

Frontiers  
in  
Artificial  
Intelligence  
and  
Applications

# **NEW TRENDS IN INTELLIGENT SOFTWARE METHODOLOGIES, TOOLS AND TECHNIQUES**

**Proceedings of the 20th International  
Conference on New Trends in Intelligent  
Software Methodologies, Tools and  
Techniques (SoMeT\_21)**

Edited by  
Hamido Fujita  
Hector Perez-Meana



**IOS Press**

## **NEW TRENDS IN INTELLIGENT SOFTWARE METHODOLOGIES, TOOLS AND TECHNIQUES**

The integration of AI with software is an essential enabler for science and the new economy, creating new markets and opportunities for a more reliable, flexible and robust society. Current software methodologies, tools and techniques often fall short of expectations, however, and much software remains insufficiently robust and reliable for a constantly changing and evolving market.

This book presents 54 papers delivered at the 20th edition of the International Conference on New Trends in Intelligent Software Methodology Tools, and Techniques (SoMeT\_21), held in Cancun, Mexico, from 21–23 September 2021. The aim of the conference was to capture the essence of a new state-of-the-art in software science and its supporting technology and to identify the challenges that such a technology will need to master, and this book explores the new trends and theories illuminating the direction of development in this field as it heads towards a transformation in the role of software and science integration in tomorrow's global information society.

The 54 revised papers were selected for publication by means of a rigorous review process involving 3 or 4 reviewers for each paper, followed by selection by the SoMeT\_21 international reviewing committee. The book is divided into 9 chapters, classified by paper topic and relevance to the chapter theme.

Covering topics ranging from research practices, techniques and methodologies to proposing and reporting on the solutions required by global business, the book offers an opportunity for the software science community to consider where they are today and where they are headed in the future.



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## Preface

The integration of Applied Intelligence with Software is an essential enabler for science and the new economy. It creates new markets and opens up new directions for a more reliable, flexible and robust society. It empowers the exploration of our world in ever more depth. However, the software involved often falls short of our expectations. Current software methodologies, tools, and techniques remain insufficiently robust and reliable for a constantly changing and evolving market, and many promising approaches have proved to be no more than case-oriented methods that are not fully automated.

This book explores the new trends and theories which illuminate the direction of developments in this field and which we believe will lead to a transformation in the role of software and science integration in tomorrow's global information society.

Discussing issues ranging from research practices, techniques and methodologies, to proposing and reporting on the solutions required by global business, the book offers an opportunity for the software science community to think about where we are today and where we are headed in the future.

The book aims to capture the essence of a new state of the art in software science and its supporting technology, as well as to identify the challenges that such a technology will need to master. It contains the extensively reviewed papers presented at the 20th round of the International Conference on New Trends in Intelligent Software Methodology Tools, and Techniques, (SoMeT\_21) held in Cancun Mexico, with the collaboration of National Polytechnic Institute, (IPN) Mexico City, Mexico, from 21–23 September 2021. (<https://atenea.esimecu.ipn.mx/SOMET2021.html>). This 2021 edition of SoMeT1 also celebrates the 20th anniversary of the conference series, which is ranked B+ among other high-ranking Computer Science conferences worldwide. The 2021 event is supported by the i-SOMET Incorporated Association, ([www.i-somet.org](http://www.i-somet.org)) established by Prof. Hamido Fujita.

As ever, the 2021 conference brought together researchers and practitioners to share their original research results and practical development experience in software science and related new technologies.

This volume participates in the conference and the SoMeT series of which it forms

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<sup>1</sup>Previous related events that contributed to this publication are: SoMeT\_02 (the Sorbonne, Paris, 2002); SoMeT\_03 (Stockholm, Sweden, 2003); SoMeT\_04 (Leipzig, Germany, 2004); SoMeT\_05 (Tokyo, Japan, 2005); SoMeT\_06 (Quebec, Canada, 2006); SoMeT\_07 (Rome, Italy, 2007); SoMeT\_08 (Sharjah, UAE, 2008); SoMeT\_09 (Prague, Czech Republic, 2009); SoMeT\_10 (Yokohama, Japan, 2010), and SoMeT\_11 (Saint Petersburg, Russia), SoMeT\_12 (Genoa, Italy), SoMeT\_13 (Budapest, Hungary), SoMeT\_14 (Langkawi, Malaysia), SoMeT\_15 (Naples, Italy), SoMeT\_16 (Larnaca, Cyprus), SoMeT\_17 (Kitakyushu, Japan), SoMeT\_18 (Granada, Spain), SoMeT\_19 (Sarawak, Malaysia), SoMeT\_20 (Kitakyushu, Japan).

a part by providing an opportunity for the exchange of ideas and experiences in the field of software technology; opening up new avenues for software development, methodologies, tools, and techniques, especially with regard to intelligent software, by applying artificial intelligence techniques in Software Development and tackling human interaction in the development process for better high level interface. The emphasis has been placed on human-centric software methodologies, end-user development techniques, and emotional reasoning, for an optimally harmonized performance between the design tool and the user.

The word “intelligent” in the full SOMET title emphasizes the need to apply artificial intelligence to issues of software design for systems application, for example, in disaster recovery and other systems supporting civil protection and in other areas where human intelligence is a requirement in system engineering.

A major goal of this volume was to assemble the work of scholars from the international research community as part of the process of discussing and sharing the research experiences of new software methodologies and techniques. One of the important areas addressed is the handling of cognitive issues in software development to adapt it to the user’s mental state. Tools and techniques related to this aspect form part of the contributions to this book. Another subject raised at the conference was intelligent software design in software ontology and conceptual software design in the practice of human-centric information system application.

The book also investigates other comparable theories and practices in software science, including emerging technologies, from their computational foundations in terms of models, methodologies, and tools. This is essential for a comprehensive overview of information systems and research projects, and to assess their practical impact on real-world software problems. This represents another milestone in mastering the new challenges of software and its promising technology addressed by the SoMeT conferences, and provides the reader with new insights and inspiration, as well as concrete material to further the study of this new technology.

The book contains a collection of carefully selected papers, refereed by the reviewing committee, and covering (but not limited to):

- 1) Software engineering aspects of software security programs, diagnosis and maintenance
- 2) Static and dynamic analysis of software performance models
- 3) Software security aspects and networking
- 4) Agile software and lean methods
- 5) Practical artifacts of software security, software validation and diagnosis
- 6) Software optimization and formal methods
- 7) Intelligent Decision Support Systems
- 8) Software methodologies and related techniques
- 9) Automatic software generation, re-coding and legacy systems
- 10) Software quality and process assessment
- 11) Intelligent software systems design and evolution
- 12) Artificial Intelligence techniques for Software Engineering and Requirement Engineering
- 13) End-user requirement engineering and programming environments for Web applications
- 14) Ontology, cognitive models and philosophical aspects on software design
- 15) Business oriented software application models



- 16) Emergency Management Informatics, software methods and application for supporting Civil Protection, First Response and Disaster Recovery
- 17) Model Driven Development (DVD), code centric to model centric software engineering
- 18) Cognitive Software and human behavioral analysis in software design.

From the 112 high-quality submissions received, we have selected 54 of the best revised articles for publication in this book. The referees in the program committee have reviewed all these submissions carefully, and on the basis of technical soundness, relevance, originality, significance, and clarity, these 54 papers were selected. They were then revised on the basis of the review reports before being selected by the SoMeT\_21 international reviewing committee. It is worth stating that there were three or four reviewers for each paper published in this book. The book is divided into 9 Chapters, classified based on paper topic and its relevance to each chapter-related theme, and as follows:

CHAPTER 1	Software System with Intelligent Design
CHAPTER 2	Software System Security and techniques
CHAPTER 3	Formal Techniques for System Software and Quality assessment
CHAPTER 4	Applied Intelligence in Software
CHAPTER 5	Intelligent Decision Support Systems
CHAPTER 6	Document Analytics- based Systems
CHAPTER 7	Knowledge Science and Intelligent Computing
CHAPTER 8	Ontology in Data and Software
CHAPTER 9	Machine Learning in Systems Software

This book is the result of a collective effort from many industrial partners and colleagues from around the world. We would particularly like to express our gratitude for the support provided by the National Polytechnic Institute, (IPN) Mexico, and for the work of all those authors who have contributed their invaluable support to this work. Most especially, we thank the program committee, reviewing committee and all those who participated in the rigorous reviewing process and the lively discussion and evaluation meetings which led to the selected papers which appear in this book. Last but not least, we would also like to thank the Microsoft Conference Management Tool team for their expert guidance on the use of the Microsoft CMT System as a conference-support tool throughout all the phases of SoMeT\_21.

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