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## VLSI-SoC: Technology Advancement on SoC Design

Victor Grimblatt, Chip Hong Chang, Ricardo Reis, Anupam Chattopadhyay,  
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*IFIP is the global non-profit federation of societies of ICT professionals that aims at achieving a worldwide professional and socially responsible development and application of information and communication technologies.*

IFIP is a non-profit-making organization, run almost solely by 2500 volunteers. It operates through a number of technical committees and working groups, which organize events and publications. IFIP's events range from large international open conferences to working conferences and local seminars.

The flagship event is the IFIP World Computer Congress, at which both invited and contributed papers are presented. Contributed papers are rigorously refereed and the rejection rate is high.

As with the Congress, participation in the open conferences is open to all and papers may be invited or submitted. Again, submitted papers are stringently refereed.

The working conferences are structured differently. They are usually run by a working group and attendance is generally smaller and occasionally by invitation only. Their purpose is to create an atmosphere conducive to innovation and development. Refereeing is also rigorous and papers are subjected to extensive group discussion.

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Victor Grimblatt · Chip Hong Chang ·  
Ricardo Reis · Anupam Chattopadhyay ·  
Andrea Calimera (Eds.)


# VLSI-SoC: Technology Advancement on SoC Design


29th IFIP WG 10.5/IEEE International Conference  
on Very Large Scale Integration, VLSI-SoC 2021  
Singapore, October 4–8, 2021

Revised and Extended Selected Papers


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# Preface

This book contains extended and revised versions of the highest quality papers, presented during the 29th edition of the IFIP/IEEE WG 10.5 International Conference on Very Large Scale Integration (VLSI-SoC 2021), a global system-on-chip design and computer-aided design conference. The 29th edition of the conference was held during October 4–8, 2021, virtually from Singapore. Previous conferences have taken place in Edinburgh, Scotland (1981); Trondheim, Norway (1983); Tokyo, Japan (1985); Vancouver, Canada (1987); Munich, Germany (1989); Edinburgh, Scotland (1991); Grenoble, France (1993); Chiba, Japan (1995); Gramado, Brazil (1997); Lisbon, Portugal (1999); Montpellier, France (2001); Darmstadt, Germany (2003); Perth, Australia (2005); Nice, France (2006); Atlanta, GA, USA (2007); Rhodes, Greece (2008); Florianopolis, Brazil (2009); Madrid, Spain (2010); Kowloon, Hong Kong (2011); Santa Cruz, CA, USA (2012); Istanbul, Turkey (2013); Playa del Carmen, Mexico (2014); Daejeon, South Korea (2015); Tallin, Estonia (2016); Abu Dhabi, United Arab Emirates (2017); Verona, Italy (2018); Cuzco, Peru (2019); and Salt Lake City (2020, virtual edition).

The purpose of this conference, sponsored by IFIP TC 10 Working Group 10.5, the IEEE Council on Electronic Design Automation (CEDA), and the IEEE Circuits and Systems Society, with the In-Cooperation of ACM SIGDA, is to provide a forum for the presentation and discussion of the latest academic and industrial results and developments as well as the future trends in the field of system-on-chip (SoC) design, considering the challenges of nano-scale, state-of-the-art, and emerging manufacturing technologies. In particular, VLSI-SoC 2021 addressed cutting-edge research fields like emerging technologies, analog and mixed-signal circuits, VLSI and embedded system design, testing and verification, computer-aided design, design for security, reliable in-memory computing, secure hardware architectures, and cyber-physical systems on heterogeneous system-on-chips. The chapters of this new book in the VLSI-SoC series continue its tradition of providing an internationally acknowledged platform for scientific contributions and industrial progress in this field.

For VLSI-SoC 2021, 44 papers out of 75 submissions were selected for oral and poster presentations. There was an average of 3.45 reviews of each paper in the conference selection process and out of the 44 full papers presented at the conference, 12 papers were chosen by a special selection committee to have an extended and revised version included in this book. The selection process of these papers considered the evaluation scores during the conference review process as well as the review forms provided by members of the Technical Program Committee and the session chairs as a result of the presentations. After the authors sent their extended versions, the book co-editors reviewed the final papers.

The chapters of this book have authors from Canada, France, Italy, Germany, Singapore, and the USA. The Technical Program Committee for the regular tracks comprised 125 members from more than 25 countries.

VLSI-SoC 2021 was the culmination of the work of many dedicated volunteers: paper authors, reviewers, session chairs, invited speakers, and various committee chairs. We thank them all for their contributions.

This book is intended for the VLSI community at large, and in particular the many colleagues who did not have the chance to attend the conference. We hope you will enjoy reading this book and that you will find it useful in your professional life and for the development of the VLSI community as a whole.

August 2022

Victor Grimblatt  
Chip Hong Chang  
Ricardo Reis  
Anupam Chattopadhyay  
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# Organization

The IFIP/IEEE International Conference on Very Large Scale Integration System-on-Chip (VLSI-SoC) 2021 took place during October 4–8, 2021, virtually from Singapore. VLSI-SoC 2021 was the 29th in a series of international conferences, sponsored by IFIP TC 10 Working Group 10.5 (VLSI), IEEE CEDA, and ACM SIGDA. The Organization Committee of the conference consisted of the following colleagues:

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