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Computational Science and Its Applications – ICCSA 2019

19th International Conference
Saint Petersburg, Russia, July 1–4, 2019
Proceedings, Part II

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Preface

These six volumes (LNCS volumes 11619–11624) consist of the peer-reviewed papers from the 2019 International Conference on Computational Science and Its Applications (ICCSA 2019) held in St. Petersburg, Russia during July 1–4, 2019, in collaboration with the St. Petersburg University, St. Petersburg, Russia.

ICCSA 2019 was a successful event in the International Conferences on Computational Science and Its Applications (ICCSA) series, previously held in Melbourne, Australia (2018), Trieste, Italy (2017), Beijing, China (2016), Banff, Canada (2015), Guimaraes, Portugal (2014), Ho Chi Minh City, Vietnam (2013), Salvador, Brazil (2012), Santander, Spain (2011), Fukuoka, Japan (2010), Suwon, South Korea (2009), Perugia, Italy (2008), Kuala Lumpur, Malaysia (2007), Glasgow, UK (2006), Singapore (2005), Assisi, Italy (2004), Montreal, Canada (2003), and (as ICCS) Amsterdam, The Netherlands (2002) and San Francisco, USA (2001).

Computational science is a main pillar of most of the current research, industrial and commercial activities, and plays a unique role in exploiting ICT innovative technologies. The ICCSA conference series have been providing a venue to researchers and industry practitioners to discuss new ideas, to share complex problems and their solutions, and to shape new trends in computational science.

Apart from the general track, ICCSA 2019 also included 33 workshops, in various areas of computational sciences, ranging from computational science technologies, to specific areas of computational sciences, such as software engineering, security, artificial intelligence, and blockchain technologies. We accepted 64 papers distributed in the five general tracks, 259 in workshops and ten short papers. We would like to show our appreciations to the workshop chairs and co-chairs.

The success of the ICCSA conference series, in general, and ICCSA 2019, in particular, is due to the support of many people: authors, presenters, participants, keynote speakers, workshop chairs, Organizing Committee members, student volunteers, Program Committee members, Advisory Committee members, international liaison chairs, reviewers and people in other various roles. We would like to thank them all.

We also thank our publisher, Springer, for accepting to publish the proceedings, for sponsoring part of the best papers awards and for their kind assistance and cooperation during the editing process.

We cordially invite you to visit the ICCSA website http://www.iccsa.org where you can find all relevant information about this interesting and exciting event.

July 2019

Osvaldo Gervasi
Beniamino Murgante
Sanjay Misra

Welcome to St. Petersburg

Welcome to St. Petersburg, the Venice of the North, the city of three revolutions, creation of czar Peter the Great, the most European city in Russia. ICCSA 2019 was hosted by St. Petersburg State University, during July 1–4, 2019.

St. Petersburg is the second largest city in Russia after Moscow. It is the former capital of Russia and has a lot of attractions related to this role in the past: imperial palaces and parks both in the city center and suburbs, respectable buildings of nobles and state institutions, multitude of rivers and canals with more than 300 bridges of various forms and sizes. Extraordinary history and rich cultural traditions of both imperial Russia and the Soviet Union attracted and inspired many examples of world's greatest architecture, literature, music, and visual art, some of which can be found in the famous Hermitage and State Russian Museum located in the heart of the city. Late June and early July is the season of white nights where the sun sets only for a few hours, and the nighttime is covered with mysterious twilight.

What to do in the city:

- Enjoy the white nights, see the open bridges during the night and cargo ships passing by from Ladoga Lake to the Gulf of Finland and back. Dvortsovy bridge is open at about 1am. Be sure to stay on the correct side of the river when the bridges open!
- Visit Hermitage (Winter palace) and State Russian Museum to see great examples of international and Russian art, and the Kunstkammer, the oldest museum of St. Petersburg founded by Peter the Great.
- Travel to St. Petersburg suburbs Peterhof and Tsarskoe Selo to see imperial palaces and splendid parks, famous Peterhof fountains.
- Eat Russian food: borsch (beetroot soup), pelmeni and vareniki (meat and sweet dumplings), bliny (pancakes), vinegret (beetroot salad), drink kvas and maybe some vodka.
- Walk around and inside the Peter and Paul Fortress, the place where the city began in 1703.
- Visit the Mariinsky Theater for famous Russian ballet and opera.
- Have a boat tour along the Neva River and canals to look at the city from the water.
- Walk along Nevsky Prospect, the main street of the city.
- Climb St. Isaac's Cathedral colonnade to enjoy great city views.
- Go down to the Metro, the city's underground train network with some Soviet-style museum-like stations.
- Pay a visit to the recently renovated Summer Garden, the oldest park of St. Petersburg.
- Visit a new modern open space on the New Holland Island to see modern art exhibitions, performances and just to relax and enjoy sitting on the grass with an ice cream or lemonade during a hot summer day.

St. Petersburg State University is the oldest university in Russia, an actively developing, world-class center of research and education. The university dates back to 1724, when Peter the Great founded the Academy of Sciences and Arts as well as the first Academic University and the university preparatory school in Russia. At present there are over 5,000 academic staff members and more than 30,000 students, receiving education in more than 400 educational programs at 25 faculties and institutes.

The venue of ICCSA is the Faculty of Economics located on Tavricheskaya Street, other faculties and university buildings are distributed all over the city with the main campus located on Vasilievsky Island and the natural science faculties (Mathematics and Mechanics, Applied Mathematics and Control Processes, Physics, Chemistry) located on the campus about 40 kilometers away from the city center in Peterhof.

Elena Stankova
Vladimir Korkhov
Nataliia Kulabukhova

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ICCSA 2019 was organized by St. Petersburg University (Russia), University of Perugia (Italy), University of Basilicata (Italy), Monash University (Australia), Kyushu Sangyo University (Japan), University of Minho, (Portugal).

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