

Engineering Adaptive Software Systems

Yijun Yu • Arosha Bandara • Shinichi Honiden
Zhenjiang Hu • Tetsuo Tamai • Hausi Muller
John Mylopoulos • Bashar Nuseibeh
Editors

Engineering Adaptive Software Systems

Communications of NII Shonan Meetings

 Springer

Editors

Yijun Yu
The Open University
Milton Keynes, UK

Arosha Bandara
The Open University
Milton Keynes, UK

Shinichi Honiden
National Institute of Informatics
Tokyo, Japan

Zhenjiang Hu
National Institute of Informatics
Tokyo, Japan

Tetsuo Tamai
Hosei University
Tokyo, Japan

Hausi Muller
University of Victoria
Victoria, BC, Canada

John Mylopoulos
University of Toronto
Toronto, Canada

Bashar Nuseibeh
The Open University
Milton Keynes, UK

ISBN 978-981-13-2184-9 ISBN 978-981-13-2185-6 (eBook)
<https://doi.org/10.1007/978-981-13-2185-6>

Library of Congress Control Number: 2018961997

© Springer Nature Singapore Pte Ltd. 2019

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, express 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 Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

Preface

The first Shonan Meeting on Engineering Adaptive Systems (EASy) [1], which was held in 2012, generated heated discussions on the problems and challenges about self-managing systems. Participants from multiple disciplines reached the consent that EASy has by no means an easy solution in software engineering alone, not to mention many other challenges in general system engineering.

The organisers of the following Shonan meetings [2, 3] decided to focus on the problems and solutions that can help engineer adaptive software, hence a change of the focus to Engineering Adaptive Software Systems (EASSy). The technical reports above have gathered from abstracts of all individual participants; however, there has not yet been a full report on the crux of interesting viewpoints, which could collaboratively pave the way to solve some aspects of the long-standing research problems.

This book is a collection of materialised reflections by some of our active participants present in much greater details, which we hope can fuel a tank of thoughts for engineering the next-generation adaptive software systems.

The chapters included in the book have a good coverage of the area, ranging from design and engineering principles (Chap. 1) to control-theoretic solutions (Chap. 2) and bidirectional transformations (Chap. 3), which can be seen as promising ways to implement the functional requirements of self-adaptive systems. Important quality requirements are also dealt with by these approaches: parallel adaptation for performance (Chap. 4), self-adaptive authorization infrastructure for security (Chap. 5), and self-adaptive risk assessment for self-protection (Chap. 6). Finally, Chap. 7 provides a concrete self-adaptive robotics operating system as a testbed for self-adaptive systems.

Although by no means a complete coverage of all possible research topics, these chapters can be seen as concrete research agenda's proposed by experts in these areas.

In a nutshell, we hope the book will initiate promising progresses in this interdisciplinary research field.

Shonan Village, Japan,
 Milton Keynes, UK
 Milton Keynes, UK
 Tokyo, Japan
 Tokyo, Japan
 Tokyo, Japan
 Victoria, BC, Canada
 Toronto, Canada
 Milton Keynes, UK
 July 2018

EASSy Shonan Meetings Organisers
 Yijun Yu
 Arosha Bandara
 Shinichi Honiden
 Zhenjiang Hu
 Tetsuo Tamai
 Hausi Muller
 John Mylopoulos
 Bashar Nuseibeh

References

1. Bandara, A., Yu, Y., Nuseibeh, B., Honiden, S.: Engineering adaptive systems. In: Shonan Meetings, Shonan Technical Report 003, Shonan, Japan (2012)
2. Yu, Y., Honiden, S., Muller, H.A., Mylopoulos, J.: Engineering adaptive software systems. In: Shonan Meetings, Shonan Technical Report 027, Shonan, Japan (2013)
3. Tamai, T., Muller, H.A., Nuseibeh, B.: Engineering adaptive software systems. In: Shonan Meetings, Shonan Technical Report 052, Shonan, Japan (2015)

Contents

| | |
|---|------------|
| 1 Design and Engineering of Adaptive Software Systems | 1 |
| Soichiro Hidaka, Zhenjiang Hu, Marin Litoiu, Lin Liu, Patrick Martin, Xin Peng, Guiling Wang, and Yijun Yu | |
| 2 Self-Adaptation of Software Using Automatically Generated Control-Theoretical Solutions | 35 |
| Stepan Shevtsov, Danny Weyns, and Martina Maggio | |
| 3 Challenges in Engineering Self-Adaptive Authorisation Infrastructures | 57 |
| Lionel Montrieux, Rogério de Lemos, and Chris Bailey | |
| 4 Bidirectional Transformations for Self-Adaptive Systems | 95 |
| Lionel Montrieux, Naoyasu Ubayashi, Tianqi Zhao, Zhi Jin, and Zhenjiang Hu | |
| 5 Parallel Adaptation of Multiple Service Composition Instances | 115 |
| Rafael Roque Aschoff, Andrea Zisman, and Pedro Alexandre | |
| 6 Assessing Security and Privacy Behavioural Risks for Self-Protection Systems | 135 |
| Yijun Yu, Yoshioka Nobukazu, and Tetsuo Tamai | |
| 7 Experimenting with Adaptation in Smart Cyber-Physical Systems: A Model Problem and Testbed | 149 |
| Vladimir Matena, Tomas Bures, Ilias Gerostathopoulos, and Petr Hnetyuka | |