

International Federation of Automatic Control

# 20<sup>th</sup> IFAC World Congress

Toulouse, France, 9–14 July 2017

## PROCEEDINGS

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# FOREWORD

The 20th IFAC World Congress in 2017 was the opportunity to celebrate the IFAC 60<sup>th</sup> anniversary. On top of excellent standard contributions from all areas covered by IFAC, the program featured highlights on the history of IFAC and history Automatic Control, on control education and outreach, as well as on control applications both in industry and in social system.

## Plenary lectures

Professor Janan Zaytoon (IFAC President 2014-2017) received many excellent suggestions for plenary lectures. The final list of plenary speakers in alphabetical is as follows:

- Christos Cassandras, *Autonomous Mobility in Smart Cities*
- Charles Champion and Grazia Vittadini, *Pioneering the future of aerospace*
- Jean-Michel Coron, *Some Key Steps in the History of Feedback Control*
- Frank Försterling, *Electronic Horizon: Cloud based solution for automated driving.*
- Jong-Hwan Kim, *Towards Smart Service Robots with Task Intelligence*
- Iven Mareels, *Systems Engineering in Water Engineering*
- Carlos Eduardo Pereira, Shimon Nof and Gérard Morel, *Historical Survey & Emerging Challenges in Manufacturing System Control – A Global Perspective*
- Kristin Pettersen, *Snake Robots: from Biology, through University, towards Industry*
- *A Tribute in Memory of Roberto Tempo*, by Tamer Başar, Alberto Isidori, B. Ross Barmish, Fabrizio Dabbene, Hideaki Ishii and Anton V. Proskurnikov
- Dawn Tilbury, *Hybrid Processes for Controlling Cyber-Physical Manufacturing Systems*
- Qing-Chang Zhong, *Synchronized & Democratized Smart Grids*

Most plenary talks were associated to extended abstract contributions, which are not part of the Proceedings. Speakers are invited to submit an extended version of their contribution to the IFAC Journal *Annual Reviews in Control*. Presentations are planned to be available on the IFAC YouTube channel.

## Panel Sessions

The 20<sup>th</sup> IFAC World Congress delegates have had the opportunity to attend high quality panel sessions on the program highlights. The list of these panel sessions in chronological order is as follows:

- *The IFAC Story.*  
Organizer & Chairperson: Stephen J. Kahne  
Panelists: Stephen J. Kahne, Pedro Albertos Pérez, Vladimír Kučera, Wook H. Kwon
- *Preparing Tomorrow's Scientists and Engineers for the Challenges of the 21st Century*  
Organizers: Bozenna Pasik-Duncan & Frank Doyle  
Chairpersons: Bozenna Pasik-Duncan & Linda Bushnell  
Panelists: Bozenna Pasik-Duncan, Linda Bushnell, John S. Baras, Tamer Başar, Lucy Pao, Christos G. Cassandras, Dawn M. Tilbury, Sebastian

Trimpe, Maria Elena Valcher, Iven Mareels, Francoise Lamnabhi-Lagarrigue

- *History of Automatic Control*  
Organizer & Chairperson: Luc Dugard  
Panelists: Sergio Bittanti, Lennart Ljung, Pavel Pakshin, Manuel Silva Suarez, Gérard Morel, Daniel Alazard, Luc Dugard
- *Your Research Sharing through Outreach*  
Organizer & Chairperson: Bozenna Pasik-Duncan  
Panelists: Bozenna Pasik-Duncan, Iven Mareels, Linda Bushnell, J A Rossiter, Sebastian Trimpe
- *How to Enhance Industry/University Collaboration on Advanced Control*  
Organizer & Chairpersons: Silvia Mastellone, Alex van Delft  
Panelists: Silvia Mastellone, Alex van Delft, Kevin Brooks, Sebastian Engell, Thomas Jones, Michael Lees, Takashi Yamaguchi
- *Automated Vehicles and Safety*  
Organizer: MOVEO  
Chairpersons: Gérard Yahiaoui  
Panelists: Gérard Yahiaoui, Anne Guillaume, Phillipe Chrétien, Olivier Anselme
- *Control Challenges for Social Systems*  
Organizers & Chairpersons: Francoise Lamnabhi-Lagarrigue  
Panelists: Francoise Lamnabhi-Lagarrigue, C. L. Philip Chen, Wilfrid Perruquetti, (Samuel) Qing-Shan Jia, Sebastián Dormido, Larry Stapleton
- *Advanced Control in Industry: The Path Forward*  
Organizers & Chairpersons: Tariq Samad, Kazuya Asano  
Panelists: Kazuya Asano, Tariq Samad, Philippe Goupil, Benyamin Grosman, Angeliki Pantazi, Jaroslav Pekar, Ricardo S. Sánchez-Peña

The panel sessions are planned to be available on the IFAC YouTube channel.

## Technical contributions

The International Program Committee was responsible for the technical standards of the Congress. The Congress attracted a total number of 4 267 contributions, which include:

- 98 Open Invited Tracks with an average of 13 papers per track. 5 of these Open Invited Tracks have attracted more than 30 contributions
- 46 Invited Sessions of six papers
- 30 Workshops and Tutorials
- 4 093 papers

The 4 093 submitted papers have the following distributions

- 3 870 IFAC-standard papers, 187 Extended Abstracts, and 36 Survey papers
- 2 540 Contributed papers, 1 265 Open Invited Track papers, 288 Invited Session papers
- 3 816 Regular papers, 167 Application papers, 66 Demonstrator papers, 33 History papers, and 11 plenary papers.

Reviewing of the contributions was conducted under the supervision of the International Program Committee Chairs, with the help of the nine IFAC Coordinating Committee Chairs, the 40 Technical Committee Chairs,

281 Technical Associate Editors and 5 726 reviewers. Overall 11 302 reviews have been collected.

A total of 2 919 submissions were accepted, among which 2 800 are papers. Details of accepted contributions are as follows:

- 1 512 Contributed Papers
- 1 145 Papers submitted in Invited Sessions or Open Invited Tracks
- 143 Extended Abstract Papers
- 35 Invited Sessions
- 76 Open Invited Tracks that appear in the program as Open Invited Sessions with a number of sessions ranging from 1 to 5

The acceptance rate for Contributed Papers is 62%. It goes up to 72% for papers submitted to Open Invited Tracks, and up to 82% for those submitted to Invited Sessions, thus indicating the excellent work done by the organizers of these invited items. Overall, the acceptance rate of papers with IFAC Copyright is 66.4%.

The statistics per IFAC areas as represented by the Coordinating Committees are as indicated in the following table. Column **A** gives the percentage of papers of a CC among all submitted contributions. Column **B** gives the percentage of papers of a CC among accepted papers.

| Coordinating Committees                  | A     | B     |
|--|-------|-------|
| 1 Systems & Signals                      | 20.6% | 19.4% |
| 2 Design Methods                         | 26.7% | 26.4% |
| 3 Computers, Cognition and Communication | 2.3%  | 2.1%  |
| 4 Mechatronics, Robotics and Components  | 11.4% | 10.4% |
| 5 Manufacturing and Logistics Systems    | 6.1%  | 6.5%  |
| 6 Process and Power Systems              | 12.1% | 12.8% |
| 7 Transportation and Vehicle Systems     | 10.7% | 10.7% |
| 8 Bio- and Ecological Systems            | 5.5%  | 6.4%  |
| 9 Social Systems                         | 4.6%  | 5.2%  |

The final program included 2 723 presentations (some accepted papers were not submitted on time to be included in the program) organized in 389 sessions. Among these, 329 were oral podium sessions, 54 were oral interactive sessions with individual TV screens for each presentation, and 6 were demonstrator sessions. Among the 389 sessions, 36 were invited sessions and 127 were open invited sessions. No value ranking is implied by the presentation format, all the papers underwent the same review process and appear the same way in the proceedings. It was at the discretion of the IPC to choose which papers are presented in either podium or interactive sessions. Demonstrator sessions were organized by the IPC based on papers suggested to be in such sessions by the authors.

The very special demonstrator sessions were inspired by a domestic conference dedicated to control demonstrators organized every 4 years in Angers, France. In 2017 this even was successfully integrated

into the IFAC World Congress. Two demonstrator sessions resulted from contributed submissions. The four other sessions were by-products of open invited track proposals. The covered topics were:

- Tools and demonstrators for Discrete Event and Hybrid Systems
- Exhibition of Demonstrators for Educational purposes in Control sciences
- Automotive Advanced Control Demonstrators
- Mini-Unmanned Aerial Vehicles Demonstrators

## Workshops and Tutorials

The pre-congress Workshops and Tutorials were held on 8-9 July. Most of them were selected by the IPC for their tutorial features. Other workshops were organized and sponsored by GdR MACS (CNRS structure dedicated to scientific coordination of automation and control research activities in France), iCODE (Institute for Control and Decision of Paris Saclay University) and Elsevier jointly with IFAC (*A Guide to Being Active in the Community as Author and Reviewer*). The list of IFAC World Congress Tutorials selected by the IPC is as follows:

- *Flight Dynamics, Simulation and Control with MATLAB and Simulink*, by Tayfun Çimen, Metin U. Salamci
- *Analysis and Design of Model Based Fault Diagnosis Systems for Large Scale Models*, by Erik Frisk, Mattias Krysander
- *Biological Control Systems*, by Babatunde A. Ogunnaike
- *Cooperative and noncooperative decision making in multi-agent systems: An operator theoretic perspective*, by Sergio Grammatico, Kostas Margellos, Giuseppe Notarstefano, Maria Prandini
- *Modelling and Control of Flexible Link Multi-Body Systems*, by Vicente Feiu Battle, Wayne Book, Hubert Gattringer, Paul Kotyczka, Jörn Malzahn, Denis Matignon
- *Simple Adaptive Control and New Results in Stability Analysis*, by Itzhak Barkana, Ilan Rusnak, Haim M. Weiss
- *Iterative Learning Control and Repetitive Control: Theoretical Advances and Emerging Applications*, by Kevin L Moore, David H Owens, Tom Oomen, Ying Tan, Kira Barton, Bing Chu, Chris Freeman, Deqing Huang, Mikael Norrlöf
- *Learning and Discovery through Process Data Analytics*, by Sirish L. Shah, Nina Thornhill, Biao Huang, Tongwen Chen, Jiandong Wang
- *Rigidity Theory for Multi-agent Systems Meets Parallel Robots: Towards the Discovery of Common Models and Methods*, by Hyo-Sung Ahn, Shiyu Zhao, Daniel Zelazo, Jean-Pierre Merlet, Marco Carricato, Sébastien Briot, Antonio Franchi
- *Regional Analysis of Distributed Parameter Systems: A Tutorial*, by A. El Jai, E. Hassa, Zerrik, YangQuan Chen, Ge Fudong
- *Predictive repetitive control system design and implementation using MATLAB/Simulink*, by Liuping Wang, Eric Rogers
- *Tutorial on time-delay and sampled-data systems*, by Emilia Fridman, Alexandre Seuret, Laurentiu Hetel, Pierdomenico Pepe, Frédéric Mazenc, Kun Liu, Anton Selivanov



- *Cyber Threats in Distributed Model Predictive Control*, by Ali Haseltalab, José María Maestre, Carlos Ocampo-Martinez, Hideaki Ishii
- *Fault Diagnosis of Interconnected Cyber-Physical Systems*, by Marios M. Polycarpou, Vasso Reppa
- *Model-Based and Model-Guided Approaches for Automotive Powertrain Calibration and Control*, by Guoming Zhu, Xiang Chen

## Technical Visits

A total of 7 Technical Visits were organized during the Congress. The chronological list follows:

- LAAS-CNRS, Academic research center. Included two tracks: "Robotics platform" and "How chips are made?"
- Airbus (commercial aircraft) ground test facilities
- Quai des Savoirs, Science dedicated Museum. Visit of the current exhibition about Cities and welcome by the exhibition creators.
- Cité de l'Espace, Space dedicated Museum. Short visit of part of the Exhibition with a presentation of how it has been conceived.
- Airbus Defence & Space, Space Industry. View on Satellites Integration Room & Exchanges on Control Engineering for Space Systems
- Automotive Demonstrators, Special visit to the Automotive Demonstrators at Manoir du Prince.
- Veolia, Ginestou-Garonne water de-pollution plant

## Authors and delegates

There were a total of 8 956 authors of papers in the Congress program from 83 countries/regions. The total number of delegates is 3 462 from 68 countries/regions. The following table indicates in column **A** the number of corresponding authors of submitted contributions; in column **B** the number of corresponding authors of papers in the program; in column **C** the number of authors of papers in the program; in column **D** the number of delegates.

|                | <b>A</b> | <b>B</b> | <b>C</b> | <b>D</b> |
|----------------|----------|----------|----------|----------|
| France         | 748      | 506      | 1 783    | 829      |
| Germany        | 314      | 238      | 741      | 295      |
| China          | 430      | 208      | 709      | 284      |
| USA            | 310      | 216      | 679      | 237      |
| Italy          | 239      | 184      | 641      | 175      |
| United Kingdom | 163      | 109      | 334      | 136      |
| Netherlands    | 115      | 92       | 296      | 116      |
| Japan          | 165      | 101      | 293      | 162      |
| Spain          | 107      | 71       | 273      | 96       |
| Sweden         | 98       | 81       | 258      | 107      |
| Brazil         | 131      | 69       | 246      | 70       |
| Russia         | 152      | 89       | 209      | 77       |
| Canada         | 95       | 60       | 181      | 63       |
| Australia      | 72       | 55       | 176      | 52       |
| Mexico         | 96       | 56       | 166      | 41       |
| Switzerland    | 56       | 48       | 165      | 49       |
| Belgium        | 55       | 39       | 139      | 52       |
| Austria        | 43       | 36       | 112      | 51       |
| New Zealand    | 26       | 19       | 103      | 11       |
| India          | 70       | 31       | 94       | 31       |
| Portugal       | 40       | 24       | 92       | 23       |
| Korea, South   | 58       | 26       | 90       | 63       |
| Denmark        | 29       | 22       | 87       | 29       |
| Hungary        | 33       | 25       | 83       | 33       |
| Slovakia       | 45       | 25       | 80       | 25       |
| Norway         | 28       | 24       | 78       | 37       |
| Poland         | 40       | 27       | 71       | 33       |

|                        |    |    |    |    |
|------------------------|----|----|----|----|
| Turkey                 | 45 | 23 | 61 | 28 |
| Greece                 | 25 | 14 | 53 | 17 |
| Israel                 | 29 | 19 | 53 | 22 |
| Tunisia                | 33 | 14 | 48 | 11 |
| Czech Republic         | 33 | 21 | 47 | 22 |
| Finland                | 24 | 13 | 45 | 19 |
| Colombia               | 16 | 8  | 41 | 14 |
| Romania                | 29 | 12 | 39 | 7  |
| Chile                  | 17 | 10 | 34 | 12 |
| South Africa           | 25 | 11 | 32 | 17 |
| Ireland                | 16 | 12 | 31 | 13 |
| Singapore              | 11 | 8  | 26 | 11 |
| Morocco                | 35 | 8  | 22 | 14 |
| Iran                   | 19 | 6  | 20 | 4  |
| Algeria                | 22 | 4  | 19 | 3  |
| Argentina              | 5  | 4  | 19 | 2  |
| Croatia                | 8  | 6  | 18 | 7  |
| Saudi Arabia           | 13 | 6  | 14 | 8  |
| Luxembourg             | 8  | 4  | 12 | 4  |
| Slovenia               | 5  | 3  | 12 | 4  |
| Taiwan                 | 15 | 4  | 12 | 7  |
| Egypt                  | 5  | 3  | 11 | 2  |
| Cyprus                 | 4  | 2  | 10 | 5  |
| Ukraine                | 4  | 2  | 9  | 2  |
| Bulgaria               | 3  | 2  | 7  | 2  |
| United Arab Emirates   | 7  | 3  | 7  | 3  |
| Cameroon               | 1  | 1  | 6  | 0  |
| Cuba                   | 4  | 2  | 5  | 0  |
| Malaysia               | 5  | 1  | 5  | 2  |
| Pakistan               | 9  | 2  | 5  | 3  |
| Belarus                | 2  | 0  | 4  | 0  |
| Peru                   | 2  | 1  | 4  | 2  |
| Bangladesh             | 0  | 0  | 3  | 0  |
| Costa Rica             | 1  | 1  | 3  | 0  |
| Ecuador                | 5  | 2  | 3  | 2  |
| Ghana                  | 0  | 0  | 3  | 0  |
| Iceland                | 2  | 1  | 3  | 2  |
| Lebanon                | 3  | 2  | 3  | 1  |
| Macedonia              | 0  | 0  | 3  | 0  |
| Serbia                 | 0  | 0  | 3  | 1  |
| Thailand               | 1  | 1  | 3  | 1  |
| Burkina Faso           | 1  | 1  | 2  | 0  |
| Estonia                | 1  | 1  | 2  | 2  |
| Indonesia              | 2  | 1  | 2  | 1  |
| Kenya                  | 0  | 0  | 2  | 0  |
| Kosovo                 | 2  | 0  | 2  | 0  |
| Qatar                  | 3  | 1  | 2  | 2  |
| Albania                | 0  | 0  | 1  | 0  |
| Jordan                 | 0  | 0  | 1  | 0  |
| Oman                   | 0  | 0  | 1  | 0  |
| Panama                 | 0  | 0  | 1  | 1  |
| Sri Lanka              | 0  | 0  | 1  | 0  |
| Venezuela              | 1  | 1  | 1  | 0  |
| Vietnam                | 1  | 1  | 1  | 2  |
| Bosnia and Herzegovina | 1  | 0  | 0  | 0  |
| Georgia                | 1  | 0  | 0  | 0  |
| Nigeria                | 1  | 0  | 0  | 1  |
| Trinidad and Tobago    | 1  | 0  | 0  | 0  |
| Kuwait                 | 0  | 0  | 0  | 2  |

## Sponsors

The 20<sup>th</sup> IFAC World Congress was sponsored by

- **Main sponsor:** Continental Automotive
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- **Contributors:** INSA Toulouse, INP Toulouse, ITMO University

**13 Exhibitors** participated to the Congress Exhibition: Continental Automotive, Elsevier, WAGO, Springer Nature, MathWorks, The Journal of The Franklin Institute, Robotikum, OPAL-RT, SOBEN, THALES, Taylor & Francis, Robotex, InTeCo.

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## Thanks

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Dimitri Peaucelle  
IFAC 2017 General Chair