
2.4. Molecular electronics;
2.5. Future challenges in mobile computing and multimedia.

3. **Relationship between software, hardware and *configware* (reconfigurable hardware)**
3.1. Software/hardware partitioning;
3.2. Software/*configware* partitioning;
3.3. Statically and dynamically reconfigurable accelerators for mobile and multimedia applications;
3.4. Chipsets for application-specific microprocessors targeting at mobile and multimedia applications;
3.5. Relationship between FPGA and ASIC (application-specific integrated circuits) targeting at mobile and multimedia applications.

4. **Design flow, design languages and design automation**
4.1. Design flow and design methodologies;
4.2. Hardware description languages;
4.3. System-level specification languages;
4.4. Hardware/software systems for rapid prototyping;
4.5. Design automation tools and methodologies.

5. **Reconfigurable systems for engineering and research**
6.1. The use of reconfigurable systems for general-purpose and application-specific computations, such as that are common for mobile and multimedia applications;
6.2. Reconfigurable embedded systems for mobile and multimedia applications;
6.3. Implementation of computationally intensive algorithms (example: the Boolean satisfiability);
6.4. Alternative and competitive algorithms (example: recursive and iterative algorithms);
6.5. Rapid prototyping and experiments;
6.6. Concluding remarks about advantages of reconfigurable systems for mobile and multimedia applications.

7. **Reconfigurable systems in education**
7.1. Strong relationship between rapid evolution of reconfigurable systems and education;
7.2. Multidisciplinary features;
7.3. Reconfigurable systems' courses overview and analysis;
7.4. Novel methods, tools and tutorials for teaching reconfigurable systems;
7.5. Applying various alternative methods for evaluation of students;
7.6. The importance of experience with design languages and commercially available automation tools;
7.7. The importance of projects;
7.8. The importance of distance learning and web based teaching materials and tools.

Brief biography of the presenters

Valery Sklyarov received the Engineering degree from the Technical University – UPI, Uljanovsk, Russia, in 1972; the Ph.D. degree in computer science from the Technical University – BSUIR, Minsk, Belarus, in 1978; the Doctor of Science degree in computer science from the Technical University – LETI, St. Petersburg, Russia, in 1986; and the Aggregation (*Agregação*) in Electrical Engineering from the University of Aveiro, Portugal, in 2001. From 1972 to 1978 he was with the Research Institute, Minsk, Belarus, where he became the Project Leader of the Design Peripheral Devices Group. From 1978 to 1994 he was with the Belorussian State University of Informatics and Radioelectronics (formerly the Minsk Radioengineering Institute), Belarus, as an Associate Professor; and since 1987 he has been a Full Professor and the Head of the Computer Science Department. Since 1994, he has been with the Department of Electronics and Telecommunications, University of Aveiro (from 2006 renamed to the Department of Electronics, Telecommunications and Informatics), Portugal, where he is currently a Full Professor of Computer Engineering. He has also been teaching and researching at Bialystok University, Poland, and Kassel University, Germany. He has authored and co-authored 17 books (and more than 250 papers) on subjects, which include digital design, computer architecture,

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