

16th International Workshop on Real and Complex Singularities  
On-line edition  
23th - 30th November, 2020

## **Preface**

This volume is dedicated to the Proceedings of the 16th International Workshop on Real and Complex Singularities held in the year 2020. This is a biennial conference promoted by the Group of Singularities, Institute of Mathematical and Computer Sciences of University of São Paulo (ICMC-USP), São Carlos, Brazil. The workshop started in 1990 and it has since been acknowledged by the quality of its programs and speakers and by the innovation of the discussed topics from singularity theory, algebraic geometry, bifurcation theory and related areas.

The 16th International Workshop of Real and Complex Singularities was an online conference, due to the Pandemic of Covid-19, from the 23th to the 30th of November, 2020.

The talks in the workshop covered current research topics in real and complex singularity theory and its applications to distinct areas, including differential topology, algebraic topology, differential geometry, algebraic geometry and dynamical systems. The workshop was attended by 258 participants from Brazil, Austria, Chile, China, France, Germany, Greece, India, Israel, Japan, Mexico, Nederland, New Zeland, Norway Peru, Poland, Portugal, Romania, Russia, Spain, Turkey, United Kingdom, United States of America and Vietnam.

The members of the Organizing Committee of this edition were Thaís Maria Dalbelo (Federal University of São Carlos, Brazil), Konstantinos Kourliouros (ICMC, Universidade de São Paulo, Brazil), Miriam Manoel (ICMC, Universidade de São Paulo, Brazil), Alex Carlucci Rezende (Federal University of São Carlos, Brazil), Maico Ribeiro (Fedead Universith of Espírito Santo, Brazil), Pedro Benedini Riul (Federal Universith of São João del Rei, Brazil) and Marcelo José Saia (University of São Paulo, Brazil).

The members of the Scientific Committee of this edition were Fuensanta Aroca (Universidad Nacional Autónoma de México, Mexico), Lev Birbrair (Universidade Federal do Ceará, Brazil), Mauricio Correa (Universidade Federal de Minas Gerais, Brazil), Daniel Dreibelbis (University of North Florida, USA), Nivaldo de Góes Grulha Junior (ICMC - Universidade de São Paulo, Brazil) June Huh (Stanford University, USA), Stanislaw Janeczko (Warsaw University of Technology, Poland), Krzysztof Kurdyka (Savoie University, France), Miriam Manoel (ICMC - Universidade de São Paulo, Brazil), Maria del Carmen Romero Fuster (Universitat de València, Spain) and Osamu Saeki (Kyushu University, Japan).

The contributions in this workshop consisted of 6 plenary talks, 48 oral presentations and 17 posters. These are available at the 16th Workshop of Singularities 2020 YouTube channel.

This volume contains 23 research papers, including 2 survey papers, refereed and selected following the standards of the Journal of Singularities.

We would like to express our thanks to the authors for their contributions to this issue. We also thank the referees and the Managing Editors of the Journal of Singularities for their collaboration in the evaluation process of the papers.

### **30 years of the Workshop**

We are celebrating 30 years of the International Workshop on Real and Complex Singularities. It is the longest running sequence of international workshops in singularities, which have been providing an exceptional opportunity for both junior researchers and recognized leaders working in the field to meet together in a very productive scientific atmosphere.

Singularity theory was introduced in Brazil in the early 60's, by professor Gilberto Francisco Loibel. He discovered the new theory through lectures by Renée Thom who was visiting Berkeley at the same time. Led by him, the São Carlos singularity group already existed even before the foundation of the Brazilian Mathematical Society, which took place at the Brazilian Mathematical Colloquium, in 1969.

In the 80's and 90's, the main driver of the junior group of singularities was professor Luis Fávoro, the first doctoral student of professor Loibel. The group comprised Paulo Porto, Claudio Mendes, Maria Aparecida Ruas and Ton Marar. Maria del Carmen Romero Fuster also held a position at the Institute from 1987 to 1989. They had been mentors and organizers of the first edition of the series of São Carlos workshops. "Reunião sobre Singularidades Reais e Complexas" was held at the ICMC-USP, from 10th to 12th of September, 1990, with 49 participants, 4 of them from abroad. The meeting was a satellite of the VII Brazilian Topology Meeting held at the Federal University of São Carlos, from 3th to 8th of September, 1990. The first two workshops in 1990 and 1992 were small meetings, with few participants from abroad. However, the long-lasting collaboration of the São Carlos singularists with many researchers from different singularity groups began at that time. The third workshop organized by Ton Marar in 1994 was a turning point. It was the first big meeting, with 90 participants. Renowned names of area, from 10 different countries attended the meeting.

The role played by the series of workshops in building a collaborative network between research groups around the world is unquestionable, opening up a range of opportunities for junior researchers. The nodes of this collaborative network include the singularity groups at Valencia, Northeastern, Warwick and Liverpool, Marseille, Cuernavaca and Mexico City, Porto, Halle, Warsaw, Sapporo, Kyushu and Yokohama. And more recently, Barcelona, Lille, Krakow, Kobe, Hannover, Madison and Oldenburg. The benefits of this scientific collaboration extend to the Brazilian singularity groups at UFSCar in São Carlos, Ceará, João Pessoa, Maringá, São José do Rio Preto, Rio Claro, and the emerging groups in Uberlândia, Itajubá, São João del Rei, Lavras, Teresina, Porto Velho, Viçosa and São José dos Campos.

The proceedings of all workshops have been published since 1992, and are a rich source of information on the trends of the theory along these 30 years.

We express our warm thanks to our friends Jean-Paul Brasselet, Terry Gaffney, Stanislaw Janeczko, Isabel Labouriau, Juan Nuño Ballesteros, Osamu Saeki, Pepe Seade and David Trotman for sharing with us their memories on the workshops. These are collected in a series of videos that can be watched from the Singularity Group of São Carlos channel, at [Opening Session 2020](#).

São Carlos, 20th of August, 2022.

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