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Michele Bici · Francesco Gherardini ·
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Editors


Design Tools and Methods in Industrial Engineering II

Proceedings of the Second International
Conference on Design Tools and Methods
in Industrial Engineering, ADM 2021,
September 9–10, 2021, Rome, Italy


 Springer


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Preface

The ADM International Conference, promoted by the Italian Association of Design Methods and Tools for Industrial Engineering (ADM), constitutes the biennial international conference organized in the years in which the JCM Conference (joint conference of ADM, INGEGRAF, and S.mart) is not held.

The ADM2021 International Conference, held with a blended formula in Rome, Italy, September 9–10, 2021, and hosted by Sapienza University, represents the opportunity to restart after the pandemic.

On behalf of ADM, I thank the Scientific Societies INGEGRAF and S.mart that have given a very important contribution.

I wish to thank all the members of the ADM board and all the members of the Scientific Council, in particular the Coordinator, Prof. Caterina Rizzi, for their availability, sensitivity, and efforts that made possible to organize the ADM2021 International Conference.

A special thanks to all the members of the scientific and the organizing committees, in particular to Professor Francesca Campana who has solved all the organizational problems.

Thanks a lot to all the authors and to all the international and Italian reviewers. Their activity has allowed the papers to reach such a high scientific level to be published in this prestigious book.

Finally, I thank all the ADM members. Their support has been fundamental for the organization of the ADM2021 International Conference.

Vincenzo Nigrelli
ADM President

Letter to the Authors

Dear Attendees and Authors,

It is a great honor and pleasure to welcome you to the International Conference ADM 2021 promoted by ADM, the Italian Association of Design Methods and Tools for Industrial Engineering, held, with a blended formula, in Rome, Italy, September 9–10, 2021. The conference is hosted by Sapienza University, a worldwide well-known university.

The conference aims at sharing knowledge, experience, and progress in the areas of design and manufacturing with links between industry and academia. It provides a forum for researchers, educators, and professional engineers to present and discuss their latest researches, results, major bottlenecks, and future trends.

Through the exchange of ideas, even virtually due to the pandemic, ADM 2021 is intended to facilitate the creation of multidisciplinary collaborations, new developments and discoveries for new product design and manufacture, health care, transportation, cultural heritage, and sustainability.

The conference offers the opportunity to the delegates to interact and understand how the application of emerging technologies impacts on critical engineering activities such as product design, manufacturing, management, and integration of information along the product life cycle.

This book collects 96 scientific papers across a wide range of session topics that cover a broad spectrum of themes including theoretical issues, methods, tools, processes, and case studies. The topics span from geometric modeling to virtual/augmented reality, human-related and user-centered design, integrated methods for system design, simulation, analysis and optimization, design for additive manufacturing, eco-design, engineering education, and many other subjects applied in different contexts, such as automotive, aerospace, cultural heritage, and health care.

We have also the privilege to host outstanding keynote speakers who will focus on related state-of-the-art technologies in some of main topics of the conference.

To conclude, I would like to thank all the authors for their valuable contribution to the book and each and every one of you for making ADM 2021 successful with your expertise, commitment and active engagement. Special thanks go to Conference Program Chair, Prof. Francesca Campana, and to the members of the organizing committee for their tremendous efforts for making this conference possible, especially during the pandemic.

You are warmly welcome to enjoy the conference and, who will be in presence, the wonderful Rome city.

Caterina Rizzi
ADM2021 Conference Chair

Introduction

This volume collects the proceedings of the ADM2021 International Conference, entitled “Design tools and methods in industrial engineering II,” held in Rome (Italy) from September 9–10, 2021, Faculty of Civil and Industrial Engineering of Sapienza.

It is a great honor for me hosting the conference as Chair and coordinating the second edition of this International Conference, which took place for the first time in the University Campus of Modena in September 2019. ADM conference was conceived as the Italian venue to strengthen the network of international research and to meet our colleagues in Italy. The spirit of this venue is similar in conception to that inspiring the Joint Conference on Mechanics, Design Engineering and Advanced Manufacturing (JCM), organized by ADM (Italian Association of Design and Methods for Industrial Engineering) together with the Spanish members of INGEGRAF and the French members of S.mart.

The presence of 96 articles, coming from different European countries and the work of over 100 reviewers, demonstrates the activity of our research community, despite the problems related to the pandemic.

I wish to thank all the colleagues who have collaborated with me as Organizers: Michele Bici and Daniela Pilone of Sapienza, Paolo Cicconi of the University of Roma 3, Tommaso Ingrassia of the University of Palermo, and Francesco Gherardini of the University of Modena and Reggio Emilia to whom I deserve special thanks for having “passed the baton” to me in the conference organizational relay.

I wish to thank also all the colleagues who have supported us as Members of the Scientific Committee and as Reviewers and all Authors who gave their valuable contribution to the conference with their research. Likewise, I thank President of ADM Prof. Vincenzo Antonio Nigrelli and Prof. Caterina Rizzi, Coordinator of the Scientific Council of the ADM.

A further thank is due to Altair and the ASME Italian Section for their patronage, to the Sapienza institutions, the Faculty of Civil and Industrial Engineering and the Department of Mechanics and Aerospace, for hosting us. Last, but not least, the

publisher Springer Nature, who honored us by publishing the proceedings of this second edition in the series “Lecture Notes in Mechanical Engineering.”

With the hope that ADM2021 and the presence in Rome can also set the restart for new opportunities for social sharing and research.

Francesca Campana
ADM2021 Conference Program Chair

Organization

ADM2021 is organized by ADM—Italian Association of Design Methods and Tools for Industrial Engineering, in cooperation with Dipartimento di Ingegneria Meccanica e Aerospaziale of Sapienza Università di Roma, Italy.

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