Lecture Notes in Computer Science

12700

Founding Editors

Gerhard Goos

Karlsruhe Institute of Technology, Karlsruhe, Germany

Juris Hartmanis

Cornell University, Ithaca, NY, USA

Editorial Board Members

Elisa Bertino

Purdue University, West Lafayette, IN, USA

Wen Gao

Peking University, Beijing, China

Bernhard Steffen

TU Dortmund University, Dortmund, Germany

Gerhard Woeginger

RWTH Aachen, Aachen, Germany

Moti Yung

Columbia University, New York, NY, USA

More information about this subseries at http://www.springer.com/series/7407

Steven Derrien · Frank Hannig · Pedro C. Diniz · Daniel Chillet (Eds.)

Applied Reconfigurable Computing

Architectures, Tools, and Applications

17th International Symposium, ARC 2021 Virtual Event, June 29–30, 2021 Proceedings



Editors
Steven Derrien
IRISA
University of Rennes 1
Rennes, France

Pedro C. Diniz INESC-ID Lisboa, Portugal

Frank Hannig (1) Friedrich-Alexander-Universität Erlangen-Nürnberg Erlangen, Germany

Daniel Chillet D ENSSAT University of Rennes 1 Lannion, France

ISSN 0302-9743 ISSN 1611-3349 (electronic) Lecture Notes in Computer Science ISBN 978-3-030-79024-0 ISBN 978-3-030-79025-7 (eBook) https://doi.org/10.1007/978-3-030-79025-7

LNCS Sublibrary: SL1 - Theoretical Computer Science and General Issues

© Springer Nature Switzerland AG 2021

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

The 17th International Symposium on Applied Reconfigurable Computing (ARC 2021) was organized by the Université de Rennes 1 and Inria, France, during June 29–30, 2021. Unfortunately, due to the ongoing protective measures resulting from the COVID-19 pandemic and the subsequent travel restrictions, we had to opt for a virtual ARC 2021 symposium meeting.

As with previous years, the ARC 2021 edition covered a broad spectrum of applications of reconfigurable computing, from driving assistance, data and graph processing acceleration, and computer security to the societal topic of supporting early diagnosis of COVID-19 infections. This year's symposium program included 14 regular and 11 short (poster) contributions selected from a total of 36 submissions. The selection process was very competitive with each submission having an average of four reviews. The strong technical program also included a keynote talk on the timely topic of FPGA hardware security in the cloud by Prof. Dirk Koch from the University of Manchester, UK.

This year's successful program was made possible by the contribution of many talented individuals. First and foremost, we would like to thank all the authors who responded to our call for papers and the members of the Program Committee and the additional external reviewers who, with their opinion and expertise, ensured a program of the highest quality. Last but not the least, we would like to thank Angeliki Kritikakou who ensured that publicity and web interactivity remained engaging and responsive.

Thank you all.

June 2021

Daniel Chillet Frank Hannig Steven Derrien Pedro C. Diniz

Organization

General Chair

Daniel Chillet University of Rennes 1/ENSSAT, France

Program Committee Chairs

Frank Hannig Friedrich-Alexander University Erlangen-Nürnberg,

Germany

Steven Derrien University of Rennes 1, France

Steering Committee

Hideharu Amano Keio University, Japan

Jürgen Becker Karlsruhe Institute of Technology, Germany

Mladen Berekovic Braunschweig University of Technology, Germany

Koen Bertels QBee.EU, Belgium

João M. P. Cardoso University of Porto, Portugal

Katherine (Compton) University of Wisconsin-Madison, USA

Morrow

George Constantinides Imperial College London, UK

Pedro C. Diniz INESC-ID, Portugal

Philip H. W. Leong University of Sydney, Australia

Walid Najjar University of California, Riverside, USA

Roger Woods Queen's University Belfast, UK

Program Committee

Hideharu Amano Keio University, Japan

Zachary Baker Los Alamos National Laboratory, USA

João Bispo University of Porto, Portugal Vanderlei Bonato University of São Paulo Brazil

Marcelo Brandalero Brandenburg University of Technology, Cottbus,

Germany

Christos Bouganis Imperial College London, UK João Canas Ferreira University of Porto, Portugal João M. P. Cardoso University of Porto, Portugal

Ray Cheung City University of Hong Kong, Hong Kong

Daniel Chillet University of Rennes 1/Inria, France Steven Derrien University of Rennes/Inria, France

Pedro C. Diniz INESC-ID, Portugal

Giorgos Dimitrakopoulos Democritus University of Thrace, Greece

Organization

viii

António Ferrari University of Aveiro, Portugal

Ricardo Ferreira Universidade Federal de Vicosa, Brazil

Mohammad Ghasemzadeh Apple, USA

Roberto Giorgi University of Siena, Italy Diana Goehringer TU Dresden, Germany

Marek Gorgon AGH University of Science and Technology, Poland Frank Hannig Friedrich-Alexander University Erlangen-Nürnberg,

Germany

Jim Harkin University of Ulster, UK Christian Hochberger TU Darmstadt, Germany

Michael Huebner Brandenburg University of Technology, Cottbus,

Germany

Kimon Karras Think Silicon S.A., Greece Krzysztof Kepa GE Global Research, USA

Georgios Keramidas Technological Educational Institute of Western Greece,

Greece

Andreas Koch TU Darmstadt, Germany

Angeliki Kritikakou University of Rennes 1/Inria, France

Tomasz Kryjak AGH University of Science and Technology, Poland

Konstantinos Masselos University of Peloponnese, Greece

Cathal McCabe Xilinx, UK

Antonio Miele Politecnico di Milano, Italy

Takefumi Miyoshi e-trees.Japan, Japan

Horacio Neto INESC-ID/IST/ULisboa, Portugal Dimitris Nikolos University of Patras, Greece

Andrés Otero Universidad Politécnica de Madrid, Spain Kyprianos Papadimitriou Technical University of Crete, Greece

Monica Pereira Universidade Federal do Rio Grande do Norte, Brazil Thilo Pionteck Otto-von-Guericke Universität Magdeburg, Germany

Marco Platzner University of Paderborn, Germany Mihalis Psarakis University of Piraeus, Greece

Fernando Rincón University of Castilla-La Mancha, Spain Yukinori Sato Toyohashi University of Technology, Japan

António Carlos Schneider Universidade Federal do Rio Grande do Sul, Brazil

Olivier Sentievs University of Rennes 1/Inria, France

Yuichiro Shibata Nagasaki University, Japan

Hayden Kwok-Hay So University of Hong Kong, Hong Kong

Dimitrios Soudris National Technical University of Athens, Greece

George Theodoridis University of Patras, Greece

Chao Wang University of Science and Technology of China, China

Additional Reviewers

Muhammad Ali Chris
Anna Drewes Dani
Hassan Ghasemzadeh Mohammadi Amin
Veronia Iskandar Pedra
Ahmed Kamaleldin Leon
Farnam Khalili Maybodi Luka
Konstantina Koliogeorgi Chris
Martin Koppehel Ioann

Christian Lienen
Daniele Passaretti
Amin Sahebi
Pedro Filipe Silva
Leonardo Solis-Vasquez
Lukas Sommer
Christoph Spang
Ioannis Stamoulias

Contents

A	p	pl	ic	at	tic	on	S
	Г,	٣-		•			_

Fast Approximation of the Top-k Items in Data Streams Using	
a Reconfigurable Accelerator	3
Exploiting 3D Memory for Accelerated In-Network Processing of Hash Joins in Distributed Databases	18
Johannes Wirth, Jaco A. Hofmann, Lasse Thostrup, Andreas Koch, and Carsten Binnig	
Design Tools	
Evaluation of Different Manual Placement Strategies to Ensure Uniformity of the V-FPGA.	35
Johannes Pfau, Peter Wagih Zaki, and Jürgen Becker	
Timing Optimization for Virtual FPGA Configurations	50
Hardware Based Loop Optimization for CGRA Architectures	65
Supporting On-chip Dynamic Parallelism for Task-Based Hardware	
Accelerators	81
Combining Design Space Exploration with Task Scheduling of Moldable	93
Streaming Tasks on Reconfigurable Platforms. Jörg Keller, Sebastian Litzinger, and Christoph Kessler	93
Task-Based Programming Models for Heterogeneous	
Recurrent Workloads	108
Jaume Bosch, Miquel Vidal, Antonio Filgueras,	
Daniel Jiménez-González, Carlos Álvarez, Xavier Martorell, and Eduard Ayguadé	

Architecture

Multi-layered NoCs with Adaptive Routing for Mixed Criticality Systems Nidhi Anantharajaiah, Zhe Zhang, and Juergen Becker	125
PDU Normalizer Engine for Heterogeneous In-Vehicle Networks in Automotive Gateways	140
StreamGrid - An AXI-Stream-Compliant Overlay Architecture	156
Security	
Increasing Side-Channel Resistance by Netlist Randomization and FPGA-Based Reconfiguration	173
Moving Target and Implementation Diversity Based Countermeasures Against Side-Channel Attacks	188
Clone-Resistant Secured Booting Based on Unknown Hashing Created in Self-Reconfigurable Platform	203
Posters	
Transparent Near-Memory Computing with a Reconfigurable Processor Fabian Lesniak, Fabian Kreβ, and Jürgen Becker	221
A Dataflow Architecture for Real-Time Full-Search Block Motion Estimation	232
Providing Tamper-Secure SoC Updates Through Reconfigurable Hardware	242
Graviton: A Reconfigurable Memory-Compute Fabric for Data Intensive Applications	254

Contents	xiii
Dynamic Spatial Multiplexing on FPGAs with OpenCL Pascal Jungblut and Dieter Kranzlmüller	265
Accelerating Convolutional Neural Networks in FPGA-based SoCs using a Soft-Core GPU	275
Evaluating the Design Space for Offloading 3D FFT Calculations to an FPGA for High-Performance Computing	285
FPGA Implementation of Custom Floating-Point Logarithm and Division Nelson Campos, Slava Chesnokov, Eran Edirisinghe, and Alexis Lluis	295
On the Suitability of Read only Memory for FPGA-Based CAM Emulation Using Partial Reconfiguration	305
Domain-Specific Modeling and Optimization for Graph Processing on FPGAs	315
Covid4HPC: A Fast and Accurate Solution for Covid Detection in the Cloud Using X-Rays	327
Author Index	337