

Proceedings of
the 2018 International Symposium on
Nonlinear Theory and its Applications (NOLTA2018)



Palau de Congressos de Tarragona,
Tarragona, Spain
September 2–6, 2018.

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Contents

Welcome Message from the General Co-Chairs	v
Technical Program Co-Chairs' Message	vi
Organizing Committee	vii
Technical Program Committee	ix
Advisory Committee	x
NOLTA Steering Committee	xi
Special Session Organizers	xii
Symposium Information	xiv
Symposium Venue	xiv
Social Events	xiv
Session at a Glance	xvii
Technical Program	xxi
A0L-AA Plenary 1 - Prof. Kunihiro Fukushima	xxi
A1L-A Special Session: Laser Dynamics and Complex Photonics 1: Laser Dynamics	xxi
A1L-B Special Session: Complex Systems, Complex Networks and Bigdata Analyses	xxii
A1L-C Engineering Applications	xxiii
A1L-D Special Session: Power packet: Energy-and-Information Integrated Technology	xxiii
A2L-A Special Session: Laser Dynamics and Complex Photonics 2: Complex Photonics	xxiv
A2L-B Neural Networks 1	xxv
A2L-C Special Session: Control Theory and Dynamical Systems at Interdisciplinary Interface	xxv
A2L-D Special Session: Medical Engineering Related Optimization Problems 1	xxvi
A3L-A Special Session: Laser Dynamics and Complex Photonics 3: Reservoir Computing	xxvi
A3L-B Neural Networks 2 and Evolutionary Computation	xxvii
A3L-C Special Session: Recent Progress in the Oscillation Model on Social/Information Networks	xxviii
A3L-D Special Session: Medical Engineering Related Optimization Problems 2	xxviii
B0L-AA Plenary 2 - Prof. Soumitro Banerjee	xxix
B1L-A Special Session: Laser Dynamics and Complex Photonics 4: Decision Making	xxix
B1L-B Chaos and Bifurcation 1	xxx
B1L-C Control Systems 1	xxx
B1L-D Special Session: Nonlinear Phenomena in Non-Smooth Systems 1	xxx
B2L-A Special Session: Optimization Algorithms with Nonlinear Dynamics 1	xxxii
B2L-B Chaos and Bifurcation 2 and Nonlinear Phenomena	xxxii
B2L-C Control Systems 2	xxxiii
B2L-D Special Session: Nonlinear Phenomena in Non-Smooth Systems 2	xxxiii
B3L-A Special Session: Optimization Algorithms with Nonlinear Dynamics 2	xxxiv
B3L-B Special Session: Cellular Dynamical Systems 1	xxxiv
B3L-C Complex Networks/Systems 1	xxxv
B3L-D Special Session: Nonlinear Phenomena in Non-Smooth Systems 3	xxxv
B4L-A Special Session: Non-Algorithmic Computing by Complex Systems	xxxvi
B4L-B Special Session: Cellular Dynamical Systems 2	xxxvii
B4L-C Complex Networks/Systems 2	xxxvii
B4L-D Special Session: Reinforcement Learning and Its Applications	xxxviii
C1L-A Special Session: Complex Communication Sciences	xxxviii
C1L-B Special Session: Nonlinear Circuits Distributed and Coupled across Nontrivial Network Topologies 1	xxxix
C1L-C Nonlinear Circuits and Systems 1	xxxix
C1L-D Special Session: Nonlinear Waves and Localizations 1	xl
C2L-A Special Session: Category Theoretic Approach to Composite Systems	xli
C2L-B Special Session: Nonlinear Circuits Distributed and Coupled across Nontrivial Network Topologies 2	xli
C2L-C Nonlinear Circuits and Systems 2	xlii
C2L-D Special Session: Nonlinear Waves and Localizations 2	xlii
D1L-A Special Session: Nonlinear Time Series Analysis	xliii
D1L-B Oscillations and Synchronization	xliv
D1L-C Special Session: Recent Theory and Applications Related to Multimedia Communication	xliv
D1L-D Communication Networks and Systems, Signal Processing and Applied Mathematics	xliv
D2L-A Special Session: Theory and Implementation of Neuromorphic Systems	xlvi
D2L-B Special Session: Recent Theory and Applications Related to Communication Quality	xlvi
D2L-C Special Session: Noise-Driven and Stochastic Information Sensing and Processing Systems	xlvii

Author Index

A	xlviii
B	xlviii
C	xlviii
D	xlviii
E	xlviii
F	xliv
G	xliv
H	xliv
I	xliv
J	i
K	i
L	ii
M	ii
N	ii
O	iii
P	iii
Q	iii
R	iii
S	iii
T	iii
U	liv
V	liv
W	liv
Y	liv
Z	liv

2018 International Symposium on Nonlinear Theory and its Applications

Palau de Congressos de Tarragona, Tarragona, Spain
September 2–6, 2018

Organizer:

NOLTA Society, IEICE



In Cooperation with:

Universitat Rovira i Virgili

International Conference Center Fundació URV



**UNIVERSITAT
ROVIRA i VIRGILI**

Italian Society for Chaos and Complexity



Technical Group on Nonlinear Problems, IEICE
Technical Group on Complex Communication Sciences, IEICE

Welcome Message from the General Co-Chairs

Dear Friends and Colleagues,

On behalf of the organizing committee, we feel greatly honoured to welcome you to the 2018 International Symposium on Nonlinear Theory and Its Applications (NOLTA2018) which will be held at *Palau de Congressos de Tarragona*, Tarragona, Spain, Sep. 2–6, 2018. This conference is organized by the IEICE NOLTA Society and hosted by the *Grupo de Automática y Electrónica Industrial (GAEI)* of Universitat Rovira i Virgili, Tarragona (Spain).

NOLTA is established to provide a forum for exchange of the latest results related to nonlinear theory and a large number of applications in different science and engineering fields reflecting the pluridisciplinarity of topics and activities. The hard work of the technical program committee allowed to prepare to delegates a very high-quality scientific program reflecting the broad spectrum of topics and increasing research interests in the field. In addition to traditional content including Keynote speeches, regular lecture sessions and posters sessions, NOLTA 2018 features special sessions organized by different experts over the world.

We would like to take this opportunity to thank all members of the organizing committee, the technical program committee co-chairs, the keynote speakers, all of the authors worldwide who have chosen to submit their contributions to NOLTA 2018, and so many reviewers, who made the selection of best contributions. Special and warm thanks are to the NOLTA Society giving us this opportunity to host this edition of NOLTA in Tarragona. We believe that we have reached our goal of providing the attendees a favourable environment to discuss significant developments that will contribute to the evolution of their research fields.

Palau de Congressos de Tarragona is located in the center of the city of Tarragona, a city recognized by UNESCO as a World Heritage Site. It is characterized by its opening to the Mediterranean. The conference venue, thanks to the qualities of the city in which it is held and being a unique building brings together history and technology in its facilities. Tarragona is a flourishing seaport, an important agricultural market, and the centre of active tourism, concentrated in some well-known beach resorts. The city also supports the petrochemical industry that is concentrated around it, and Tarragona's port is equipped for handling and transporting millions of tons of oil annually.

The festivities of Santa Tecla are the set of activities carried out during the month of September in Tarragona on occasion of the festivity of the city's patron saint. Santa Tecla is a series of festive and religious celebrations that takes place around the festivity of the 23rd of September. Tarragona celebrates the tradition of the castells in spectacular fashion. This popular event involves people creating human towers up to a height of between six and ten tiers. Tarragona is also well known for its distinctive urban life, entertainment and Mediterranean gastronomy. Its dynamism and charm make it a memorable city to visit. The best way to discover its rich cultural histories is to take a tour. A social visit to the Tarraco's amphitheatre and Les Ferreres Aqueduct (*Pont del diable*) has been programmed.

We sincerely hope that NOLTA 2018 will not only provide you with the wonderful experience of a technology conference, but will also offer a place to meet old friends, make new contacts, and enjoy the local culture. We also hope that this NOLTA edition will enrich you with new ideas and that you will enjoy your stay in Tarragona.

Welcome to the NOLTA 2018! Welcome to Tarragona!

Thank you very much,



General Co-Chairs, NOLTA2018:
Abdelali El Aroudi (Universitat Rovira i Virgili, Tarragona, Spain)

Hiroo Sekiya (Chiba University, Japan)

Technical Program Co-Chairs' Message

On behalf of the Technical Program Committee, we would like to welcome you to the 2018 International Symposium on Nonlinear Theory and Its Applications (NOLTA 2018) held in Tarragona, Spain, September 2–6, 2018.

A total of 199 papers received from 15 countries have been included for presentation in the technical program. In this year's symposium, we have 43 oral sessions. 142 papers will be presented in 30 special sessions which consist of 20 specific topics and 57 papers will be presented in 13 regular sessions. Also, we have two plenary talks given by Prof. Kunihiko Fukushima (Fuzzy Logic Systems Institute, Japan) on September 3 and Prof. Soumitro Banerjee (Indian Institute of Science Education & Research, India) on September 4. In addition, the poster session to select the candidates of Student Paper Award will be held in the morning of September 5. All the participants have the right to recommend the award-winner candidates. Please join this session, discuss with the presenters and vote on the award.

We would like to express our deepest gratitude to the Technical Program Committee members and all the reviewers for their dedicated contribution to the review process. We also wish to thank all the organizers of the special sessions.

Finally, we hope all the participants will enjoy the technical program of NOLTA 2018 and have a great experience in Tarragona.



Luis Martínez-Salamero
Universitat Rovira i Virgili
Technical Program Co-Chairs, NOLTA 2018



Seiichiro Moro
University of Fukui
Technical Program Co-Chairs, NOLTA 2018

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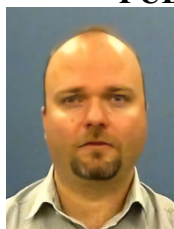
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Special Session Organizers

A1L-A Laser Dynamics and Complex Photonics 1: Laser Dynamics

A2L-A Laser Dynamics and Complex Photonics 2: Complex Photonics

A3L-A Laser Dynamics and Complex Photonics 3: Reservoir Computing

B1L-A Laser Dynamics and Complex Photonics 4: Decision Making

Organizers Kazutaka Kanno (Saitama University) Fumiyoshi Kuwashima (Fukui University of Technology) and Atsushi Uchida (Saitama University)

A1L-B Complex Systems, Complex Networks and Bigdata Analyses

Organizers Atsushi Tanaka (Yamagata University) and Michio Yokoyama (Yamagata University)

A1L-D Power packet: Energy-and-Information Integrated Technology

Organizers Nobuo Satoh (Chiba Institute of Technology) Ryo Takahashi (Aichi University of Technology) and Hiroyasu Ando (University of Tsukuba)

A2L-C Control Theory and Dynamical Systems at Interdisciplinary Interface

Organizers Hiroyasu Ando (University of Tsukuba) and Shinji Nakaoka (JST PRESTO, University of Tokyo)

A2L-D Medical Engineering Related Optimization Problems 1

A3L-D Medical Engineering Related Optimization Problems 2

Organizers Yuichi Tanji (Kagawa University) and Mio Kobayashi (National Institute of Technology, Anan College)

A3L-C Recent Progress in the Oscillation Model on Social/Information Networks

Organizers Masaki Aida (Tokyo Metropolitan University)

B1L-D Nonlinear Phenomena in Non-Smooth Systems 1

B2L-D Nonlinear Phenomena in Non-Smooth Systems 2

B3L-D Nonlinear Phenomena in Non-Smooth Systems 3

Organizers Viktor Avrutin (University of Stuttgart) Zhanybai T. Zhusubaliyev (South-West State University) and Gerard Olivar (Universidad Nacional de Colombia)

B2L-A Optimization Algorithms with Nonlinear Dynamics 1

B3L-A Optimization Algorithms with Nonlinear Dynamics 2

Organizers Hidehiro Nakano (Tokyo City University)

B3L-B Cellular Dynamical Systems 1

B4L-B Cellular Dynamical Systems 2

- Organizers** Hiroyuki Torikai (Hosei University)
- B4L-A** Non-Algorithmic Computing by Complex Systems
- Organizers** Miguel C. Soriano (IFISC UIB-CSIC) and Ingo Fischer (IFISC UIB-CSIC)
- B4L-D** Reinforcement Learning and Its Applications
- Organizers** Takashi Matsubara (Kobe University)
- C1L-A** Complex Communication Sciences
- Organizers** Hidehiro Nakano (Tokyo City University)
- C1L-B** Nonlinear Circuits Distributed and Coupled across Nontrivial Network Topologies 1
- C2L-B** Nonlinear Circuits Distributed and Coupled across Nontrivial Network Topologies 2
- Organizers** Yoko Uwate (Tokushima University) Tadashi Tsubone (Nagaoka University of Technology) and Keiji Konishi (Osaka Prefecture University)
- C1L-D** Nonlinear Waves and Localizations 1
- C2L-D** Nonlinear Waves and Localizations 2
- Organizers** Yusuke Doi (Osaka University) and Masayuki Kimura (Kyoto University)
- C2L-A** Category Theoretic Approach to Composite Systems
- Organizers** Hayato Saigo (Nagahama Institute of Bio-Science and Technology) Kazuya Okamura (Nagoya University) and Makoto Naruse (NICT)
- D1L-A** Nonlinear Time Series Analysis
- Organizers** Takaya Miyano (Ritsumeikan University)
- D1L-C** Recent Theory and Applications Related to Multimedia Communication
- Organizers** Ki-Ryong Kwon (Pukyong National University) Soon-Kak Kwon (Dong-eui University) Suk-Hwan Lee (Tongmyong University) Hyeyoung Ko (Seoul Women's University) and Young-mee Choi (Sungkyul University)
- D2L-A** Theory and Implementation of Neuromorphic Systems
- Organizers** Takashi Kohno (University of Tokyo)
- D2L-B** Recent Theory and Applications Related to Communication Quality
- Organizers** Kenko Ota (Nippon Institute of Technology) and Ryogo Kubo (Keio University)
- D2L-C** Noise-Driven and Stochastic Information Sensing and Processing Systems
- Organizers** Seiya Kasai (Hokkaido University) Yukihiro Tadokoro (Toyota Central Research and Development Labs., Inc.) and Shintaro Arai (Okayama University of Science)

Symposium Information

Symposium Venue

Palau de Congressos de Tarragona
Arquitecte Rovira, 2, 43001 Tarragona, Spain

◦ [Opening Ceremony & Plenary Talks]
Eutyches Auditorium on Floor -1

◦ [Parallel Sessions]
Eutyches Auditorium and Three rooms (Isis, Minerva and Medusa) on Floor -1

◦ [Poster Session, presented by Award candidates]
The entrance of Eutyches Auditorium on Floor -1

City Map



Symposium Registration

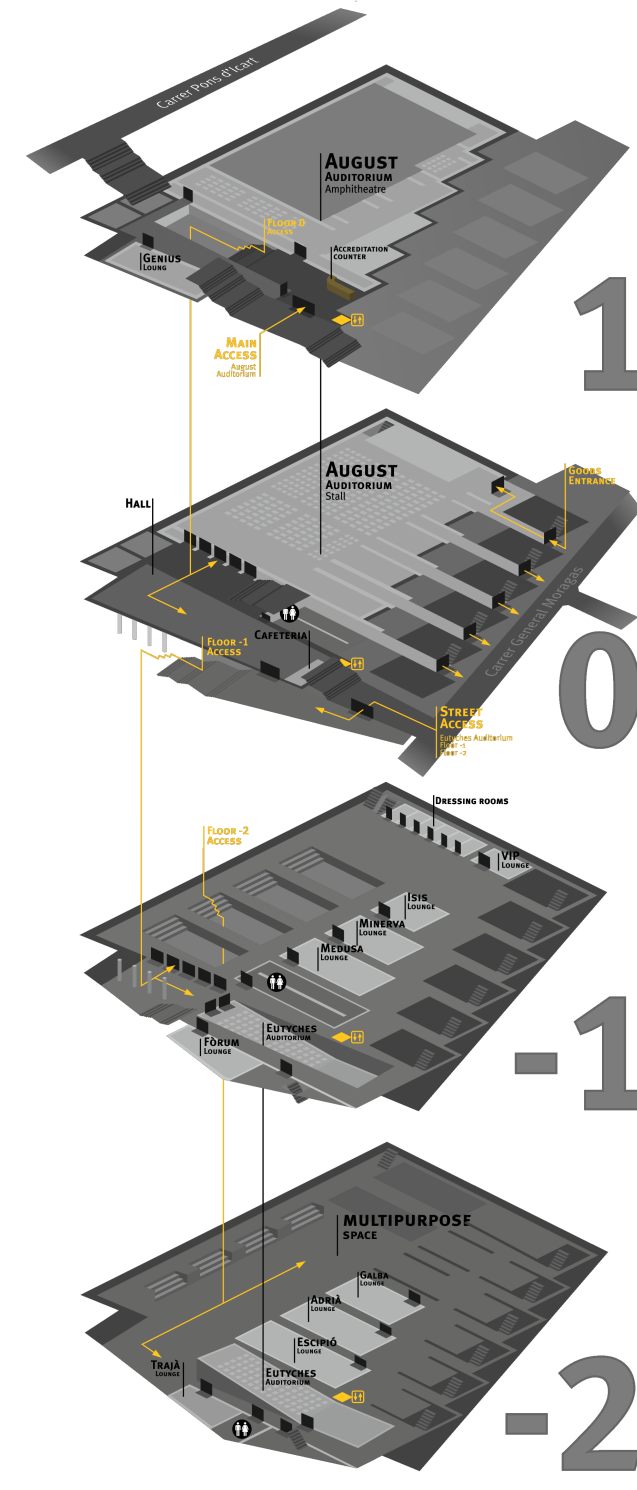
- Sep. 2, 14:00 – 18:00 at the entrance of Eutyches Auditorium, Palau de Congressos de Tarragona
- Sep. 3, 7:30 – 17:30 at the entrance of Eutyches Auditorium, Palau de Congressos de Tarragona
- Sep. 4, 8:00 – 17:30 at the entrance of Eutyches Auditorium, Palau de Congressos de Tarragona
- Sep. 5, 8:00 – 15:00 at the entrance of Eutyches Auditorium, Palau de Congressos de Tarragona
- Sep. 6, 8:00 – 11:00 at the entrance of Eutyches Auditorium, Palau de Congressos de Tarragona

Social Events

- Sep. 2, 19:00 –, Welcome Reception: Anfiteatro de Tarraco
- Sep. 5, 17:00 –, Excursion: L'Aqueduc de les Ferreres & Banquet: La Boella
Meeting place for transportation(Bus); plaza de la imperial Tarraco at 17:00–17:30.
- Sep. 6, 13:00 –, Farewell Party: Casa Joan Miret









Session Room Information

Hall	Eutyches Auditorium on Floor -1	Room 2	Isis on Floor -1
Poster Session	The entrance of Eutyches Auditorium on Floor -1	Room 4	Medusa on Floor -1
Room 1	Eutyches Auditorium on Floor -1	Room 3	Minerva on Floor -1
Room 3	Minerva on Floor -1	Room 4	Medusa on Floor -1



Session rooms



- 1-  Elevator. Access located on the terrace of the Congress Center.
- 2-  Offices access.
- A  Main access. Gate A.
- B  Acces to lower floors. Gate B.
- 5-  Elevator. Located at the end of the stairs.
- 6-  Goods Entrance. General Moragues street.
- 7-  Public parking La Pedrera.
- 8-  Trade fair. Film Office and TCB offices.

Session at a Glance

September 3, 2018 (Monday)

Palau de Congressos de Tarragona				
8:20– 8:40	Opening ceremony Place: Hall, Eutyches Auditorium			
8:40– 9:40	Plenary Talk 1, Prof. Kunihiko Fukushima (Fuzzy Logic Systems Institute, Japan) Chair: Hiroo Sekiya (Chiba University) Place: Hall, Eutyches Auditorium			
9:40– 10:10	Coffee break			
	Room 1	Room 2	Room 3	Room 4
10:10– 12:10	A1L-A Special Session: Laser Dynamics and Complex Photonics 1: Laser Dynamics Chair: Atsushi Uchida Page xxi	A1L-B Special Session: Complex Systems, Complex Networks and Bigdata Analyses Chair: Fujio Toriumi Page xxii	A1L-C Engineering Applications Chair: Takeshi Kamio Page xxiii	A1L-D Special Session: Power packet: Energy-and-Information Integrated Technology Chairs: Hiroyasu Ando and Ryo Takahashi Page xxiii
12:10– 14:10	Lunch break			
14:10– 15:50	A2L-A Special Session: Laser Dynamics and Complex Photonics 2: Complex Photonics Chair: Kazutaka Kanno Page xxiv	A2L-B Neural Networks 1 Chair: Takafumi Matsuura Page xxv	A2L-C Special Session: Control Theory and Dynamical Systems at Interdisciplinary Interface Chairs: Hiroyasu Ando and Shinji Nakaoka Page xxv	A2L-D Special Session: Medical Engineering Related Optimization Problems 1 Chairs: Yuichi Tanji and Mio Kobayashi Page xxvi
15:50– 16:05	Coffee break			
16:05– 18:05	A3L-A Special Session: Laser Dynamics and Complex Photonics 3: Reservoir Computing Chair: Fumiyoshi Kuwashima Page xxvi	A3L-B Neural Networks 2 and Evolutionary Computation Chair: Hiroaki Kurokawa Page xxvii	A3L-C Special Session: Recent Progress in the Oscillation Model on Social/Information Networks Chair: Masaki Aida Page xxviii	A3L-D Special Session: Medical Engineering Related Optimization Problems 2 Chairs: Yuichi Tanji and Mio Kobayashi Page xxviii

September 4, 2018 (Tuesday)

Palau de Congressos de Tarragona				
8:30–9:30	Plenary Talk 2, Prof. Soumitro Banerjee (Indian Institute of Science Education & Research, India) Chair: Abdelali El Aroudi (Universitat Rovira i Virgili) Place: Hall, Eutyches Auditorium			
9:30–10:00	Coffee break			
	Room 1	Room 2	Room 3	Room 4
10:00–12:00	B1L-A Special Session: Laser Dynamics and Complex Photonics 4: Decision Making Chair: Damien Rontani Page xxix	B1L-B Chaos and Bifurcation 1 Chair: Hideyuki Kato Page xxx	B1L-C Control Systems 1 Chair: Yasuhiro Sugimoto Page xxxi	B1L-D Special Session: Nonlinear Phenomena in Non-Smooth Systems 1 Chairs: Viktor Avrutin and Zhanybai Zhusubaliyev Page xxxi
12:00–14:00	Lunch break			
14:00–15:20	B2L-A Special Session: Optimization Algorithms with Nonlinear Dynamics 1 Chair: Hidehiro Nakano Page xxxii	B2L-B Chaos and Nonlinear Phenomena Chair: Masaharu Adachi Page xxxii	B2L-C Control Systems 2 Chair: Tatsuya Kai Page xxxiii	B2L-D Special Session: Nonlinear Phenomena in Non-Smooth Systems 2 Chairs: Viktor Avrutin and Gerard Olivar Page xxxiii
15:20–15:35	Coffee break			
15:35–16:55	B3L-A Special Session: Optimization Algorithms with Nonlinear Dynamics 2 Chair: Kenya Jin'no Page xxxiv	B3L-B Special Session: Cellular Dynamical Systems 1 Chair: Hiroyuki Torikai Page xxxiv	B3L-C Complex Networks/Systems 1 Chair: Yutaka Shimada Page xxxv	B3L-D Special Session: Nonlinear Phenomena in Non-Smooth Systems 3 Chairs: Gerard Olivar and Zhanybai Zhusubaliyev Page xxxv
16:55–17:10	Coffee break			
17:10–18:30	B4L-A Special Session: Non-Algorithmic Computing by Complex Systems Chair: Ingo Fischer Page xxxvi	B4L-B Special Session: Cellular Dynamical Systems 2 Chair: Hiroyuki Torikai Page xxxvii	B4L-C Complex Networks/Systems 2 Chair: Naoki Wakamiya Page xxxvii	B4L-D Special Session: Reinforcement Learning and Its Applications Chair: Takashi Matsubara Page xxxviii

September 5, 2018 (Wednesday)

Palau de Congressos de Tarragona				
	Room 1	Room 2	Room 3	Room 4
8:30– 10:30	C1L-A Special Session: Complex Communication Sciences Chair: Hidehiro Nakano Page xxxviii	C1L-B Special Session: Nonlinear Circuits Distributed and Coupled across Nontrivial Network Topologies 1 Chair: Yoko Uwate Page xxxix	C1L-C Nonlinear Circuits and Systems 1 Chair: Seiichiro Moro Page xxxix	C1L-D Special Session: Nonlinear Waves and Localizations 1 Chair: Masayuki Kimura Page xl
10:30– 10:45	Coffee break			
10:45– 12:15	Poster Session, presented by Award candidates Place: The entrance of Eutyches Auditorium on Floor -1			
12:15– 14:15	Lunch break			
14:15– 15:35	C2L-A Special Session: Category Theoretic Approach to Composite Systems Chair: Makoto Naruse Page xli	C2L-B Special Session: Nonlinear Circuits Distributed and Coupled across Nontrivial Network Topologies 2 Chairs: Keiji Konishi and Tadashi Tsubone Page xli	C2L-C Nonlinear Circuits and Systems 2 Chair: Xiuqin Wei Page xlii	C2L-D Special Session: Nonlinear Waves and Localizations 2 Chair: Yusuke Doi Page xlii
19:00–	Banquet Place: La Boella			

September 6, 2018 (Thursday)

Palau de Congressos de Tarragona				
	Room 1	Room 2	Room 3	Room 4
8:30– 10:10	D1L-A Special Session: Nonlinear Time Series Analysis Chair: Takaya Miyano Page xliv	D1L-B Oscillations and Synchronization Chair: Kuniyasu Shimizu Page xliv	D1L-C Special Session: Recent Theory and Applications Related to Multimedia Communication Chair: Suk-Hwan Lee Page xliv	D1L-D Communication Networks and Systems, Signal Processing and Applied Mathematics Chair: Kaori Kuroda Page xlv
10:10– 10:25	Coffee break			
10:25– 12:05	D2L-A Special Session: Theory and Implementation of Neuromorphic Systems Chairs: Takashi Kohno and Shintaro Arai Page xlv	D2L-B Special Session: Recent Theory and Applications Related to Communication Quality Chair: Kenko Ota Page xlvi	D2L-C Special Session: Noise-Driven and Stochastic Information Sensing and Processing Systems Chairs: Yukihiro Tadokoro and Shintaro Arai Page xlvii	
13:00–	Farewell party and Student paper award ceremony Place: Casa Joan Miret			

Technical Program

A0L-AA Plenary 1 - Prof. Kunihiro Fukushima

DATE: 2018/9/3 08:40–9:40

ROOM: Hall

Chair: Hiroo Sekiya (Chiba University)

- A0L-AA1 Recent Advances in the Deep CNN Neocognitron** 1
Kunihiro Fukushima (Fuzzy Logic Systems Institute)

A1L-A Special Session: Laser Dynamics and Complex Photonics 1: Laser Dynamics

DATE: 2018/9/3 10:10–12:10

ROOM: Room 1

Chair: Atsushi Uchida (Saitama University)

- A1L-A1 State-Dependent Delay Dynamics in Semiconductor Lasers** 5
Moritz Pflüger (IFISC UIB-CSIC), Xavier Porte (IFISC UIB-CSIC), Jade Martinez-Llinas (IFISC UIB-CSIC), Miguel C. Soriano (IFISC UIB-CSIC), Elena Turitsyna (Aston Institute of Photonics Technologies), Sergei Turitsyn (Aston Institute of Photonics Technologies), Pere Colet (IFISC UIB-CSIC), Ingo Fischer (IFISC UIB-CSIC)
- A1L-A2 Time-Delay Dimensional Analysis of Laser Diode Chaos Over Fibers** 9
Jing-Ya Ruan (City University of Hong Kong), Song-Sui Li (City University of Hong Kong), Sze-Chun Chan (City University of Hong Kong)
- A1L-A3 Entrainment Experimental Study Using a Semiconductor Laser with Feedback** 13
Jordi Tiana-Alsina (Universitat Politècnica de Catalunya), Carlos Quintero-Quiroz (Universitat Politècnica de Catalunya), Mattia Panozzo (Universitat Politècnica de Catalunya), Maria Carme Torrent (Universitat Politècnica de Catalunya), Cristina Masoller (Universitat Politècnica de Catalunya)
- A1L-A4 Orbital Instability of Laser Diode with Chaotic Signal Applied to Drive Current** 17
Taiki Ishihara (Niigata Institute of Technology), Satoshi Ebisawa (Niigata Institute of Technology)
- A1L-A5 Crisis Route to Chaos of a Laser Diode Subjected to Optical Feedback** 21

Michael J. Wishon (UMI-2958 Georgia Tech-CNRS, Georgia Tech Lorraine), Daeyoung Choi (UMI-2958 Georgia Tech-CNRS, Georgia Tech Lorraine), David S. Citrin (UMI-2958 Georgia Tech-CNRS, Georgia Tech Lorraine), Alexandre Locquet (UMI-2958 Georgia Tech-CNRS, Georgia Tech Lorraine)

A1L-A6 **The Stability of Quantum Cascade Lasers Subject to Optical Feedback in the Large Delay Limit** 25

Thomas Erneux (Université Libre de Bruxelles), Romain Modeste Nguimdo (Université Libre de Bruxelles)

A1L-B Special Session: Complex Systems, Complex Networks and Bigdata Analyses

DATE: 2018/9/3 10:10–12:10

ROOM: Room 2

Chair: Fujio Toriumi (University of Tokyo)

A1L-B1 **Estimation of Awakening Time Using a Deep Neural Network with Physiological Data During Sleep** 27

Minami Tsuchiya (Yamagata University), Atsushi Tanaka (Yamagata University), Muneki Yasuda (Yamagata University), Tomochika Harada (Yamagata University), Seung-Il Cho (Yamagata University), Michio Yokoyama (Yamagata University)

A1L-B2 **The Multiple Beacon System for Detection of the Gathering Degree of People in a Certain Place** 31

Tomochika Harada (Yamagata University), Michio Yokoyama (Yamagata University), Muneki Yasuda (Yamagata University), Atsushi Tanaka (Yamagata University)

A1L-B3 **Detecting Human-Interaction Networks Based on Statistical Machine Learning and Sparse Modeling** 34

Muneki Yasuda (Yamagata University), Yoshitaka Mikuni (Yamagata University), Yuuki Yokoyama (Yamagata University), Tomochika Harada (Yamagata University), Atsushi Tanaka (Yamagata University), Michio Yokoyama (Yamagata University)

A1L-B4 **Community Analysis of Social Networks Based on Network Indexes** 38

Atsushi Tanaka (Yamagata University), Seung-Il Cho (Yamagata University), Muneki Yasuda (Yamagata University), Tomochika Harada (Yamagata University), Michio Yokoyama (Yamagata University)

A1L-B5 **Analysis of a Co-Author Network of Nursing Research** 42

Tetsuo Imai (Tokyo University of Information Sciences), Takayasu Kawaguchi (Tokyo University of Information Sciences)

A1L-B6 **Implementation of High-Performance Pseudo-Random Number Generator by Chaos Neural Networks Using Fix-Point Arithmetic with Perturbation** 46

Hitoaki Yoshida (Iwate University), Yoshino Akatsuka (Iwate University), Takeshi Murakami (Iwate University)

A1L-C Engineering Applications

DATE: 2018/9/3 10:10–12:10

ROOM: Room 3

Chair: Takeshi Kamio (Hiroshima City University)

- A1L-C1 Generating Random Bits with Electronic Chaos** 50
Michael J. Wishon (UMI-2958 Georgia Tech-CNRS, Georgia Tech Lorraine), Nianqiang Li (University of Essex), Daeyoung Choi (UMI-2958 Georgia Tech-CNRS, Georgia Tech Lorraine), David S. Citrin (UMI-2958 Georgia Tech-CNRS, Georgia Tech Lorraine), Alexandre Locquet (UMI-2958 Georgia Tech-CNRS, Georgia Tech Lorraine)
- A1L-C2 Robust Loop Shaping and Feedback Linearizing Control Design of Three Cells Inverter** 54
Said Boudjana (Unité de Développement des Equipements Solaires), Mohamed Tadjine (Process Control Laboratory, Ecole Nationale polytechnique), Djamil Ghribi (Unité de Développement des Equipements Solaires)
- A1L-C3 Transmittancy of Melanin Pigment Using Laser Irradiations** 58
Keiko Kohmoto (Kindai University), Fumiyoshi Kuwashima (Fukui University of Technology)
- A1L-C4 Solving the Steiner Tree Problem in Graphs Using the Key-Path Based Neighborhood with the kth Shortest Path** 61
Misa Fujita (Tokyo University of Science), Takayuki Kimura (Nippon Institute of Technology), Kantaro Fujiwara (Tokyo University of Science), Tohru Ikeguchi (Tokyo University of Science)
- A1L-C5 A Basic Circuit Design of Pile-Up DC-DC Converters** 65
Shota Uchino (Okayama University of Science), Tsutomu Iida (Tokyo University of Science), Nobuyuki Kasa (Okayama University of Science), Takuji Kousaka (Chukyo University), H. Ohtagaki (Okayama University of Science), Kenta Shinohara (Okayama University of Science), Hiroyuki Asahara (Okayama University of Science)
- A1L-C6 Influence of Failures of Transmission Lines in Power Grid Using Oscillator Networks** 69
Toshichika Aoki (Nippon Institute of Technology), Hideyuki Kato (Oita University), Takafumi Matsuura (Nippon Institute of Technology), Takayuki Kimura (Nippon Institute of Technology)

A1L-D Special Session: Power packet: Energy-and-Information Integrated Technology

DATE: 2018/9/3 10:10–12:10

ROOM: Room 4

Chairs: Hiroyasu Ando (University of Tsukuba) and Ryo Takahashi (Aichi University of Technology)

- A1L-D1 Research Related to Power Packet and its Applications** 73
Takashi Hikihara (Kyoto University)

A1L-D2	High-Frequency Soft-Switching Resonant Driver for SiC Class-D Amplifier	75
Ryoko Sugano (Chiba University), Xiuqin Wei (Chiba Institute of Technology), Hiroo Sekiya (Chiba University)		
A1L-D3	A Study on Physical Behavior of Power Packet Congestion in Power Packet Router	79
Ryo Takahashi (Aichi University of Technology), Yanzi Zhou (Kyoto University), Naomitsu Yoshida (Kyoto University), Shinya Nawata (Kyoto University), Naoaki Fujii (Kyoto University), Takashi Hikihara (Kyoto University)		
A1L-D4	High Frequency Isolated Flyback Converter and Cascaded Boost DC-DC Converter Hybrid System for Packet Energy Distribution System	80
Yasuyuki Nishida (Chiba Institute of Technology), Nobuo Satoh (Chiba Institute of Technology)		
A1L-D5	A Bio-Inspired Power Sharing Model in Consensus Networks	84
Hiroyasu Ando (University of Tsukuba), Takashi Hikihara (Kyoto University)		
A1L-D6	Design and Implementation of a Flexible Routing Protocol for Power Packet Networks	86
Toshiyuki Matsuda (Tokyo University of Science), Yuma Yamamoto (Tokyo University of Science), Mikio Hasegawa (Tokyo University of Science)		

A2L-A Special Session: Laser Dynamics and Complex Photonics 2: Complex Photonics

DATE: 2018/9/3 14:10–15:50

ROOM: Room 1

Chair: Kazutaka Kanno (Saitama University)

A2L-A1	Development of Longitudinally Excited CO₂ Laser for Ps Pulse by Using Chaos	90
Kazuyuki Uno (University of Yamanashi), Fumiyoshi Kuwashima (Fukui University of Technology)		
A2L-A2	Observation of Stochastic Resonance Induced by Dichotomous Noise in a Liquid Crystal Light Valve with Optical Feedback	93
Yoshitomo Goto (Oita University), Tomoyuki Nagaya (Oita University), Hiroshi Orihara (Hokkaido University)		
A2L-A3	Operation Mode of Wavefront Propagation for Maze Exploration in Two-Dimensional Optical Bistable Device	97
Takashi Isoshima (RIKEN)		
A2L-A4	Terahertz Spectroscopy Using Laser Chaos	101
Fumiyoshi Kuwashima (Fukui University of Technology), Takuya Shirao (Fukui University of Technology), Kazuyuki Iwao (Fukui University of Technology), Toshihiro Kishibata (Fukui University of Technology), Naoya Sakaue (Fukui University of Technology), Siori Gouda (Fukui University of Technology), Takurou Sirasaki (Fukui University of Technology), Masahiko Tani (University of Fukui),		

Kazuyoshi Kurihara (University of Fukui), Kohji Yamamoto (University of Fukui),

A2L-A5 Reservoir Computing Model Based on Spatiotemporal Dynamics 103

Keisuke Miyamura (Kanazawa University), Satoshi Sunada (Kanazawa University), Atsushi Uchida (Saitama university), Tomoaki Niiyama (Kanazawa University)

A2L-B Neural Networks 1

DATE: 2018/9/3 14:10–15:50

ROOM: Room 2

Chair: Takafumi Matsuura (Nippon Institute of Technology)

A2L-B1 Hopfield Neural Network with Variable Resistance Synapses Using Amorphous Metal-Oxide Semiconductor Thin-Film Devices 106

Mutsumi Kimura (Ryukoku University), Kenta Umeda (Ryukoku University), Keisuke Ikushima (Ryukoku University), Toshimasa Hori (Ryukoku University), Ryo Tanaka (Ryukoku University), Tokiyoshi Matsuda (Ryukoku University), Tomoya Kameda (Nara Institute of Science and Technology), Yasuhiko Nakashima (Nara Institute of Science and Technology)

A2L-B2 Cellular Neural Networks with Two Templates Switched by Local Features of Input Images 110

Takahisa Ando (Tokushima University), Yoko Uwate (Tokushima University), Yoshifumi Nishio (Tokushima University)

A2L-B3 Development and Evaluation of Letter Reproduction System Using Cellular Neural Network and Oxide Semiconductor Synapses 114

Hiroki Yamane (Nara Institute of Science and Technology), Mutsumi Kimura (Ryukoku University), Yasuhiko Nakashima (Nara Institute of Science and Technology)

A2L-C Special Session: Control Theory and Dynamical Systems at Interdisciplinary Interface

DATE: 2018/9/3 14:10–15:50

ROOM: Room 3

Chairs: Hiroyasu Ando (University of Tsukuba) and Shinji Nakaoka (JST PRESTO, University of Tokyo)

A2L-C1 Mathematical Description for Invasibility Threshold and Persistence of Pathogenic Bacterial Species 118

Shinji Nakaoka (JST PRESTO, University of Tokyo)

A2L-C2 Control of Deterministic Diffusion in Chaotic Systems with Time-Delayed Feedback Control 122

Miki Kobayashi (Rissho University), Hiroyasu Ando (University of Tsukuba)

A2L-C3 Dynamical Processes on Periodic Temporal Networks and Their Applications 123

Naoya Fujiwara (Tohoku University), Abhijeet Sonawane (Brigham and Women's Hospital)

A2L-C4 Partial State Perfect Tracking Control of PWM-Type Input Systems 124
Masayasu Suzuki (Utsunomiya University), Mitsuo Hirata (Utsunomiya University)

A2L-C5 Control of Collective Network Chaos 128
Alexandre Wagemakers (University Rey Juan Carlos), Ernest Barreto (George Mason University), Miguel Sanjuán (University Rey Juan Carlos), Paul So (George Mason University)

A2L-D Special Session: Medical Engineering Related Optimization Problems 1

DATE: 2018/9/3 14:10–15:50

ROOM: Room 4

Chairs: Yuichi Tanji (Kagawa University) and Mio Kobayashi (National Institute of Technology, Anan College)

A2L-D1 Reconstruction of CT Images by Iterative Least Squares Methods with Non-negative Constraint 132

Hiromasa Kohno (Kagawa University), Yuichi Tanji (Kagawa University), Ken'ichi Fujimoto (Kagawa University), Hiroyuki Kitajima (Kagawa University), Yo Horikawa (Kagawa University), Norikazu Takahashi (Okayama University)

A2L-D2 Discretization of Continuous Analog to Accelerated Expectation-Maximization Algorithm for Computed Tomography 136

Takeshi Kojima (Tokushima University), Kiyoko Tateishi (Tokushima University), Yusaku Yamaguchi (Shikoku Medical Center for Children and Adults), Tetsuya Yoshinaga (Tokushima University)

A2L-D3 Image Superresolution Method Based on Iterative Back Projection Using Directional Predictors 140

Ryuya Ukai (Chukyo University), Ryohei Mizutani (Chukyo University), Yuki Kawai (Chukyo University), Teruki Uchida (Chukyo University), Hideharu Toda (Chukyo University), Tsuyosi Otake (Tamagawa University), Masatoshi Sato (Tamagawa University), Hisashi Aomori (Chukyo University)

A2L-D4 Total-Variation Minimization with Regularization for Continuous-Time Dynamical Image Reconstruction in Computed Tomography 143

Masashi Kimura (Tokushima University), Akira Kinokiri (Tokushima University), Takeshi Kojima (Tokushima University), Yusaku Yamaguchi (Shikoku Medical Center for Children and Adults), Tetsuya Yoshinaga (Tokushima University)

A3L-A Special Session: Laser Dynamics and Complex Photonics 3: Reservoir Computing

DATE: 2018/9/3 16:05–18:05

ROOM: Room 1

Chair: Fumiyo Kuwashima (Fukui University of Technology)

- A3L-A1 Soft Keyboard: a Novel User Interface for Soft Devices** 147
Kohei Nakajima (University of Tokyo), Katsuma Inoue (University of Tokyo), Yasuo Kuniyoshi (University of Tokyo), Sophon Somlor (Waseda University), Tito Pradhono Tomo (Waseda University), Alexander Schmitz (Waseda University)
- A3L-A2 Performance Analysis of Large-Scale Photonics Reservoir Computers** 151
Piotr Antonik (Centrale Supélec, Université Paris-Saclay), Nicolas Marsal (Centrale Supélec, Université Paris-Saclay), Daniel Brünner (FEMTO-ST Institute/CNRS & Université de Bourgogne Franche-Comté), Damien Rontani (Centrale Supélec, Université Paris-Saclay)
- A3L-A3 Towards Online-Trained Analogue Readout Layer for Photonic Reservoir Computers** 152
Piotr Antonik (Centrale Supélec, Université Paris-Saclay), Damien Rontani (Centrale Supélec, Université Paris-Saclay), Marc Haelterman (Université Libre de Bruxelles), Serge Massar (Université Libre de Bruxelles)
- A3L-A4 Cracking Chaos-Based Cryptography with Reservoir Computing** 153
Piotr Antonik (Centrale Supélec, Université Paris-Saclay), Marvyn Gulina (Université de Namur), Jaël Pauwels (Université Libre de Bruxelles), Damien Rontani (Centrale Supélec, Université Paris-Saclay), Marc Haelterman (Université Libre de Bruxelles), Serge Massar (Université Libre de Bruxelles)
- A3L-A5 Wave Dynamical Reservoir Computing at a Microscale** 154
Satoshi Sunada (Kanazawa University), Kenichi Arai (NTT Communication Science Laboratories, NTT Corporation), Atsushi Uchida (Saitama University)
- A3L-A6 Mutually Coupled Optoelectronic Systems with Different Delays for Reservoir Computing** 156
Kazutaka Kanno (Saitama University), Masatoshi Bunsen (Fukuoka University), Atsushi Uchida (Saitama University)

A3L-B Neural Networks 2 and Evolutionary Computation

DATE: 2018/9/3 16:05–18:05

ROOM: Room 2

Chair: Hiroaki Kurokawa (Tokyo University of Technology)

- A3L-B1 Improvement of Feed Forward Neural Network by Synchronization Pulse** 160
Chihiro Ikuta (Anan College)
- A3L-B2 Synaptic Dynamics in ISO by Dopaminergic Modulation and Inhibitory Synaptic Learnings** 164
Tohru Ikeguchi (Tokyo University of Science), Yutaka Shimada (Saitama University), Kantaro Fujiwara (Tokyo University of Science), Sakura Rai (Tokyo University of Science), Toshihiro Kobayashi (Tokyo University of Science)

A3L-B3	Tabu Search Method for Multiple-Vehicle Bike Sharing System Routing Problem	168
---------------	--	-----

Honami Tsushima (Nippon Institute of Technology), Takafumi Matsuura (Nippon Institute of Technology), Takayuki Kimura (Nippon Institute of Technology)

A3L-C Special Session: Recent Progress in the Oscillation Model on Social/Information Networks

DATE: 2018/9/3 16:05–18:05

ROOM: Room 3

Chair: Masaki Aida (Tokyo Metropolitan University)

A3L-C1	An Analysis of Flash Crowd with Network Oscillation Model	172
---------------	--	-----

Harumasa Tada (Kyoto University of Education), Masayuki Murata (Osaka University), Masaki Aida (Tokyo Metropolitan University)

A3L-C2	Flaming Countermeasure Technology for Online Social Networks Based on the Damped Oscillation Model	176
---------------	---	-----

Kouichi Nagatani (Tokyo Metropolitan University), Masaki Aida (Tokyo Metropolitan University)

A3L-C3	Efficient Orthogonalizing the Eigenvectors of the Laplacian Matrix to Estimate Social Network Structure	180
---------------	--	-----

Naoki Hirakura (Tokyo Metropolitan University), Chisa Takano (Hiroshima City University), Masaki Aida (Tokyo Metropolitan University)

A3L-C4	A New Model of Flaming Phenomena in on-Line Social Networks Caused by Degenerated Oscillation Modes	184
---------------	--	-----

Takahiro Kubo (Tokyo Metropolitan University), Chisa Takano (Hiroshima City University), Masaki Aida (Tokyo Metropolitan University)

A3L-C5	Damped Oscillation Model with Frequency-Dependent Decay Rate in Social Networks	188
---------------	--	-----

Chisa Takano (Hiroshima City University), Masaki Aida (Tokyo Metropolitan University)

A3L-D Special Session: Medical Engineering Related Optimization Problems 2

DATE: 2018/9/3 16:05–18:05

ROOM: Room 4

Chairs: Yuichi Tanji (Kagawa University) and Mio Kobayashi (National Institute of Technology, Anan College)

A3L-D1	Nonlinear Dynamical System with Order-Preserving Function for Inverse Problem of Intensity-Modulated Radiation Therapy Treatment Planning	192
---------------	--	-----

Ryosei Nakada (Shizuoka Cancer Center), Takeshi Kojima (Tokushima University), Tetsuya Yoshinaga (Tokushima University)

A3L-D2 Optimization for Thin Plate Spline Registration of Tongue Spectral Images 196

Kazunari Murai (Chiba University), Toshiya Nakaguchi (Chiba University), Yuichiro Yoshimura (Chiba University), Yuki Watanabe (Chiba University), Akira Morita (Chiba University), Takao Namiki (Chiba University)

A3L-D3 Nonautonomous Nonlinear Dynamical System for Reconstructing Magnetic Resonance Image 200

Yusaku Yamaguchi (Shikoku Medical Center for Children and Adults), Michiko Mori (Tokushima University), Takeshi Kojima (Tokushima University), Tetsuya Yoshinaga (Tokushima University)

B0L-AA Plenary 2 - Prof. Soumitro Banerjee

DATE: 2018/9/4 08:30–9:30

ROOM: Hall

Chair: Abdelali El Aroudi (Universitat Rovira i Virgili)

B0L-AA1 Nonlinear Phenomena in Power Electronics 204

Soumitro Banerjee (Indian Institute of Science Education & Research)

B1L-A Special Session: Laser Dynamics and Complex Photonics 4: Decision Making

DATE: 2018/9/4 10:00–12:00

ROOM: Room 1

Chair: Damien Rontani (Centrale Supélec, Université Paris-Saclay)

B1L-A1 Photonic Spatio-Temporal Networks of 2025 Ikeda Maps 205

Louis Andreoli (FEMTO-ST Institute/CNRS & Université de Bourgogne Franche-Comté), Maxime Jacquot (FEMTO-ST Institute & University Bourgogne Franche-Comte), Laurent Larger (FEMTO-ST Institute & University Bourgogne Franche-Comte), Daniel Brünner (FEMTO-ST Institute/CNRS & Université de Bourgogne Franche-Comté)

B1L-A2 Decision Making by Classical and Quantum Light 209

Makoto Naruse (National Institute of Information and Communications Technology), Nicolas Chauvet (Institut Néel), David Jegouso (Institut Néel), Atsushi Uchida (Saitama University), Hirokazu Hori (University of Yamanashi), Aurélien Drezet (Institut Néel), Benoît Boulanger (Institut Néel), Serge Huant (Institut Néel), Guillaume Bachelier (Institut Néel)

B1L-A3 Optical Decision Making with a Semiconductor Ring Laser 211

Ryutaro Homma (Kanazawa University), Satoshi Kochi (Kanazawa University), Tomoaki Niiyama (Kanazawa University), Atsushi Uchida (Saitama University), Makoto Naruse (National Institute of Information and Communications Technology), Satoshi Sunada (Kanazawa University)

- B1L-A4 Decision Making Using Lag Synchronization of Chaos in Mutually-Coupled Semiconductor Lasers** 215
 Takatomo Mihana (Saitama University), Yusuke Mitsui (Saitama University), Kazutaka Kanno (Saitama University), Makoto Naruse (National Institute of Information and Communications Technology), Atsushi Uchida (Saitama University)
- B1L-A5 Experiment on Leader-Laggard Relationship in Mutually-Coupled Semiconductor Lasers with Time Delay** 219
 Yusuke Mitsui (Saitama University), Takatomo Mihana (Saitama University), Kazutaka Kanno (Saitama University), Atsushi Uchida (Saitama University)
- B1L-A6 Entropy Estimation of White Chaos Generated from Optical Heterodyne for Random Number Generation** 223
 Keigo Yoshiya (Saitama University), Atsushi Uchida (Saitama University)

B1L-B Chaos and Bifurcation 1

DATE: 2018/9/4 10:00–12:00

ROOM: Room 2

Chair: Hideyuki Kato (Oita University)

- B1L-B1 Demonstration of Various Synchronized and Asynchronized Mixed-Mode Oscillations from a Two-Coupled Driven Bonhoeffer-Van der Pol Oscillator** 227
 Katsuhiro Ogawa (Meiji University), Naohiko Inaba (Meiji University), Tetsuro Endo (Meiji University), Kuniyasu Shimizu (Chiba Institute of Technology)
- B1L-B2 Bifurcation Analysis of a Model of Cardiovascular Variability** 231
 Franco Sebastian Gentile (Universidad Nacional del Sur and IIIE UNS-CONICET), Griselda Ruth Itovich (Universidad Nacional de Río Negro), Guillermo Luis Calandrini (Universidad Nacional del Sur), Jorge Luis Moiola (Universidad Nacional del Sur and IIIE UNS-CONICET)
- B1L-B3 Stability Analysis of a Time-Delay System with Quadratic Nonlinearity** 235
 Griselda Ruth Itovich (Universidad Nacional de Río Negro), Franco Sebastian Gentile (Universidad Nacional del Sur and IIIE UNS-CONICET), Jorge Luis Moiola (Universidad Nacional del Sur and IIIE UNS-CONICET)
- B1L-B4 Border Collisions in Interleaved Multi-Output DC-DC Boost Converters** 239
 Georgios Gkizas (Newcastle University), Damian Giaouris (Newcastle University), Soumitro Banerjee (Indian Institute of Science Education and Research Kolkata), Abdelali El Aroudi (Universitat Rovira i Virgili), Kuntal Mandal (National Institute of Technology Sikkim), Volker Pickert (School of Electrical and Electronic Engineering, Newcastle University)
- B1L-B5 Reconstructing Bifurcation Diagrams of the Duffing Equations** 243
 Yoshitaka Itoh (Tokyo Denki University), Masaharu Adachi (Tokyo Denki University)
- B1L-B6 Bifurcations in a Sinusoidally Driven LCR Circuit with a Hysteresis** 247
 Yuu Miino (Tokushima University), Tetsushi Ueta (Tokushima University), Hiroshi Kawakami

(Tokushima University)

B1L-C Control Systems 1

DATE: 2018/9/4 10:00–12:00

ROOM: Room 3

Chair: Yasuhiro Sugimoto (Osaka University)

- B1L-C1 Discrete-Time Sliding Mode Control of a Boost Converter Loaded by a CPL** 251
Abdelali El Aroudi (Universitat Rovira i Virgili), Blanca Martínez-Treviño (Universitat Rovira i Virgili), Enric Vidal-Idiarte (Universitat Rovira i Virgili), Luis Martínez-Salamero (Rovira i Virgili University)
- B1L-C2 Stabilization of Fourth-Order Chained System by Rough Signals** 255
Kouki Takeuchi (Kagoshima University), Yuki Nishimura (Kagoshima University)
- B1L-C3 A Distributed Algorithm for Solving Sandberg-Willson Equations** 259
Masaaki Takeuchi (Okayama University), Norikazu Takahashi (Okayama University)
- B1L-C4 Robustness of a Traveling Wave Segment to Obstacles in Excitable Media with Pi Control** 263
Ikuma Yamamoto (Osaka Prefecture University), Keiji Konishi (Osaka Prefecture University), Naoyuki Hara (Osaka Prefecture University)

B1L-D Special Session: Nonlinear Phenomena in Non-Smooth Systems 1

DATE: 2018/9/4 10:00–12:00

ROOM: Room 4

Chairs: Viktor Avrutin (University of Stuttgart) and Zhanybai Zhusubaliyev (South-West State University)

- B1L-D1 Manifolds and Crises in an Impacting System** 267
Petri Piiroinen (National University of Ireland Galway), Joanna Jordan (University of Bath)
- B1L-D2 Noise and Bistability in the Square Root Map** 270
Eoghan Staunton (National University of Ireland Galway), Petri Piiroinen (National University of Ireland Galway)
- B1L-D3 Illusions of Noise in Nonsmooth Systems** 274
Mike Jeffrey (University of Bristol)
- B1L-D4 Understanding Noise-Shaping in Sigma-Delta Controls of Surface Potential for MOX Gas Sensors** 275
Manuel Dominguez-Pumar (Universitat Politècnica de Catalunya), Lukasz Kowalski (Universitat

Politécnica de Catalunya), Oscar Monge (Universitat Politècnica de Catalunya), Josep Maria Olm (Universitat Politècnica de Catalunya), Eric Navarrete (Universitat Rovira i Virgili), Eduard Llobet (Universitat Rovira i Virgili), Joan Pons-Nin (Universitat Politècnica de Catalunya)

B1L-D5 Non-Smooth Bifurcations in a Control Strategy for Coffee Borer 279

Carlos Andrés Trujillo (Universidad Nacional de Colombia), Gerard Olivar (Universidad Nacional de Colombia), Enric Trullols (Universitat Politècnica de Catalunya), Immaculada Massana (Universitat Politècnica de Catalunya), Joana D'Arc Prat (Universitat Politècnica de Catalunya)

B2L-A Special Session: Optimization Algorithms with Nonlinear Dynamics 1

DATE: 2018/9/4 14:00–15:20

ROOM: Room 1

Chair: Hidehiro Nakano (Tokyo City University)

B2L-A1 PSO Based Control of Switching Power Converters for Dynamic Maximum Power Point Tracking 280

Shin Yasukawa (Hosei University), Toshimichi Saito (Hosei University)

B2L-A2 Learning Method Using Acetylcholine Among Neurotransmitter in Feed Forward Neural Networks 284

Kazuki Nagao (Tokushima University), Yoko Uwate (Tokushima University), Yoshifumi Nishio (Tokushima University)

B2L-A3 Analysis of Particle Swarm Optimization with Individual Dropout 288

Takuya Shindo (Nippon Institute of Technology), Takefumi Hiraguri (Nippon Institute of Technology), Kenya Jin'no (Tokyo City University)

B2L-A4 On a Nonlinear Map Optimization 292

Kenya Jin'no (Tokyo City University)

B2L-B Chaos and Bifurcation 2 and Nonlinear Phenomena

DATE: 2018/9/4 14:00–15:20

ROOM: Room 2

Chair: Masaharu Adachi (Tokyo Denki University)

B2L-B1 An Indication of Quantum Chaos Based on Stochastic Quantization 296

Keita Matsuura (Hiroshima City University), Hisato Fujisaka (Hiroshima City University), Masaru Fukushima (Hiroshima City University)

B2L-B2 Treatment of Ionic Concentration Variables in a Hodgkin–Huxley-Type Model of Human Atrial Myocytes 300

Rikutarō Inoshi (Kyoto University), Shinji Doi (Kyoto University)

B2L-B3 **Reconstructing the State Space of Dynamical Systems from Data: Comparison Between One-Dimensional Spatially Extended and Time Delayed Systems** 304

Carlos Quintero-Quiroz (Universitat Politècnica de Catalunya), Maria Carme Torrent (Universitat Politècnica de Catalunya), Cristina Masoller (Universitat Politècnica de Catalunya)

B2L-B4 **Amplitude Death in a Pair of Reaction-Diffusion Models on Networks Coupled by a Diffusive Connection** 308

Hakui Teki (Osaka Prefecture University), Keiji Konishi (Osaka Prefecture University), Naoyuki Hara (Osaka Prefecture University)

B2L-C Control Systems 2

DATE: 2018/9/4 14:00–15:20

ROOM: Room 3

Chair: Tatsuya Kai (Tokyo University of Science)

B2L-C1 **Design of Quantizers with Neural Networks: Classification Based Approach** 312

Juan Esteban Rodriguez Ramirez (Nara Institute of Science and Technology), Yuki Minami (Osaka University), Kenji Sugimoto (Nara Institute of Science and Technology)

B2L-C2 **Bidirectional Converter Based on SLFR for Microgrid Application** 316

Reham Haroun (Universitat Rovira i Virgili), Angel Cid-Pastor (Universitat Rovira i Virgili), Abdelali El Aroudi (Universitat Rovira i Virgili), Luis Martínez-Salamero (Rovira i Virgili University)

B2L-C3 **Controllability Invariant Subspaces for Switched Linear Systems** 320

M. Dolors Magret (Universitat Politècnica de Catalunya)

B2L-C4 **Pheromone Trap for Distributed Task Achievement by Homogeneous Termites-Like Agents** 324

Yuichiro Sueoka (Osaka University), Kazuma Nakanishi (Osaka University), Yasuhiro Sugimoto (Osaka University), Koichi Osuka (Osaka University)

B2L-C5 **Design of Anisotropic Impulse Motion Based on Snap-Through Buckling for Fish-Like Swimming Robot** 328

Yuichiro Sueoka (Osaka University), Fumiaki Nose (Osaka University), Daisuke Nakanishi (Matsue College), Yasuhiro Sugimoto (Osaka University), Koichi Osuka (Osaka University)

B2L-D Special Session: Nonlinear Phenomena in Non-Smooth Systems 2

DATE: 2018/9/4 14:00–15:20

ROOM: Room 4

Chairs: Viktor Avrutin (University of Stuttgart) and Gerard Olivar (Universidad Nacional de Colombia)

B2L-D1 **Persistence Border Collisions in a Vibration System with a Relay Control** 332

Zhanybai Zhusubaliyev (South-West State University), Viktor Avrutin (University of Stuttgart), Vasily Rubanov (Belgorod State Technological University), Dmitry Bushuev (Belgorod State Technological University), Dmitry Titov (Southwest State University), Olga Yanochkina (Southwest State University)

B2L-D2 **Multistable Oscillations in the 4D Canonical Memristor Oscillator: the Parametric Onset** 335

Enrique Ponce (Universidad de Sevilla), Andres Amador (Pontificia Universidad Javeriana Cali), Javier Ros (Universidad de Sevilla)

B2L-D3 **Hybrid Model for the Diagnose of Dengue in Caldas (Colombia)** 339

Carolina Ospina Aguirre (Universidad Nacional de Colombia), Gerard Olivar (Universidad Nacional de Colombia)

B3L-A Special Session: Optimization Algorithms with Nonlinear Dynamics 2

DATE: 2018/9/4 15:35–16:55

ROOM: Room 1

Chair: Kenya Jin'no (Tokyo City University)

B3L-A1 **An Artificial Bee Colony Algorithm for Dynamic Optimization Problems** 343

Masato Omika (Tokyo City University), Hidehiro Nakano (Tokyo City University), Arata Miyauchi (Tokyo City University)

B3L-A2 **Particle Swarm Optimizer Networks with Switching Local and Global Network Topologies** 347

Santana Sato (Tokyo City University), Hidehiro Nakano (Tokyo City University), Arata Miyauchi (Tokyo City University)

B3L-A3 **Collision Particle Swarm Optimizers for Search of Periodic Points in Dynamical Systems** 351

Satonao Okitsu (Hosei University), Toshimichi Saito (Hosei University)

B3L-A4 **Application of Particle Swarm Optimization to the Calculation of Border Collision Bifurcation Point in a One-Dimensional Map** 355

Wataru Kinoshita (Oita University), Motoaki Sakai (Oita University), Hideyuki Kato (Oita University), Hiroaki Kurokawa (Tokyo University of Technology), Haruna Matsushita (Kagawa University), Takuji Kousaka (Chukyo University)

B3L-B Special Session: Cellular Dynamical Systems 1

DATE: 2018/9/4 15:35–16:55

ROOM: Room 2

Chair: Hiroyuki Torikai (Hosei University)

- B3L-B1** **A Simple Evolutionary Algorithm for Design of Desired Digital Spike Maps** 359
Hayate Arai (Hosei University), Toshimichi Saito (Hosei University)
- B3L-B2** **Supervised Learning of Pseudo-Cerebellar Circuit with Threshold Learning Neuron** 363
Tomohiro Fujita (Ritsumeikan University), Sosuke Esaki (Ritsumeikan University), Teruto Nimura (Ritsumeikan University), Takeshi Kumaki (Ritsumeikan University), Takeshi Ogura (Ritsumeikan University)
- B3L-B3** **A Bipartite Graph Consisting of Delta-Sigma Min-Max Function Nodes and Shift Register Edges for $GF(2^q)$ LDPC Decoding** 367
Akiyoshi Yasuda (Hiroshima City University), Hisato Fujisaka (Hiroshima City University), Takeshi Kamio (Hiroshima City University)
- B3L-B4** **A Probabilistic Cellular Array Model of Three-Port ElectronWave Filter** 371
Shota Hayakawa (Hiroshima City University), Hisato Fujisaka (Hiroshima City University), Takeshi Kamio (Hiroshima City University)

B3L-C Complex Networks/Systems 1

DATE: 2018/9/4 15:35–16:55

ROOM: Room 3

Chair: Yutaka Shimada (Saitama University)

- B3L-C1** **Temporal Fluctuation in Spontaneous Activity of a Spiking Neural Network with Long-Tailed Synaptic Weights** 375
Sou Nobukawa (Chiba Institute of Technology), Hiroshi Aiura (Chiba Institute of Technology), Hiroki Yoshida (Chiba Institute of Technology), Haruhiko Nishimura (University of Hyogo), Teruya Yamanishi (Fukui University of Technology)
- B3L-C2** **Involutive Automorphisms and Twin Structures in Complex Networks** 379
Ricardo Rianza (Universidad Politécnica de Madrid)
- B3L-C3** **Stability Problems in Consensus-Like Networked Dynamical Systems** 383
Ricardo Rianza (Universidad Politécnica de Madrid)

B3L-D Special Session: Nonlinear Phenomena in Non-Smooth Systems 3

DATE: 2018/9/4 15:35–16:55

ROOM: Room 4

Chairs: Gerard Olivar (Universidad Nacional de Colombia) and Zhanybai Zhusubaliyev (South-West State University)

- B3L-D1 Control of a DC-DC Buck Converter Through Contraction Techniques** 387
 Fabiola Angulo (Universidad Nacional de Colombia), David Angulo (Universidad de Cartagena), Gustavo Osorio (Universidad Nacional de Colombia), Gerard Olivar (Universidad Nacional de Colombia)
- B3L-D2 Simulation and Experimental Verification of Boost-Flyback Converter with Peak Current Control** 391
 Frank Florez (Universidad Nacional de Colombia), John Alexander Taborda (Universidad del Magdalena), Gerard Olivar (Universidad Nacional de Colombia)
- B3L-D3 Delay Effects on the Limit Cycling Behavior in an H-Bridge Resonant Inverter with Zero Current Switching Control Strategy** 395
 Luis Benadero (Universitat Politècnica de Catalunya), Francisco Torres (Universidad de Sevilla), Abdelali El Aroudi (Universitat Rovira i Virgili), Carlos Olalla (Universitat Rovira i Virgili), Enrique Ponce (Universidad de Sevilla), Luis Martínez-Salamero (Rovira i Virgili University)
- B3L-D4 Non-Observable Chaos in Power Converters** 399
 Viktor Avrutin (University of Stuttgart), Zhanybai Zhusubaliyev (South-West State University), Abdelali El Aroudi (Universitat Rovira i Virgili)

B4L-A Special Session: Non-Algorithmic Computing by Complex Systems

DATE: 2018/9/4 17:10–18:30

ROOM: Room 1

Chair: Ingo Fischer (IFISC UIB-CSIC)

- B4L-A1 Reservoir Computing Using Semiconductor Laser with Short External Cavity** 400
 Chihiro Sugano (Saitama University), Kosuke Takano (Saitama University), Kazutaka Kanno (Saitama University), Masanobu Inubushi (NTT Communication Science Laboratories, Osaka University), Kazuyuki Yoshimura (Tottori University), Atsushi Uchida (Saitama University)
- B4L-A2 Computation Performance of Mixture-Unit Echo State Networks** 404
 Kazuyuki Yoshimura (Tottori University), Masanobu Inubushi (NTT Communication Science Laboratories, Osaka University), Yoshiaki Ikeda (Tottori University), Yuto Nagasawa (Tottori University), Takayuki Kogahara (Tottori University)
- B4L-A3 Autonomous Operation of Echo State Networks** 408
 Miguel C. Soriano (IFISC UIB-CSIC), Ingo Fischer (IFISC UIB-CSIC)
- B4L-A4 A Recipe for Designing Chaotic Itinerancy: Innate Training Approach** 412
 Katsuma Inoue (University of Tokyo), Kohei Nakajima (University of Tokyo), Yasuo Kuniyoshi (University of Tokyo)
- B4L-A5 Reinforcement Learning in a Large Scale Photonic Recurrent Neural Network** 415

Julian Bueno (IFISC UIB-CSIC), Sheler Maktoobi (FEMTO-ST Institute & University Bourgogne Franche-Comte), Luc Froehly (FEMTO-ST Institute & University Bourgogne Franche-Comte), Ingo Fischer (IFISC UIB-CSIC), Maxime Jacquot (FEMTO-ST Institute & University Bourgogne Franche-Comte), Laurent Larger (FEMTO-ST Institute & University Bourgogne Franche-Comte), Daniel Br nner (FEMTO-ST Institute/CNRS & Universit  de Bourgogne Franche-Comt )

B4L-B Special Session: Cellular Dynamical Systems 2

DATE: 2018/9/4 17:10–18:30

ROOM: Room 2

Chair: Hiroyuki Torikai (Hosei University)

Expansion of Object and Background Image Features Using Point Spread

B4L-B1 **Function for Accuracy Improvement of Maximum-Flow Neural Network Image Segmentation** 419

Masatoshi Sato (Tamagawa University), Hisashi Aomori (Chukyo University), Tsuyoshi Otake (Tamagawa University)

B4L-B2 **A Discrete Mechanics Approach to Vibration Suppression Control of Free-Fixed Euler-Bernoulli Beams** 423

Tatsuya Kai (Tokyo University of Science), Kouhei Yamaki (Mitsubishi Chemical Corporation)

B4L-B3 **Asynchronous Cellular Automaton Models of Biological Systems** 427

Kentaro Takeda (Kyoto Sangyo University), Hiroyuki Torikai (Kyoto Sangyo University)

B4L-B4 **Scalable Lossless Image Coding Using Directional CNN Predictors with Dynamical Predictor Reduction Strategy** 428

Hideharu Toda (Chukyo University), Hisashi Aomori (Chukyo University), Tsuyoshi Otake (Tamagawa University), Ichiro Matsuda (Tokyo University of Science), Susumu Itoh (Tokyo University of Science)

B4L-C Complex Networks/Systems 2

DATE: 2018/9/4 17:10–18:30

ROOM: Room 3

Chair: Naoki Wakamiya (Osaka University)

B4L-C1 **Nonlinear Time Series Analysis on LOTO7** 430

Shiki Kanamaru (Tokyo University of Science), Yutaka Shimada (Saitama University), Kantaro Fujiwara (Tokyo University of Science), Tohru Ikeguchi (Tokyo University of Science)

B4L-C2 **Nonlinear Analysis on Temporally High Resolution Data of Stock Markets in Japan** 434

Kohei Yamamoto (Tokyo University of Science), Yutaka Shimada (Saitama University), Kantaro Fujiwara (Tokyo University of Science), Tohru Ikeguchi (Tokyo University of Science)

B4L-C3 **Exploiting Lag-Time Information for Optimizing the Inference of Network Connectivity** 438

Nicolas Rubido (Universidad de la Republica), Cristina Masoller (Universitat Politècnica de Catalunya)

B4L-D Special Session: Reinforcement Learning and Its Applications

DATE: 2018/9/4 17:10–18:30

ROOM: Room 4

Chair: Takashi Matsubara (Kobe University)

- B4L-D1 Reinforcement Learning of Optimal Risk-Tolerant Supervisor with Recovery Mechanism** 442
Tatsushi Yamasaki (Setsunan University)
- B4L-D2 Enhancement of Reference Course Tracking Capability in Multi-Agent Reinforcement Learning System to Search Ships' Courses** 444
Takahiro Tomihara (Hiroshima City University), Takeshi Kamio (Hiroshima City University), Takahiro Tanaka (Japan Coast Guard Academy), Kunihiro Mitsubori (Takushoku University), Hisato Fujisaka (Hiroshima City University)
- B4L-D3 Application of Reinforcement Learning to Adaptive Control of Connected Vehicles** 448
Ikumi Ichikawa (Osaka University), Toshimitsu Ushio (Osaka University)
- B4L-D4 Episode-Efficient Exploration for Safe Reinforcement Learning** 452
Xiao Zeng (Kobe University), Takashi Matsubara (Kobe University), Kuniaki Uehara (Kobe University)

C1L-A Special Session: Complex Communication Sciences

DATE: 2018/9/5 08:30–10:30

ROOM: Room 1

Chair: Hidehiro Nakano (Tokyo City University)

- C1L-A1 A Media Access Control Using Capture Effect for Bi-Directional Flows Over Densely Placed WLANs** 456
Yosuke Izumikawa (Hiroshima City University), Yoshiki Miura (Hiroshima City University), Hiroyasu Obata (Hiroshima City University), Chisa Takano (Hiroshima City University), Tutomu Murase (Nagoya University), Kenji Ishida (Hiroshima City University)
- C1L-A2 Analysis of LSM-Based Event Detection in Impulse-Based Wireless Sensor Networks** 460
Daito Kamei (Osaka University), Naoki Wakamiya (Osaka University)
- C1L-A3 Automata Modeling on Power Packet Distribution Network for Power Flow Analysis** 464
Seongcheol Baek (Kyoto University), Hiroyasu Ando (University of Tsukuba), Takashi Hikiyara

(Kyoto University)

C1L-A4 **Suppression of Mode Collapse in Generative Adversarial Nets** 468
Shinya Hidai (Tokyo City University), Hidehiro Nakano (Tokyo City University), Arata Miyauchi (Tokyo City University)

C1L-A5 **Performance Evaluation of a Coherent Ising Machine with Hardware Constraints** 472
Hirotake Ito (Tokyo University of Science), Yukio Murata (Tokyo University of Science), Kaori Kuroda (Tokyo University of Science), Hiroki Takesue (NTT Corporation), Kazuyuki Aihara (University of Tokyo), Mikio Hasegawa (Tokyo University of Science)

C1L-B Special Session: Nonlinear Circuits Distributed and Coupled across Nontrivial Network Topologies 1

DATE: 2018/9/5 08:30–10:30

ROOM: Room 2

Chair: Yoko Uwate (Tokushima University)

C1L-B1 **Analysis of Elementary Cellular Automata with Time-Variant Rules** 476
Takahiro Ozawa (Hosei University), Toshimichi Saito (Hosei University)

C1L-B2 **Gene Network Models Based on Asynchronous Cellular Automaton** 480
Takuya Yoshimoto (Kyoto Sangyo University), Hiroyuki Torikai (Kyoto Sangyo University)

C1L-B3 **Synchronization in Cellular Automata: the Learning Approach** 481
Martin Schüle (ZHAW Zurich University of Applied Sciences), Thomas Ott (ZHAW Zurich University of Applied Sciences)

C1L-B4 **Influence of Coupling Strengths on Synchronization Phenomena in Two Rings of Coupled Van der Pol Oscillators** 483
Daiki Nariai (Tokushima University), Yoko Uwate (Tokushima University), Yoshifumi Nishio (Tokushima University)

C1L-B5 **Suppression of Oscillation in Delay-Coupled Oscillator Networks with Slow Switching Topology** 487
Tetsu Iwamoto (Osaka Prefecture University), Yoshiki Sugitani (Ibaraki University), Shinnosuke Masamura (Osaka Prefecture University), Keiji Konishi (Osaka Prefecture University), Naoyuki Hara (Osaka Prefecture University)

C1L-C Nonlinear Circuits and Systems 1

DATE: 2018/9/5 08:30–10:30

ROOM: Room 3

Chair: Seiichiro Moro (University of Fukui)

C1L-C1	Symmetry Recovering of an AC/AC Converter Working in a Chaotic Regime	491
	Manuel Sánchez (Kyoto University), Takashi Hikiyara (Kyoto University)	
C1L-C2	Algorithmic Aspects of a Continuous-Time Dynamical System for Solving SAT Problems	495
	Hiroshi Yamashita (University of Tokyo), Kazuyuki Aihara (University of Tokyo), Hideyuki Suzuki (Osaka University)	
C1L-C3	Analysis of the Inverse Class-E Inverter with the Switch-Voltage Fall Time	499
	Natsumi Obinata (Chiba Institute of Technology), Xiuqin Wei (Chiba Institute of Technology), Hiroo Sekiya (Chiba University), Tadashi Suetsugu (Fukuoka University)	
C1L-C4	Robustness of Paralleled Buck Converters with WTA Switching	503
	Hiroataka Kanzaki (Hosei University), Kaito Ando (Hosei University), Toshimichi Saito (Hosei University)	
C1L-C5	Basic Analysis of Paralleled Boost Converters with Photovoltaic Inputs	507
	Yusuke Kunii (Hosei University), Toshimichi Saito (Hosei University)	

C1L-D Special Session: Nonlinear Waves and Localizations 1

DATE: 2018/9/5 08:30–10:30

ROOM: Room 4

Chair: Masayuki Kimura (Kyoto University)

C1L-D1	Dynamics of Intrinsic Localized Modes in Pairwise Interaction Relative Symmetric Lattices	511
	Yusuke Doi (Osaka University), Kazuyuki Yoshimura (Tottori University), Akihiro Nakatani (Osaka University)	
C1L-D2	Breathers and Tail-Breathers in a Realistic Model of a Silicate	513
	Juan Rodríguez Archilla (Universidad de Sevilla), Yusuke Doi (Osaka University), Masayuki Kimura (Kyoto University)	
C1L-D3	On the Mechanical Control of Electrons at the Nanolevel	514
	Manuelg Velarde (Universidad Complutense de Madrid)	
C1L-D4	Kinks in a Chain of Magnetic Coupled Pendulums: Experimental and Numerical Study	515
	Luis Miguel García Raffi (Universitat Politècnica de València), Luis José Salmerón-Contreras (Universitat Politècnica de València), Noé Jiménez (Universitat Politècnica de València), Ahmed Mehrem (Universitat Politècnica de València), Víctor José Sánchez-Morcillo (Universitat Politècnica de València), Juan Rodríguez Archilla (Universidad de Sevilla)	
C1L-D5	Numerical Study on Dynamics of Nonlinear Discrete Bridge Induced by Pedestrians	517
	Naoki Uchida (Osaka University), Yusuke Doi (Osaka University), Akihiro Nakatani (Osaka University)	

versity)

C2L-A Special Session: Category Theoretic Approach to Composite Systems

DATE: 2018/9/5 14:15–15:35

ROOM: Room 1

Chair: Makoto Naruse (NICT)

- C2L-A1 Category of Mobility—A Mathematical Foundation for Composite Systems** 521
Hayato Saigo (Nagahama Institute of Bio-Science and Technology)
- C2L-A2 Category Theory of Decision Making** 525
Hirokazu Hori (University of Yamanashi), Makoto Naruse (National Institute of Information and Communications Technology)
- C2L-A3 A Categorical Approach to Quantum Measurement** 527
Kazuya Okamura (Nagoya University)
- C2L-A4 A Perfect Transmission Tunneling Induced by Quantum Walks** 528
Kamane Matsue (Kyushu University), Leo Matsuoka (Hiroshima University), Osamu Ogurisu (Kanazawa University), Etsuo Segawa (Tohoku University)

C2L-B Special Session: Nonlinear Circuits Distributed and Coupled across Nontrivial Network Topologies 2

DATE: 2018/9/5 14:15–15:35

ROOM: Room 2

Chairs: Keiji Konishi (Osaka Prefecture University) and Tadashi Tsubone (Nagaoka University of Technology)

- C2L-B1 Synchronization Phenomena of Discrete-Time Oscillators Coupled by Comparator Elements** 530
Hiromasa Takeshita (Nagaoka University of Technology), Tadashi Tsubone (Nagaoka University of Technology)
- C2L-B2 Stability Analysis of Amplitude Death on Cartesian Product of Multiple Delayed-Coupled Stuart-Landau Oscillator Networks** 534
Takahiro Kikuchi (Ibaraki University), Yoshiki Sugitani (Ibaraki University)
- C2L-B3 Amplitude Death in Large-Scale Polygonal Oscillatory Networks** 538
Yoko Uwate (Tokushima University), Yoshifumi Nishio (Tokushima University)
- C2L-B4 Synchronization of Coupled Van der Pol Oscillators with Distributed Hub Nodes** 542

Shuhei Hashimoto (Tokushima University), Yoko Uwate (Tokushima University), Yoshifumi Nishio (Tokushima University)

C2L-B5 **Structural Evolution in Networks of Coupled Maps with Asymmetric Influence Amplification** 546

Thomas Ott (ZHAW Zurich University of Applied Sciences), Martin Schüle (ZHAW Zurich University of Applied Sciences), Harold Fellermann (Newcastle University), Yoko Uwate (Tokushima University)

C2L-C Nonlinear Circuits and Systems 2

DATE: 2018/9/5 14:15–15:35

ROOM: Room 3

Chair: Xiuqin Wei (Chiba Institute of Technology)

C2L-C1 **Design of "Bubble-Inspired Single-Electron Circuit" Mimicking Behavior of Bubble Film** 550

Nobuhiko Kurata (Yokohama National University), Takahide Oya (Yokohama National University)

C2L-C2 **A Driven Chaotic Rotating Coil** 554

Arturo Buscarino (DIEEI, University of Catania), Carlo Famoso (DIEEI, University of Catania), Luigi Fortuna (DIEEI, University of Catania), Mattia Frasca (DIEEI, University of Catania)

C2L-C3 **Turing Pattern Formation in the Simplest M-CNN** 558

Arturo Buscarino (DIEEI, University of Catania), Claudia Corradino (DIEEI, University of Catania), Luigi Fortuna (DIEEI, University of Catania), Mattia Frasca (DIEEI, University of Catania)

C2L-C4 **An Accurate Full Charge Capacity Estimation Algorithm for Primary Batteries of IoT Devices** 561

Hirofumi Shiora (Ritsumeikan University), Shuhei Matsushita (Alps Electric Co., Ltd.), Naoki Yoshida (Ritsumeikan University), Masahiro Fukui (Ritsumeikan University)

C2L-C5 **Cryptanalysis of a Chaotic Video Encryption Scheme** 565

Salih Ergün (ERGTECH Research Center)

C2L-D Special Session: Nonlinear Waves and Localizations 2

DATE: 2018/9/5 14:15–15:35

ROOM: Room 4

Chair: Yusuke Doi (Osaka University)

C2L-D1 **Bifurcation of Intrinsic Localized Modes in Perturbed Pairwise Interaction Symmetric Lattice** 569

Masayuki Kimura (Kyoto University), Yusuke Doi (Osaka University), Kazuyuki Yoshimura (Tottori University)

C2L-D2	Intersite Resistance Effect on a Saturable Nonlinear Electrical Transmission Line	571
	Kazaki Miyasaka (Kanazawa University), Akane Nishizaki (Kanazawa University), Masayuki Sato (Kanazawa University), Albert J. Sievers (Cornell University)	
C2L-D3	Velocity of Propagating Waves in Weakly Five-Coupled Bistable Oscillators	575
	Kuniyasu Shimizu (Chiba Institute of Technology), Tetsuro Endo (Meiji University)	
C2L-D4	A Numerical Study on Generating Condition of a Train of Moving ILMs by Exciting an Edge of Stretched FPU Chain with an Impurity	579
	Soichiro Tanaka (Kyoto University), Masayuki Kimura (Kyoto University), Shinji Doi (Kyoto University)	

D1L-A Special Session: Nonlinear Time Series Analysis

DATE: 2018/9/6 08:30–10:10

ROOM: Room 1

Chair: Takaya Miyano (Ritsumeikan University)

D1L-A1	Detection of Blowout in a Laboratory-Scale Gas-Turbine Model Combustor	583
	Tsubasa Kobayashi (Tokyo University of Science), Motoi Funatsu (Tokyo University of Science), Hiroshi Gotoda (Tokyo University of Science)	
D1L-A2	Dynamic Behavior of Flow Velocity Fluctuations During High-Frequency Combustion Oscillations in a Cylindrical Combustor with an Off-Center Installed Coaxial Injector	585
	Tatsuya Hashimoto (Tokyo University of Science), Hiroshi Gotoda (Tokyo University of Science), Yuya Ohmichi (Japan Aerospace Exploration Agency), Shingo Matsuyama (Japan Aerospace Exploration Agency)	
D1L-A3	Feature Pattern Extraction Using Data Synchronization from Time Series of Wind Velocity	589
	Shinya Takaramoto (Ritsumeikan University), Takaya Miyano (Ritsumeikan University)	
D1L-A4	Estimation of a Surrogate Measure for the Largest Lyapunov Exponent from the Information Entropy of Symbolic Dynamics	593
	Kazuki Kajita (Ritsumeikan University), Hiroshi Gotoda (Tokyo University of Science), Takaya Miyano (Ritsumeikan University)	
D1L-A5	Noise-Enhanced Coherence of Crystal Oscillation	597
	Kazuyoshi Ishimura (Ritsumeikan University), Shintaro Hiraoka (Ritsumeikan University), Ryota Inden (Ritsumeikan University), Isao Tokuda (Ritsumeikan University)	

D1L-B Oscillations and Synchronization

DATE: 2018/9/6 08:30–10:10

ROOM: Room 2

Chair: Kuniyasu Shimizu (Chiba Institute of Technology)

- D1L-B1 Solitary State Chimera: Appearance, Structure, and Synchronization** 601
Elena Rybalova (Saratov State University), Nadezhda Semenova (Saratov State University), Vadim Anishchenko (Saratov State University)
- D1L-B2 Synchronization of Chimera States in Two Coupled Ensembles of Nonlinear Chaotic Oscillators** 605
Andrei Bukh (Saratov State University), Galina Strelkova (Saratov State University), Vadim Anishchenko (Saratov State University)
- D1L-B3 Walking Analysis of Hexapedal Quasi-Passive Dynamic Walking Robot Focusing on Input Phase Difference and Yaw Angle** 609
Yasuhiro Sugimoto (Osaka University), Motoki Sasaki (Osaka University), Koichi Osuka (Osaka University)
- D1L-B4 Stability Analysis of Amplitude Death in Ring Coupled Stuart-Landau Oscillators with Heterogeneous Connection Delays** 613
Yuki Okigawa (Ibaraki University), Yoshiki Sugitani (Ibaraki University)
- D1L-B5 A Suitable Connection Delay in Shortcut Paths Enhances the Stability of Amplitude Death in Ring of Delay-Coupled Oscillators** 617
Yoshiki Sugitani (Ibaraki University)

D1L-C Special Session: Recent Theory and Applications Related to Multimedia Communication

DATE: 2018/9/6 08:30–10:10

ROOM: Room 3

Chair: Suk-Hwan Lee (Tongmyong University)

- D1L-C1 Segmentation of Mitochondria in Electron Microscope Images Using Deep Learning Based Feature Generation and Support Vector Machine** 621
Caleb Vununu (Pukyong National University), Oh-Heum Kwon (Pukyong National University), Kwang-Seok Moon (Pukyong National University), Chee-Yong Kim (Dong-eui University), Suk-Hwan Lee (Tongmyong University), Ki-Ryong Kwon (Pukyong National University)
- D1L-C2 Histogram Shifting Based Reversible DNA Steganography for Secure Bioinformatics** 625
Jaemin Kim (Tongmyong University), Changseok Song (Tongmyong University), Suk-Hwan Lee (Tongmyong University), Ki-Ryong Kwon (Pukyong National University)
- D1L-C3 Depth Picture Prediction Using Curved Surface Modeling** 629
Dong-Seok Lee (Dong-eui University), Kyoo-Jin Oh (Dong-eui University), Soon-Kak Kwon (Dong-eui University)

- D1L-C4** **Study on the Possibility of Cartoon Character Images Utilization in Mobile App for Foreign Language Learning : Focusing on Cartoon Character Images As Text Learning Aids** 633
 Minsuh Choi (Seoul Women's University), Hyeyoung Ko (Seoul Women's University)
- D1L-C5** **The Proposal of Studying the Optimal Ratio of Mammals to Be Used for Face Recognition Stickers** 637
 Young-Suk Lee (Dongguk University), Young-June Lim (Dongguk University)

D1L-D Communication Networks and Systems, Signal Processing and Applied Mathematics

DATE: 2018/9/6 08:30–10:10

ROOM: Room 4

Chair: Kaori Kuroda (Toyo University)

- D1L-D1** **Chaotic Encryption Applied to 10Gbps Ethernet Optical Links** 639
 Adrián Pérez-Resa (University of Zaragoza), Miguel García-Bosque (University of Zaragoza), Carlos Sánchez-Azqueta (University of Zaragoza), Santiago Celma (University of Zaragoza)
- D1L-D2** **A Multi-Encryption Scheme and its Application to Improve the Random Properties of a Chaos-Based Stream Cipher** 643
 Miguel Garcia-Bosque (University of Zaragoza), Adrián Pérez-Resa (University of Zaragoza), Carlos Sánchez-Azqueta (University of Zaragoza), Concepción Aldea (University of Zaragoza), Santiago Celma (University of Zaragoza)
- D1L-D3** **Image-to-Sound Transformation Using Image Inpainting Technique** 647
 Yuya Hosoda (Osaka University), Arata Kawamura (Osaka University), Youji Iiguni (Osaka University)
- D1L-D4** **Improvement of Sinc-Nyström Methods for Initial Value Problems** 651
 Ryota Hara (Hiroshima City University), Tomoaki Okayama (Hiroshima City University)
- D1L-D5** **A New Definition of Saddle Value Set and Classifications of Objective Functions in Continuous Optimization Problems** 655
 Hideo Kanemitsu (Hokkaido University of Education)

D2L-A Special Session: Theory and Implementation of Neuromorphic Systems

DATE: 2018/9/6 10:25–12:05

ROOM: Room 1

Chairs: Takashi Kohno (University of Tokyo) and Shintaro Arai (Okayama University of Science)

- D2L-A1** **Demonstration of Artificial Neural Network Computation Based on Coupled Nano-Scale Oscillators** 659

Hiroko Arai (National Institute of Advanced Industrial Science and Technology), Hiroshi Imamura (National Institute of Advanced Industrial Science and Technology)

D2L-A2 Motion Stereo Vision LSI for Spatial Perception 663

Hisanao Akima (Tohoku University), Shota Kurihara (Tohoku University), Satoshi Moriya (Tohoku University), Susumu Kawakami (Tohoku University), Jordi Madrenas (Universitat Politècnica de Catalunya), Masafumi Yano (Tohoku University), Koji Nakajima (Tohoku University), Masao Sakuraba (Tohoku University), Shigeo Sato (Tohoku University)

D2L-A3 Analog Spintronics Device for Artificial Neural Networks 664

Shunsuke Fukami (Tohoku University), William Borders (Tohoku University), Aleksandr Kurenkov (Tohoku University), Chaoliang Zhang (Tohoku University), Samik Duttagupta (Tohoku University), Hideo Ohno (Tohoku University)

D2L-A4 Noise-Driven Stochastic Bistable Circuits for Brain-Morphic Systems 666

Yusuke Sakemi (University of Tokyo), Seiji Uenohara (University of Tokyo), Kazuyuki Aihara (University of Tokyo), Takashi Kohno (University of Tokyo)

D2L-A5 Modeling Primary Neurons in Drosophila Auditory System 670

Takuya Nanami (University of Tokyo), Azusa Kamikouchi (Nagoya University), Takashi Kohno (University of Tokyo)

D2L-B Special Session: Recent Theory and Applications Related to Communication Quality

DATE: 2018/9/6 10:25–12:05

ROOM: Room 2

Chair: Kenko Ota (Nippon Institute of Technology)

D2L-B1 Digital Watermarking Method Using Comb-Like Histogram Shift for Audio Tamper Detection 674

Yuya Nakayama (Nippon Institute of Technology), Masanori Kimoto (Nippon Institute of Technology)

D2L-B2 Experimental Testbed for Massive MIMO at 19 GHz Band -Measurement Results and Propagation Modeling - 678

Ryotaro Taniguchi (Niigata University), Kentaro Nishimori (Niigata University), Takefumi Hiraguri (Nippon Institute of Technology), Shigeki Morisawa (RFtestLab), Jiro Hirokawa (Tokyo Institute of Technology)

D2L-B3 A Dynamic Base Station Switching Scheme Using Change-Point Detection in Heterogeneous Networks 681

Eigo Matsuyama (Osaka University), Takahiro Matsuda (Tokyo Metropolitan University), Tetsuya Takine (Osaka University)

D2L-B4 A Study on Multiple-Transmission-Rate Scheme Using SVC and QoE Control Suitable for Multicast Distribution in WLAN Systems 685

Isamu Shitara (Nippon Institute of Technology), Yoshiaki Morino (Nippon Institute of Technology), Takefumi Hiraguri (Nippon Institute of Technology), Kentaro Nishimori (Niigata University)

D2L-B5 A Study on the Relationship Between QoE and Perceived Emotion 689

Kenko Ota (Nippon Institute of Technology), Takefumi Hiraguri (Nippon Institute of Technology), Hideaki Yoshino (Nippon Institute of Technology)

D2L-C Special Session: Noise-Driven and Stochastic Information Sensing and Processing Systems

DATE: 2018/9/6 10:25–12:05

ROOM: Room 3

Chairs: Yukihiro Tadokoro (Toyota Central Research and Development Labs., Inc.) and Shintaro Arai (Okayama University of Science)

D2L-C1 Noise-Harnessing Nanodevices 693

Takahide Oya (Yokohama National University)

D2L-C2 Use of Room-Temperature Molecular Noise Improves Signal Detection in Single Walled Carbon Nanotube Device 697

Megumi Akai-Kasaya (Osaka University)

D2L-C3 Stochastic Resonance in Field Emission Current on Carbon Nanotube 698

Yukihiro Tadokoro (Toyota Central R&D Labs., Inc.), Keita Funayama (Toyota Central R&D Labs., Inc.), Hiroya Tanaka (Toyota Central R&D Labs., Inc.)

D2L-C4 User-Adaptive Surface Myoelectric Signal Detection System Using Nonlinear Device Network 701

Kazuki Inada (Hokkaido University), Kouichi Tajima (Hokkaido University), Seiya Kasai (Hokkaido University)

D2L-C5 Detectability Enhancement Using Interference Signals in Wireless Communication Systems 705

Shintaro Hiraoka (Nagoya University), Yasuo Nakashima (Nagoya University), Takaya Yamazato (Nagoya University), Shintaro Arai (Okayama University of Science), Yukihiro Tadokoro (Toyota Central R&D Labs., Inc.), Hiroya Tanaka (Toyota Central R&D Labs., Inc.)

Author Index

A

Adachi, Masaharu: **243**, [B1L-B5](#)(xxx)
Aida, Masaki: **172**, [A3L-C1](#)(xxviii), **176**,
[A3L-C2](#)(xxviii), **180**, [A3L-C3](#)(xxviii), **184**,
[A3L-C4](#)(xxviii), **188**, [A3L-C5](#)(xxviii)
Aihara, Kazuyuki: **472**, [C1L-A5](#)(xxxix), **495**,
[C1L-C2](#)(xl), **666**, [D2L-A4](#)(xlvi)
Aiura, Hiroshi: **375**, [B3L-C1](#)(xxxv)
Akai-Kasaya, Megumi: **697**, [D2L-C2](#)(xlviii)
Akatsuka, Yoshino: **46**, [A1L-B6](#)(xxii)
Akima, Hisanao: **663**, [D2L-A2](#)(xlvi)
Aldea, Concepción: **643**, [D1L-D2](#)(xlv)
Amador, Andres: **335**, [B2L-D2](#)(xxxiv)
Ando, Hiroyasu: **84**, [A1L-D5](#)(xxiv), **122**,
[A2L-C2](#)(xxv), **464**, [C1L-A3](#)(xxxviii)
Ando, Kaito: **503**, [C1L-C4](#)(xl)
Ando, Takahisa: **110**, [A2L-B2](#)(xxv)
Andreoli, Louis: **205**, [B1L-A1](#)(xxix)
Angulo, David: **387**, [B3L-D1](#)(xxxvi)
Angulo, Fabiola: **387**, [B3L-D1](#)(xxxvi)
Anishchenko, Vadim: **601**, [D1L-B1](#)(xliv), **605**,
[D1L-B2](#)(xliv)
Antonik, Piotr: **151**, [A3L-A2](#)(xxvii), **152**,
[A3L-A3](#)(xxvii), **153**, [A3L-A4](#)(xxvii)
Aoki, Toshichika: **69**, [A1L-C6](#)(xxiii)
Aomori, Hisashi: **140**, [A2L-D3](#)(xxvi), **419**,
[B4L-B1](#)(xxxvii), **428**, [B4L-B4](#)(xxxvii)
Arai, Hayate: **359**, [B3L-B1](#)(xxxv)
Arai, Hiroko: **659**, [D2L-A1](#)(xlv)
Arai, Kenichi: **154**, [A3L-A5](#)(xxvii)
Arai, Shintaro: **705**, [D2L-C5](#)(xlvii)
Archilla, Juan Rodríguez: **513**, [C1L-D2](#)(xl), **515**,
[C1L-D4](#)(xl)
Asahara, Hiroyuki: **65**, [A1L-C5](#)(xxiii)
Avrutin, Viktor: **332**, [B2L-D1](#)(xxxiii), **399**,
[B3L-D4](#)(xxxvi)

B

Bachelier, Guillaume: **209**, [B1L-A2](#)(xxix)
Baek, Seongcheol: **464**, [C1L-A3](#)(xxxviii)

Banerjee, Soumitro: **204**, [B0L-AA1](#)(xxix), **239**,
[B1L-B4](#)(xxx)
Barreto, Ernest: **128**, [A2L-C5](#)(xxvi)
Benadero, Luis: **395**, [B3L-D3](#)(xxxvi)
Borders, William: **664**, [D2L-A3](#)(xlvi)
Boudjana, Said: **54**, [A1L-C2](#)(xxiii)
Boulanger, Benoît: **209**, [B1L-A2](#)(xxix)
Brünner, Daniel: **151**, [A3L-A2](#)(xxvii), **205**,
[B1L-A1](#)(xxix), **415**, [B4L-A5](#)(xxxvi)
Bueno, Julian: **415**, [B4L-A5](#)(xxxvi)
Bukh, Andrei: **605**, [D1L-B2](#)(xliv)
Bunsen, Masatoshi: **156**, [A3L-A6](#)(xxvii)
Buscarino, Arturo: **554**, [C2L-C2](#)(xlii), **558**,
[C2L-C3](#)(xlii)
Bushuev, Dmitry: **332**, [B2L-D1](#)(xxxiii)

C

Calandrini, Guillermo Luis: **231**, [B1L-B2](#)(xxx)
Celma, Santiago: **639**, [D1L-D1](#)(xlv), **643**,
[D1L-D2](#)(xlv)
Chan, Sze-Chun: **9**, [A1L-A2](#)(xxi)
Chauvet, Nicolas: **209**, [B1L-A2](#)(xxix)
Cho, Seung-Il: **27**, [A1L-B1](#)(xxii), **38**, [A1L-B4](#)(xxii)
Choi, Daeyoung: **21**, [A1L-A5](#)(xxi), **50**, [A1L-C1](#)(xxiii)
Choi, Minsuh: **633**, [D1L-C4](#)(xlv)
Cid-Pastor, Angel: **316**, [B2L-C2](#)(xxxiii)
Citrin, David S.: **21**, [A1L-A5](#)(xxi), **50**, [A1L-C1](#)(xxiii)
Colet, Pere: **5**, [A1L-A1](#)(xxi)
Corradino, Claudia: **558**, [C2L-C3](#)(xlii)

D

Doi, Shinji: **300**, [B2L-B2](#)(xxxii), **579**, [C2L-D4](#)(xliii)
Doi, Yusuke: **511**, [C1L-D1](#)(xl), **513**, [C1L-D2](#)(xl), **517**,
[C1L-D5](#)(xl), **569**, [C2L-D1](#)(xlii)
Dominguez-Pumar, Manuel: **275**, [B1L-D4](#)(xxxix)
Drezet, Aurélien: **209**, [B1L-A2](#)(xxix)
Duttgupta, Samik: **664**, [D2L-A3](#)(xlvi)

E

Ebisawa, Satoshi: **17**, [A1L-A4](#)(xxi)

El Aroudi, Abdelali: **239**, B1L-B4(xxx), **251**,
B1L-C1(xxxi), **316**, B2L-C2(xxxiii), **395**,
B3L-D3(xxxvi), **399**, B3L-D4(xxxvi)
Endo, Tetsuro: **227**, B1L-B1(xxx), **575**, C2L-D3(xliii)
Ergün, Salih: **565**, C2L-C5(xlii)
Erneux, Thomas: **25**, A1L-A6(xxii)
Esaki, Sosuke: **363**, B3L-B2(xxxv)

F

Famoso, Carlo: **554**, C2L-C2(xlii)
Fellermann, Harold: **546**, C2L-B5(xlii)
Fischer, Ingo: **5**, A1L-A1(xxi), **408**, B4L-A3(xxxvi),
415, B4L-A5(xxxvi)
Florez, Frank: **391**, B3L-D2(xxxvi)
Fortuna, Luigi: **554**, C2L-C2(xlii), **558**, C2L-C3(xlii)
Frasca, Mattia: **554**, C2L-C2(xlii), **558**, C2L-C3(xlii)
Froehly, Luc: **415**, B4L-A5(xxxvi)
Fujii, Naoaki: **79**, A1L-D3(xxiv)
Fujimoto, Ken'Ichi: **132**, A2L-D1(xxvi)
Fujisaka, Hisato: **296**, B2L-B1(xxxii), **367**,
B3L-B3(xxxv), **371**, B3L-B4(xxxv), **444**,
B4L-D2(xxxviii)
Fujita, Misa: **61**, A1L-C4(xxiii)
Fujita, Tomohiro: **363**, B3L-B2(xxxv)
Fujiwara, Kantaro: **61**, A1L-C4(xxiii), **164**,
A3L-B2(xxvii), **430**, B4L-C1(xxxvii), **434**,
B4L-C2(xxxvii)
Fujiwara, Naoya: **123**, A2L-C3(xxv)
Fukami, Shunsuke: **664**, D2L-A3(xlvi)
Fukui, Masahiro: **561**, C2L-C4(xlii)
Fukushima, Kunihiko: **1**, A0L-AA1(xxi)
Fukushima, Masaru: **296**, B2L-B1(xxxii)
Funatsu, Motoi: **583**, D1L-A1(xliii)
Funayama, Keita: **698**, D2L-C3(xlvii)

G

García Raffi, Luis Miguel: **515**, C1L-D4(xl)
García-Bosque, Miguel: **639**, D1L-D1(xlv)
García-Bosque, Miguel: **643**, D1L-D2(xlv)
Gentile, Franco Sebastian: **231**, B1L-B2(xxx), **235**,
B1L-B3(xxx)
Ghribi, Djamila: **54**, A1L-C2(xxiii)
Giaouris, Damian: **239**, B1L-B4(xxx)
Gkizas, Georgios: **239**, B1L-B4(xxx)
Goto, Yoshitomo: **93**, A2L-A2(xxiv)
Gotoda, Hiroshi: **583**, D1L-A1(xliii), **585**,
D1L-A2(xliii), **593**, D1L-A4(xliii)
Gouda, Siori: **101**, A2L-A4(xxiv)
Gulina, Marvyn: **153**, A3L-A4(xxvii)

H

Haelterman, Marc: **152**, A3L-A3(xxvii), **153**,
A3L-A4(xxvii)
Hara, Naoyuki: **263**, B1L-C4(xxxi), **308**,
B2L-B4(xxxiii), **487**, C1L-B5(xxxix)
Hara, Ryota: **651**, D1L-D4(xlv)
Harada, Tomochika: **27**, A1L-B1(xxii), **31**,
A1L-B2(xxii), **34**, A1L-B3(xxii), **38**,
A1L-B4(xxii)
Haroun, Reham: **316**, B2L-C2(xxxiii)
Hasegawa, Mikio: **86**, A1L-D6(xxiv), **472**,
C1L-A5(xxxix)
Hashimoto, Shuhei: **542**, C2L-B4(xli)
Hashimoto, Tatsuya: **585**, D1L-A2(xliii)
Hayakawa, Shota: **371**, B3L-B4(xxxv)
Hidai, Shinya: **468**, C1L-A4(xxxix)
Hikihara, Takashi: **73**, A1L-D1(xxiii), **79**,
A1L-D3(xxiv), **84**, A1L-D5(xxiv), **464**,
C1L-A3(xxxviii), **491**, C1L-C1(xl)
Hiraguri, Takefumi: **288**, B2L-A3(xxxii), **678**,
D2L-B2(xlvi), **685**, D2L-B4(xlvi), **689**,
D2L-B5(xlvii)
Hirakura, Naoki: **180**, A3L-C3(xxviii)
Hiraoka, Shintaro: **597**, D1L-A5(xliiii), **705**,
D2L-C5(xlvii)
Hirata, Mitsuo: **124**, A2L-C4(xxvi)
Hirokawa, Jiro: **678**, D2L-B2(xlvi)
Homma, Ryutaro: **211**, B1L-A3(xxix)
Hori, Hirokazu: **209**, B1L-A2(xxix), **525**,
C2L-A2(xli)
Hori, Toshimasa: **106**, A2L-B1(xxv)
Horikawa, Yo: **132**, A2L-D1(xxvi)
Hosoda, Yuya: **647**, D1L-D3(xlv)
Huant, Serge: **209**, B1L-A2(xxix)

I

Ichikawa, Ikumi: **448**, B4L-D3(xxxviii)
Iida, Tsutomu: **65**, A1L-C5(xxiii)
Iiguni, Youji: **647**, D1L-D3(xlv)
Ikeda, Yoshiaki: **404**, B4L-A2(xxxvi)
Ikeguchi, Tohru: **61**, A1L-C4(xxiii), **164**,
A3L-B2(xxvii), **430**, B4L-C1(xxxvii), **434**,
B4L-C2(xxxvii)
Ikushima, Keisuke: **106**, A2L-B1(xxv)
Ikuta, Chihiro: **160**, A3L-B1(xxvii)
Imai, Tetsuo: **42**, A1L-B5(xxii)
Imamura, Hiroshi: **659**, D2L-A1(xlv)
Inaba, Naohiko: **227**, B1L-B1(xxx)
Inada, Kazuki: **701**, D2L-C4(xlvii)

Inden, Ryota: **597**, [D1L-A5\(xliii\)](#)
 Inoshi, Rikutarō: **300**, [B2L-B2\(xxxii\)](#)
 Inoue, Katsuma: **147**, [A3L-A1\(xxvii\)](#), **412**,
 [B4L-A4\(xxxvi\)](#)
 Inubushi, Masanobu: **400**, [B4L-A1\(xxxvi\)](#), **404**,
 [B4L-A2\(xxxvi\)](#)
 Ishida, Kenji: **456**, [C1L-A1\(xxxviii\)](#)
 Ishihara, Taiki: **17**, [A1L-A4\(xxi\)](#)
 Ishimura, Kazuyoshi: **597**, [D1L-A5\(xliiii\)](#)
 Isoshima, Takashi: **97**, [A2L-A3\(xxiv\)](#)
 Ito, Hirotake: **472**, [C1L-A5\(xxxix\)](#)
 Itoh, Susumu: **428**, [B4L-B4\(xxxvii\)](#)
 Itoh, Yoshitaka: **243**, [B1L-B5\(xxx\)](#)
 Itovich, Griselda Ruth: **231**, [B1L-B2\(xxx\)](#), **235**,
 [B1L-B3\(xxx\)](#)
 Iwamoto, Tetsu: **487**, [C1L-B5\(xxxix\)](#)
 Iwao, Kazuyuki: **101**, [A2L-A4\(xxiv\)](#)
 Izumikawa, Yosuke: **456**, [C1L-A1\(xxxviii\)](#)

J

Jacquot, Maxime: **205**, [B1L-A1\(xxix\)](#), **415**,
 [B4L-A5\(xxxvi\)](#)
 Jeffrey, Mike: **274**, [B1L-D3\(xxxi\)](#)
 Jegouso, David: **209**, [B1L-A2\(xxix\)](#)
 Jiménez, Noé: **515**, [C1L-D4\(xl\)](#)
 Jin'no, Kenya: **288**, [B2L-A3\(xxxii\)](#), **292**,
 [B2L-A4\(xxxii\)](#)
 Jordan, Joanna: **267**, [B1L-D1\(xxxi\)](#)

K

Kai, Tatsuya: **423**, [B4L-B2\(xxxvii\)](#)
 Kajita, Kazuki: **593**, [D1L-A4\(xliiii\)](#)
 Kameda, Tomoya: **106**, [A2L-B1\(xxv\)](#)
 Kamei, Daito: **460**, [C1L-A2\(xxxviii\)](#)
 Kamikouchi, Azusa: **670**, [D2L-A5\(xlvi\)](#)
 Kamio, Takeshi: **367**, [B3L-B3\(xxxv\)](#), **371**,
 [B3L-B4\(xxxv\)](#), **444**, [B4L-D2\(xxxviii\)](#)
 Kanamaru, Shiki: **430**, [B4L-C1\(xxxvii\)](#)
 Kanemitsu, Hideo: **655**, [D1L-D5\(xlv\)](#)
 Kanno, Kazutaka: **156**, [A3L-A6\(xxvii\)](#), **215**,
 [B1L-A4\(xxx\)](#), **219**, [B1L-A5\(xxx\)](#), **400**,
 [B4L-A1\(xxxvi\)](#)
 Kanzaki, Hirotaka: **503**, [C1L-C4\(xl\)](#)
 Kasa, Nobuyuki: **65**, [A1L-C5\(xxiii\)](#)
 Kasai, Seiya: **701**, [D2L-C4\(xlvii\)](#)
 Kato, Hideyuki: **69**, [A1L-C6\(xxiii\)](#), **355**,
 [B3L-A4\(xxxiv\)](#)
 Kawaguchi, Takayasu: **42**, [A1L-B5\(xxii\)](#)
 Kawai, Yuki: **140**, [A2L-D3\(xxvi\)](#)

Kawakami, Hiroshi: **247**, [B1L-B6\(xxx\)](#)
 Kawakami, Susumu: **663**, [D2L-A2\(xlvi\)](#)
 Kawamura, Arata: **647**, [D1L-D3\(xlv\)](#)
 Kikuchi, Takahiro: **534**, [C2L-B2\(xli\)](#)
 Kim, Chee-Yong: **621**, [D1L-C1\(xliv\)](#)
 Kim, Jaemin: **625**, [D1L-C2\(xliv\)](#)
 Kimoto, Masanori: **674**, [D2L-B1\(xlvi\)](#)
 Kimura, Masashi: **143**, [A2L-D4\(xxvi\)](#)
 Kimura, Masayuki: **513**, [C1L-D2\(xl\)](#), **569**,
 [C2L-D1\(xlii\)](#), **579**, [C2L-D4\(xliiii\)](#)
 Kimura, Mutsumi: **106**, [A2L-B1\(xxv\)](#), **114**,
 [A2L-B3\(xxv\)](#)
 Kimura, Takayuki: **61**, [A1L-C4\(xxiii\)](#), **69**,
 [A1L-C6\(xxiii\)](#), **168**, [A3L-B3\(xxviii\)](#)
 Kinokiri, Akira: **143**, [A2L-D4\(xxvi\)](#)
 Kinoshita, Wataru: **355**, [B3L-A4\(xxxiv\)](#)
 Kishibata, Toshihiro: **101**, [A2L-A4\(xxiv\)](#)
 Kitajima, Hiroyuki: **132**, [A2L-D1\(xxvi\)](#)
 Ko, Hyeyoung: **633**, [D1L-C4\(xlv\)](#)
 Kobayashi, Miki: **122**, [A2L-C2\(xxv\)](#)
 Kobayashi, Toshihiro: **164**, [A3L-B2\(xxvii\)](#)
 Kobayashi, Tsubasa: **583**, [D1L-A1\(xliiii\)](#)
 Kochi, Satoshi: **211**, [B1L-A3\(xxix\)](#)
 Kogahara, Takayuki: **404**, [B4L-A2\(xxxvi\)](#)
 Kohmoto, Keiko: **58**, [A1L-C3\(xxiii\)](#)
 Kohno, Hiromasa: **132**, [A2L-D1\(xxvi\)](#)
 Kohno, Takashi: **666**, [D2L-A4\(xlvi\)](#), **670**,
 [D2L-A5\(xlvi\)](#)
 Kojima, Takeshi: **136**, [A2L-D2\(xxvi\)](#), **143**,
 [A2L-D4\(xxvi\)](#), **192**, [A3L-D1\(xxviii\)](#), **200**,
 [A3L-D3\(xxix\)](#)
 Konishi, Keiji: **263**, [B1L-C4\(xxxi\)](#), **308**,
 [B2L-B4\(xxxiii\)](#), **487**, [C1L-B5\(xxxix\)](#)
 Kousaka, Takuji: **65**, [A1L-C5\(xxiii\)](#), **355**,
 [B3L-A4\(xxxiv\)](#)
 Kowalski, Lukasz: **275**, [B1L-D4\(xxxi\)](#)
 Kubo, Takahiro: **184**, [A3L-C4\(xxviii\)](#)
 Kumaki, Takeshi: **363**, [B3L-B2\(xxxv\)](#)
 Kunii, Yusuke: **507**, [C1L-C5\(xl\)](#)
 Kuniyoshi, Yasuo: **147**, [A3L-A1\(xxvii\)](#), **412**,
 [B4L-A4\(xxxvi\)](#)
 Kurata, Nobuhiko: **550**, [C2L-C1\(xlii\)](#)
 Kurenkov, Aleksandr: **664**, [D2L-A3\(xlvi\)](#)
 Kurihara, Kazuyoshi: **101**, [A2L-A4\(xxiv\)](#)
 Kurihara, Shota: **663**, [D2L-A2\(xlvi\)](#)
 Kuroda, Kaori: **472**, [C1L-A5\(xxxix\)](#)
 Kurokawa, Hiroaki: **355**, [B3L-A4\(xxxiv\)](#)
 Kuwashima, Fumiyoshi: **58**, [A1L-C3\(xxiii\)](#), **90**,
 [A2L-A1\(xxiv\)](#), **101**, [A2L-A4\(xxiv\)](#)

Kwon, Ki-Ryong: **621**, **D1L-C1(xliv)**, **625**,
D1L-C2(xliv)
Kwon, Oh-Heum: **621**, **D1L-C1(xliv)**
Kwon, Soon-Kak: **629**, **D1L-C3(xliv)**

L

Larger, Laurent: **205**, **B1L-A1(xxix)**, **415**,
B4L-A5(xxxvi)
Lee, Dong-Seok: **629**, **D1L-C3(xliv)**
Lee, Suk-Hwan: **621**, **D1L-C1(xliv)**, **625**,
D1L-C2(xliv)
Lee, Young-Suk: **637**, **D1L-C5(xlv)**
Li, Nianqiang: **50**, **A1L-C1(xxiii)**
Li, Song-Sui: **9**, **A1L-A2(xxi)**
Lim, Young-June: **637**, **D1L-C5(xlv)**
Llobet, Eduard: **275**, **B1L-D4(xxxi)**
Locquet, Alexandre: **21**, **A1L-A5(xxi)**, **50**,
A1L-C1(xxiii)

M

Madrenas, Jordi: **663**, **D2L-A2(xlvi)**
Magret, M. Dolors: **320**, **B2L-C3(xxxiii)**
Maktoobi, Sheler: **415**, **B4L-A5(xxxvi)**
Mandal, Kuntal: **239**, **B1L-B4(xxx)**
Marsal, Nicolas: **151**, **A3L-A2(xxvii)**
Martínez-Salamero, Luis: **251**, **B1L-C1(xxxi)**, **316**,
B2L-C2(xxxiii), **395**, **B3L-D3(xxxvi)**
Martinez-Llinas, Jade: **5**, **A1L-A1(xxi)**
Martinez-Treviño, Blanca: **251**, **B1L-C1(xxxi)**
Masamura, Shinnosuke: **487**, **C1L-B5(xxxix)**
Masoller, Cristina: **13**, **A1L-A3(xxi)**, **304**,
B2L-B3(xxxiii), **438**, **B4L-C3(xxxvii)**
Massana, Immaculada: **279**, **B1L-D5(xxxii)**
Massar, Serge: **152**, **A3L-A3(xxvii)**, **153**,
A3L-A4(xxvii)
Matsubara, Takashi: **452**, **B4L-D4(xxxviii)**
Matsuda, Ichiro: **428**, **B4L-B4(xxxvii)**
Matsuda, Takahiro: **681**, **D2L-B3(xlvi)**
Matsuda, Tokiyoshi: **106**, **A2L-B1(xxv)**
Matsuda, Toshiyuki: **86**, **A1L-D6(xxiv)**
Matsue, Kamane: **528**, **C2L-A4(xli)**
Matsuoka, Leo: **528**, **C2L-A4(xli)**
Matsushita, Haruna: **355**, **B3L-A4(xxxiv)**
Matsushita, Shuhei: **561**, **C2L-C4(xlii)**
Matsuura, Keita: **296**, **B2L-B1(xxxii)**
Matsuura, Takafumi: **69**, **A1L-C6(xxiii)**, **168**,
A3L-B3(xxviii)
Matsuyama, Eigo: **681**, **D2L-B3(xlvi)**
Matsuyama, Shingo: **585**, **D1L-A2(xliii)**

Mehrem, Ahmed: **515**, **C1L-D4(xl)**
Mihana, Takatomo: **215**, **B1L-A4(xxx)**, **219**,
B1L-A5(xxx)
Miino, Yuu: **247**, **B1L-B6(xxx)**
Mikuni, Yoshitaka: **34**, **A1L-B3(xxii)**
Minami, Yuki: **312**, **B2L-C1(xxxiii)**
Mitsubori, Kunihiko: **444**, **B4L-D2(xxxviii)**
Mitsui, Yusuke: **215**, **B1L-A4(xxx)**, **219**,
B1L-A5(xxx)
Miura, Yoshiaki: **456**, **C1L-A1(xxxviii)**
Miyamura, Keisuke: **103**, **A2L-A5(xxv)**
Miyano, Takaya: **589**, **D1L-A3(xliii)**, **593**,
D1L-A4(xliii)
Miyasaka, Kazaki: **571**, **C2L-D2(xliii)**
Miyachi, Arata: **343**, **B3L-A1(xxxiv)**, **347**,
B3L-A2(xxxiv), **468**, **C1L-A4(xxxix)**
Mizutani, Ryohei: **140**, **A2L-D3(xxvi)**
Moiola, Jorge Luis: **231**, **B1L-B2(xxx)**, **235**,
B1L-B3(xxx)
Monge, Oscar: **275**, **B1L-D4(xxxi)**
Moon, Kwang-Seok: **621**, **D1L-C1(xliv)**
Mori, Michiko: **200**, **A3L-D3(xxix)**
Morino, Yoshiaki: **685**, **D2L-B4(xlvi)**
Morisawa, Shigeki: **678**, **D2L-B2(xlvi)**
Morita, Akira: **196**, **A3L-D2(xxix)**
Moriya, Satoshi: **663**, **D2L-A2(xlvi)**
Murai, Kazunari: **196**, **A3L-D2(xxix)**
Murakami, Takeshi: **46**, **A1L-B6(xxii)**
Murase, Tutomu: **456**, **C1L-A1(xxxviii)**
Murata, Masayuki: **172**, **A3L-C1(xxviii)**
Murata, Yukio: **472**, **C1L-A5(xxxix)**

N

Nagao, Kazuki: **284**, **B2L-A2(xxxii)**
Nagasawa, Yuto: **404**, **B4L-A2(xxxvi)**
Nagatani, Kouichi: **176**, **A3L-C2(xxviii)**
Nagaya, Tomoyuki: **93**, **A2L-A2(xxiv)**
Nakada, Ryosei: **192**, **A3L-D1(xxviii)**
Nakaguchi, Toshiya: **196**, **A3L-D2(xxix)**
Nakajima, Kohei: **147**, **A3L-A1(xxvii)**, **412**,
B4L-A4(xxxvi)
Nakajima, Koji: **663**, **D2L-A2(xlvi)**
Nakanishi, Daisuke: **328**, **B2L-C5(xxxiii)**
Nakanishi, Kazuma: **324**, **B2L-C4(xxxiii)**
Nakano, Hidehiro: **343**, **B3L-A1(xxxiv)**, **347**,
B3L-A2(xxxiv), **468**, **C1L-A4(xxxix)**
Nakaoka, Shinji: **118**, **A2L-C1(xxv)**
Nakashima, Yasuhiko: **106**, **A2L-B1(xxv)**, **114**,
A2L-B3(xxv)

Nakashima, Yasuo: **705**, [D2L-C5\(xlvii\)](#)
Nakatani, Akihiro: **511**, [C1L-D1\(xl\)](#), **517**, [C1L-D5\(xl\)](#)
Nakayama, Yuya: **674**, [D2L-B1\(xlvi\)](#)
Namiki, Takao: **196**, [A3L-D2\(xxix\)](#)
Nanami, Takuya: **670**, [D2L-A5\(xlvi\)](#)
Nariai, Daiki: **483**, [C1L-B4\(xxxix\)](#)
Naruse, Makoto: **209**, [B1L-A2\(xxix\)](#), **211**,
[B1L-A3\(xxix\)](#), **215**, [B1L-A4\(xxx\)](#), **525**,
[C2L-A2\(xli\)](#)
Navarrete, Eric: **275**, [B1L-D4\(xxxi\)](#)
Nawata, Shinya: **79**, [A1L-D3\(xxiv\)](#)
Nguimdo, Romain Modeste: **25**, [A1L-A6\(xxii\)](#)
Niiyama, Tomoaki: **103**, [A2L-A5\(xxv\)](#), **211**,
[B1L-A3\(xxix\)](#)
Nimura, Teruto: **363**, [B3L-B2\(xxxv\)](#)
Nishida, Yasuyuki: **80**, [A1L-D4\(xxiv\)](#)
Nishimori, Kentaro: **678**, [D2L-B2\(xlvi\)](#), **685**,
[D2L-B4\(xlvi\)](#)
Nishimura, Haruhiko: **375**, [B3L-C1\(xxxv\)](#)
Nishimura, Yuki: **255**, [B1L-C2\(xxxi\)](#)
Nishio, Yoshifumi: **110**, [A2L-B2\(xxv\)](#), **284**,
[B2L-A2\(xxxii\)](#), **483**, [C1L-B4\(xxxix\)](#), **538**,
[C2L-B3\(xli\)](#), **542**, [C2L-B4\(xli\)](#)
Nishizaki, Akane: **571**, [C2L-D2\(xliii\)](#)
Nobukawa, Sou: **375**, [B3L-C1\(xxxv\)](#)
Nose, Fumiaki: **328**, [B2L-C5\(xxxiii\)](#)

O

Obata, Hiroyasu: **456**, [C1L-A1\(xxxviii\)](#)
Obinata, Natsumi: **499**, [C1L-C3\(xl\)](#)
Ogawa, Katsuhiko: **227**, [B1L-B1\(xxx\)](#)
Ogura, Takeshi: **363**, [B3L-B2\(xxxv\)](#)
Ogurusu, Osamu: **528**, [C2L-A4\(xli\)](#)
Oh, Kyoo-Jin: **629**, [D1L-C3\(xlvi\)](#)
Ohmichi, Yuya: **585**, [D1L-A2\(xliii\)](#)
Ohno, Hideo: **664**, [D2L-A3\(xlvi\)](#)
Ohtagaki, H.: **65**, [A1L-C5\(xxiii\)](#)
Okamura, Kazuya: **527**, [C2L-A3\(xli\)](#)
Okayama, Tomoaki: **651**, [D1L-D4\(xlv\)](#)
Okigawa, Yuki: **613**, [D1L-B4\(xliv\)](#)
Okitsu, Satonao: **351**, [B3L-A3\(xxxiv\)](#)
Olalla, Carlos: **395**, [B3L-D3\(xxxvi\)](#)
Olivar, Gerard: **279**, [B1L-D5\(xxxii\)](#), **339**,
[B2L-D3\(xxxiv\)](#), **387**, [B3L-D1\(xxxvi\)](#), **391**,
[B3L-D2\(xxxvi\)](#)
Olm, Josep Maria: **275**, [B1L-D4\(xxxi\)](#)
Omika, Masato: **343**, [B3L-A1\(xxxiv\)](#)
Orihara, Hiroshi: **93**, [A2L-A2\(xxiv\)](#)
Osorio, Gustavo: **387**, [B3L-D1\(xxxvi\)](#)

Ospina Aguirre, Carolina: **339**, [B2L-D3\(xxxiv\)](#)
Osuka, Koichi: **324**, [B2L-C4\(xxxiii\)](#), **328**,
[B2L-C5\(xxxiii\)](#), **609**, [D1L-B3\(xliv\)](#)
Ota, Kenko: **689**, [D2L-B5\(xlvii\)](#)
Otake, Tsuyoshi: **419**, [B4L-B1\(xxxvii\)](#), **428**,
[B4L-B4\(xxxvii\)](#)
Otake, Tsuyosi: **140**, [A2L-D3\(xxvi\)](#)
Ott, Thomas: **481**, [C1L-B3\(xxxix\)](#), **546**, [C2L-B5\(xlii\)](#)
Oya, Takahide: **550**, [C2L-C1\(xlii\)](#), **693**,
[D2L-C1\(xlvii\)](#)
Ozawa, Takahiro: **476**, [C1L-B1\(xxxix\)](#)

P

Pérez-Resa, Adrián: **639**, [D1L-D1\(xlv\)](#), **643**,
[D1L-D2\(xlv\)](#)
Panozzo, Mattia: **13**, [A1L-A3\(xxi\)](#)
Pauwels, Jaël: **153**, [A3L-A4\(xxvii\)](#)
Pflüger, Moritz: **5**, [A1L-A1\(xxi\)](#)
Pickert, Volker: **239**, [B1L-B4\(xxx\)](#)
Piironen, Petri: **267**, [B1L-D1\(xxxi\)](#), **270**,
[B1L-D2\(xxxi\)](#)
Ponce, Enrique: **335**, [B2L-D2\(xxxiv\)](#), **395**,
[B3L-D3\(xxxvi\)](#)
Pons-Nin, Joan: **275**, [B1L-D4\(xxxi\)](#)
Porte, Xavier: **5**, [A1L-A1\(xxi\)](#)
Prat, Joana D'Arc: **279**, [B1L-D5\(xxxii\)](#)

Q

Quintero-Quiroz, Carlos: **13**, [A1L-A3\(xxi\)](#), **304**,
[B2L-B3\(xxxiii\)](#)

R

Rai, Sakura: **164**, [A3L-B2\(xxvii\)](#)
Riaza, Ricardo: **379**, [B3L-C2\(xxxv\)](#), **383**,
[B3L-C3\(xxxv\)](#)
Rodriguez Ramirez, Juan Esteban: **312**,
[B2L-C1\(xxxiii\)](#)
Rontani, Damien: **151**, [A3L-A2\(xxvii\)](#), **152**,
[A3L-A3\(xxvii\)](#), **153**, [A3L-A4\(xxvii\)](#)
Ros, Javier: **335**, [B2L-D2\(xxxiv\)](#)
Ruan, Jing-Ya: **9**, [A1L-A2\(xxi\)](#)
Rubanov, Vasily: **332**, [B2L-D1\(xxxiii\)](#)
Rubido, Nicolas: **438**, [B4L-C3\(xxxvii\)](#)
Rybalova, Elena: **601**, [D1L-B1\(xliv\)](#)

S

Saigo, Hayato: **521**, [C2L-A1\(xli\)](#)

Saito, Toshimichi: **280**, B2L-A1(xxxii), **351**,
 B3L-A3(xxxiv), **359**, B3L-B1(xxxv), **476**,
 C1L-B1(xxxix), **503**, C1L-C4(xl), **507**,
 C1L-C5(xl)

Sakai, Motoaki: **355**, B3L-A4(xxxiv)

Sakaue, Naoya: **101**, A2L-A4(xxiv)

Sakemi, Yusuke: **666**, D2L-A4(xlvi)

Sakuraba, Masao: **663**, D2L-A2(xlvi)

Salmerón-Contreras, Luis José: **515**, C1L-D4(xl)

Sanjuán, Miguel: **128**, A2L-C5(xxvi)

Sasaki, Motoki: **609**, D1L-B3(xliv)

Sato, Masatoshi: **140**, A2L-D3(xxvi), **419**,
 B4L-B1(xxxvii)

Sato, Masayuki: **571**, C2L-D2(xliii)

Sato, Santana: **347**, B3L-A2(xxxiv)

Sato, Shigeo: **663**, D2L-A2(xlvi)

Satoh, Nobuo: **80**, A1L-D4(xxiv)

Schüle, Martin: **481**, C1L-B3(xxxix), **546**,
 C2L-B5(xlii)

Schmitz, Alexander: **147**, A3L-A1(xxvii)

Segawa, Etsuo: **528**, C2L-A4(xli)

Sekiya, Hiroo: **75**, A1L-D2(xxiv), **499**, C1L-C3(xl)

Semenova, Nadezhda: **601**, D1L-B1(xliv)

Shimada, Yutaka: **164**, A3L-B2(xxvii), **430**,
 B4L-C1(xxxvii), **434**, B4L-C2(xxxvii)

Shimizu, Kuniyasu: **227**, B1L-B1(xxx), **575**,
 C2L-D3(xliii)

Shindo, Takuya: **288**, B2L-A3(xxxii)

Shinohara, Kenta: **65**, A1L-C5(xxiii)

Shiora, Hirofumi: **561**, C2L-C4(xlii)

Shirao, Takuya: **101**, A2L-A4(xxiv)

Shitara, Isamu: **685**, D2L-B4(xlvi)

Sievers, Albert J.: **571**, C2L-D2(xliii)

Sirasaki, Takuro: **101**, A2L-A4(xxiv)

So, Paul: **128**, A2L-C5(xxvi)

Somlor, Sophon: **147**, A3L-A1(xxvii)

Sonawane, Abhijeet: **123**, A2L-C3(xxv)

Song, Changseok: **625**, D1L-C2(xliv)

Soriano, Miguel C.: **5**, A1L-A1(xxi), **408**,
 B4L-A3(xxxvi)

Staunton, Eoghan: **270**, B1L-D2(xxxi)

Strelkova, Galina: **605**, D1L-B2(xliv)

Sueoka, Yuichiro: **324**, B2L-C4(xxxiii), **328**,
 B2L-C5(xxxiii)

Suetsugu, Tadashi: **499**, C1L-C3(xl)

Sugano, Chihiro: **400**, B4L-A1(xxxvi)

Sugano, Ryoko: **75**, A1L-D2(xxiv)

Sugimoto, Kenji: **312**, B2L-C1(xxxiii)

Sugimoto, Yasuhiro: **324**, B2L-C4(xxxiii), **328**,
 B2L-C5(xxxiii), **609**, D1L-B3(xliv)

Sugitani, Yoshiki: **487**, C1L-B5(xxxix), **534**,
 C2L-B2(xli), **613**, D1L-B4(xliv), **617**,
 D1L-B5(xliv)

Sunada, Satoshi: **103**, A2L-A5(xxv), **154**,
 A3L-A5(xxvii), **211**, B1L-A3(xxix)

Suzuki, Hideyuki: **495**, C1L-C2(xl)

Suzuki, Masayasu: **124**, A2L-C4(xxvi)

Sánchez, Manuel: **491**, C1L-C1(xl)

Sánchez-Azqueta, Carlos: **639**, D1L-D1(xlv), **643**,
 D1L-D2(xlv)

Sánchez-Morcillo, Víctor José: **515**, C1L-D4(xl)

T

Taborda, John Alexander: **391**, B3L-D2(xxxvi)

Tada, Harumasa: **172**, A3L-C1(xxviii)

Tadjine, Mohamed: **54**, A1L-C2(xxiii)

Tadokoro, Yukihiro: **698**, D2L-C3(xlvii), **705**,
 D2L-C5(xlvii)

Tajima, Kouichi: **701**, D2L-C4(xlvii)

Takahashi, Norikazu: **132**, A2L-D1(xxvi), **259**,
 B1L-C3(xxxi)

Takahashi, Ryo: **79**, A1L-D3(xxiv)

Takano, Chisa: **180**, A3L-C3(xxviii), **184**,
 A3L-C4(xxviii), **188**, A3L-C5(xxviii), **456**,
 C1L-A1(xxxviii)

Takano, Kosuke: **400**, B4L-A1(xxxvi)

Takaramoto, Shinya: **589**, D1L-A3(xliii)

Takeda, Kentaro: **427**, B4L-B3(xxxvii)

Takeshita, Hiromasa: **530**, C2L-B1(xli)

Takesue, Hiroki: **472**, C1L-A5(xxxix)

Takeuchi, Kouki: **255**, B1L-C2(xxxi)

Takeuchi, Masaaki: **259**, B1L-C3(xxxi)

Takine, Tetsuya: **681**, D2L-B3(xlvi)

Tanaka, Atsushi: **27**, A1L-B1(xxii), **31**, A1L-B2(xxii),
34, A1L-B3(xxii), **38**, A1L-B4(xxii)

Tanaka, Hiroya: **698**, D2L-C3(xlvii), **705**,
 D2L-C5(xlvii)

Tanaka, Ryo: **106**, A2L-B1(xxv)

Tanaka, Soichiro: **579**, C2L-D4(xliii)

Tanaka, Takahiro: **444**, B4L-D2(xxxviii)

Tani, Masahiko: **101**, A2L-A4(xxiv)

Taniguchi, Ryotaro: **678**, D2L-B2(xlvi)

Tanji, Yuichi: **132**, A2L-D1(xxvi)

Tateishi, Kiyoko: **136**, A2L-D2(xxvi)

Teki, Hakui: **308**, B2L-B4(xxxiii)

Tiana-Alsina, Jordi: **13**, A1L-A3(xxi)

Titov, Dmitry: **332**, B2L-D1(xxxiii)

Toda, Hideharu: **140**, A2L-D3(xxvi), **428**,
 B4L-B4(xxxvii)

Tokuda, Isao: **597**, [D1L-A5\(xliii\)](#)
Tomihara, Takahiro: **444**, [B4L-D2\(xxxviii\)](#)
Tomo, Tito Pradhono: **147**, [A3L-A1\(xxvii\)](#)
Torikai, Hiroyuki: **427**, [B4L-B3\(xxxvii\)](#), **480**,
[C1L-B2\(xxxix\)](#)
Torrent, Maria Carme: **13**, [A1L-A3\(xxi\)](#), **304**,
[B2L-B3\(xxxiii\)](#)
Torres, Francisco: **395**, [B3L-D3\(xxxvi\)](#)
Trujillo, Carlos Andrés: **279**, [B1L-D5\(xxxii\)](#)
Trullols, Enric: **279**, [B1L-D5\(xxxii\)](#)
Tsubone, Tadashi: **530**, [C2L-B1\(xli\)](#)
Tsuchiya, Minami: **27**, [A1L-B1\(xxii\)](#)
Tsushima, Honami: **168**, [A3L-B3\(xxviii\)](#)
Turitsyn, Sergei: **5**, [A1L-A1\(xxi\)](#)
Turitsyna, Elena: **5**, [A1L-A1\(xxi\)](#)

U

Uchida, Atsushi: **103**, [A2L-A5\(xxv\)](#), **154**,
[A3L-A5\(xxvii\)](#), **156**, [A3L-A6\(xxvii\)](#), **209**,
[B1L-A2\(xxix\)](#), **211**, [B1L-A3\(xxix\)](#), **215**,
[B1L-A4\(xxx\)](#), **219**, [B1L-A5\(xxx\)](#), **223**,
[B1L-A6\(xxx\)](#), **400**, [B4L-A1\(xxxvi\)](#)
Uchida, Naoki: **517**, [C1L-D5\(xl\)](#)
Uchida, Teruki: **140**, [A2L-D3\(xxvi\)](#)
Uchino, Shota: **65**, [A1L-C5\(xxiii\)](#)
Uehara, Kuniaki: **452**, [B4L-D4\(xxxviii\)](#)
Uenohara, Seiji: **666**, [D2L-A4\(xlvi\)](#)
Ueta, Tetsushi: **247**, [B1L-B6\(xxx\)](#)
Ukai, Ryuya: **140**, [A2L-D3\(xxvi\)](#)
Umeda, Kenta: **106**, [A2L-B1\(xxv\)](#)
Uno, Kazuyuki: **90**, [A2L-A1\(xxiv\)](#)
Ushio, Toshimitsu: **448**, [B4L-D3\(xxxviii\)](#)
Uwate, Yoko: **110**, [A2L-B2\(xxv\)](#), **284**,
[B2L-A2\(xxxii\)](#), **483**, [C1L-B4\(xxxix\)](#), **538**,
[C2L-B3\(xli\)](#), **542**, [C2L-B4\(xli\)](#), **546**,
[C2L-B5\(xlii\)](#)

V

Velarde, Manuelg: **514**, [C1L-D3\(xl\)](#)
Vidal-Idiarte, Enric: **251**, [B1L-C1\(xxxi\)](#)
Vununu, Caleb: **621**, [D1L-C1\(xliv\)](#)

W

Wagemakers, Alexandre: **128**, [A2L-C5\(xxvi\)](#)
Wakamiya, Naoki: **460**, [C1L-A2\(xxxviii\)](#)
Watanabe, Yuki: **196**, [A3L-D2\(xxix\)](#)
Wei, Xiuqin: **75**, [A1L-D2\(xxiv\)](#), **499**, [C1L-C3\(xl\)](#)

Wishon, Michael J.: **21**, [A1L-A5\(xxi\)](#), **50**,
[A1L-C1\(xxiii\)](#)

Y

Yamaguchi, Yusaku: **136**, [A2L-D2\(xxvi\)](#), **143**,
[A2L-D4\(xxvi\)](#), **200**, [A3L-D3\(xxix\)](#)
Yamaki, Kouhei: **423**, [B4L-B2\(xxxvii\)](#)
Yamamoto, Ikuma: **263**, [B1L-C4\(xxxi\)](#)
Yamamoto, Kohei: **434**, [B4L-C2\(xxxvii\)](#)
Yamamoto, Kohji: **101**, [A2L-A4\(xxiv\)](#)
Yamamoto, Yuma: **86**, [A1L-D6\(xxiv\)](#)
Yamane, Hiroki: **114**, [A2L-B3\(xxv\)](#)
Yamanishi, Teruya: **375**, [B3L-C1\(xxxv\)](#)
Yamasaki, Tatsushi: **442**, [B4L-D1\(xxxviii\)](#)
Yamashita, Hiroshi: **495**, [C1L-C2\(xl\)](#)
Yamazato, Takaya: **705**, [D2L-C5\(xlvii\)](#)
Yano, Masafumi: **663**, [D2L-A2\(xlvi\)](#)
Yanochkina, Olga: **332**, [B2L-D1\(xxxiii\)](#)
Yasuda, Akiyoshi: **367**, [B3L-B3\(xxxv\)](#)
Yasuda, Muneki: **27**, [A1L-B1\(xxii\)](#), **31**, [A1L-B2\(xxii\)](#),
34, [A1L-B3\(xxii\)](#), **38**, [A1L-B4\(xxii\)](#)
Yasukawa, Shin: **280**, [B2L-A1\(xxxii\)](#)
Yokoyama, Michio: **27**, [A1L-B1\(xxii\)](#), **31**,
[A1L-B2\(xxii\)](#), **34**, [A1L-B3\(xxii\)](#), **38**,
[A1L-B4\(xxii\)](#)
Yokoyama, Yuuki: **34**, [A1L-B3\(xxii\)](#)
Yoshida, Hiroki: **375**, [B3L-C1\(xxxv\)](#)
Yoshida, Hitoaki: **46**, [A1L-B6\(xxii\)](#)
Yoshida, Naoki: **561**, [C2L-C4\(xlii\)](#)
Yoshida, Naomitsu: **79**, [A1L-D3\(xxiv\)](#)
Yoshimoto, Takuya: **480**, [C1L-B2\(xxxix\)](#)
Yoshimura, Kazuyuki: **400**, [B4L-A1\(xxxvi\)](#), **404**,
[B4L-A2\(xxxvi\)](#), **511**, [C1L-D1\(xl\)](#), **569**,
[C2L-D1\(xlii\)](#)
Yoshimura, Yuichiro: **196**, [A3L-D2\(xxix\)](#)
Yoshinaga, Tetsuya: **136**, [A2L-D2\(xxvi\)](#), **143**,
[A2L-D4\(xxvi\)](#), **192**, [A3L-D1\(xxviii\)](#), **200**,
[A3L-D3\(xxix\)](#)
Yoshino, Hideaki: **689**, [D2L-B5\(xlvii\)](#)
Yoshiya, Keigo: **223**, [B1L-A6\(xxx\)](#)

Z

Zeng, Xiao: **452**, [B4L-D4\(xxxviii\)](#)
Zhang, Chaoliang: **664**, [D2L-A3\(xlvi\)](#)
Zhou, Yanzi: **79**, [A1L-D3\(xxiv\)](#)
Zhusubaliyev, Zhanybai: **332**, [B2L-D1\(xxxiii\)](#), **399**,
[B3L-D4\(xxxvi\)](#)