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Edited by

ALFREDO BENSO
Politecnico di Torino, Italy

and

PAOLO PRINETTO
Politecnico di Torino, Italy

KLUWER ACADEMIC PUBLISHERS
NEW YORK, BOSTON, DORDRECHT, LONDON, MOSCOW

eBook ISBN: 0-306-48711-X
Print ISBN: 1-4020-7589-8

Created in the United States of America

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Contents

Contributing Authors

Joakim Aidemark, Chalmers Univ. of Technology, Göteborg, Sweden
Jean Arlat, LAAS-CNRS, Toulouse, France
Andrea Baldini, Politecnico di Torino, Torino, Italy
Juan Carlos Baraza, Università Polytecnica de Valencia, Spain
Marco Bellato, INFN, Padova, Italy
Alfredo Benso, Politecnico di Torino, Torino, Italy
Sara Blanc, Università Polytecnica de Valencia, Spain
Jérome Boué, LAAS-CNRS, Toulouse, France
Joao Carreira, Critical Software SA, Coimbra, Portugal
Marco Ceschia, Università di Padova, Padova, Italy
Fulvio Corno, Politecnico di Torino, Torino, Italy
Diamantino Costa, Critical Software SA, Coimbra, Portugal
Yves Crouzet, LAAS-CNRS, Toulouse, France
Jean-Charles Fabre, LAAS-CNRS, Toulouse, France
Luis Entrena, Universitad Carlos III, Madrid, Spain
Peter Folkesson, Chalmers Univ. of Technology, Göteborg, Sweden
Daniel Gil, Università Polytecnica de Valencia, Spain
Pedro Joaquín Gil, Università Polytecnica de Valencia, Spain
Joaquín Gracia, Università Polytecnica de Valencia, Spain
Leonardo Impagliazzo, Ansaldo Segnalamento Ferroviario, Napoli, Itlay
Eric Jenn, LAAS-CNRS, Toulouse, France
Barry W. Johnson, University of Virginia, VA, USA
Johan Karlsson, Chalmers Univ. of Technology, Göteborg, Sweden
Celia Lopez, Universitad Carlos III, Madrid, Spain
Tomislav Lovric, TÜV InterTraffic GmbH, Köln, Germany
Henrique Madeira, University of Coimbra,Portugal

Riccardo Mariani, Yogitech SpA, Pisa, Italy
Joakim Ohlsson, Chalmers Univ. of Technology, Göteborg, Sweden
Alessandro Paccagnella, Università di Padova, Padova, Italy
Fabiomassimo Poli, Ansaldo Segnalamento Ferroviario, Napoli, Itlay
Paolo Prinetto, Politecnico di Torino, Torino, Italy
Marcus Rimén, Chalmers Univ. of Technology, Göteborg, Sweden
Chantal Robach, LCIS-ESISAR, Valence, France
Manuel Rodríguez, LAAS-CNRS, Toulouse, France
Frédéric Salles, LAAS-CNRS, Toulouse, France
Mathieu Scholive, LCIS-ESISAR, Valence, France
Juan José Serrano, Università Polytecnica de Valencia, Spain
Joao Gabriel Silva, University of Coimbra,Portugal
Matteo Sonza Reorda, Politecnico di Torino, Torino, Italy
Giovanni Squillero, Politecnico di Torino, Torino, Italy
Yangyang Yu, Univ. of Virginia, VA, USA

Preface

The use of digital systems pervades all areas of our lives, from common house appliances such as microwave ovens and washing machines, to complex applications like automotive, transportations, and medical control systems. These digital systems provide higher productivity and greater flexibility, but it is also accepted that they cannot be fault-free. Some faults may be attributed to inaccuracy during the development, while others can stem from external causes such as production process defects or environmental stress. Moreover, as devices geometry decreases and clock frequencies increase, the incidence of transient errors increases, and consequently, the dependability of the systems decreases. High reliability is therefore a requirement for every digital system whose correct functionality is connected to human safety or economic investments.

In this context, the evaluation of the dependability of a system plays a critical role. Unlike performance, dependability cannot be evaluated using benchmark programs and standard test methodologies, but only observing the system behavior after the appearance of a fault. However, since the Mean-Time-Between-Failures (MTBF) in a dependable system can be of the order of years, the fault occurrence has to be artificially accelerated in order to analyze the system reaction to a fault, without waiting for its natural appearance.

Fault Injection emerged as a viable solution, and it has been deeply investigated and exploited by both academia and industry. Different techniques have been proposed and used to perform experiments. They can be grouped in *Hardware-implemented, Software-implemented,* and *Simulation-based* Fault Injection.

The process of setting up a Fault Injection environment requires different choices that can deeply influence the coherency and the meaningfulness of the final results. In this book we tried to collect some of the most significant contributions in the field of Fault Injection. The selection process has been very difficult, with the result that a lot of excellent works had to be left out. The criteria we used to select the contributing authors were based on the innovation of the proposed solution, on the historical significance of their work, and also on an effort to give the readers a global overview of the different problems and techniques that can be applied to setup a Fault Injection experiment.

The book is therefore organized in four different parts. The first part is more general, and motivates the use of Fault Injection techniques. The other three parts cover Hardware-based, Software-implemented, and Simulation-based Fault Injection techniques, respectively. In each of these parts three Fault Injection methodologies and related tools are presented and discussed. The last chapter of Part 4 discusses possible solutions to speed-up Simulation-based Fault Injection experiments, but the main guidelines highlighted in the chapter can be applicable to other Fault Injection techniques as well.

Alfredo Benso
alfredo.benso@polito.it

Paolo Prinetto
paolo.prinetto@polito.it

Acknowledgments

The editors would like to thank all the contributing authors for their patience in meeting our deadlines and requirements. We are also in debt with Giorgio Di Natale, Stefano Di Carlo and Chiara Bessone for their valuable help in the tricky task of preparing the camera ready of this book.