September 5-7 • Eindhoven • The Netherlands

SEST 2022

5th International Conference on Smart Energy Systems and Technologies

TU/e
EINDHOVEN UNIVERSITY OF TECHNOLOGY

IEEE
IEEE PES Power & Energy Society®
IAS IEEE Industry Applications Society Linking Research to Practice
IEEE Industrial Electronics Society
ies
pels IEEE Power Electronics Society
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SEST 2022

5th International Conference on Smart Energy Systems and Technologies

SEST 2022 is organized by the Electrical Energy Systems Group, Department of Electrical Engineering, Eindhoven University of Technology.

Disclaimer: Although effort has been made to ensure that all the information provided in this booklet is accurate and that the conference program shall take place as planned, the organization reserves the right to make changes at any time if deemed necessary. Changes will be communicated electronically via the conference website, social media accounts or e-mail to registered participants.

The safety and well-being of all conference participants are our priority. The organization follows the healthcare authorities' guidelines regarding monitoring and managing the COVID-19 pandemic.

The organization shall not be liable for any personal accident and/or loss or damage to the property of participants during the conference. Participants are responsible for making their own arrangements regarding insurance.

NIKOLAOS PATERAKIS - GENERAL CHAIR

Welcome Message

AFTER TWO YEARS OF ORGANISING SEST VIRTUALLY, WE WHOLEHEARTEDLY WELCOME YOU TO EINDHOVEN FOR SEST 2022!

On behalf of all Chairs and Committees, it is my pleasure to welcome you to the city of Eindhoven for the 5th edition of the International Conference on Smart Energy Systems and Technologies – SEST 2022.

Since its first edition in 2018, the SEST Conference Series has been committed to establishing itself as an attractive venue to present top-tier scientific research in Smart Energy Systems and Technologies. I want to use this opportunity to recognise the exceptional contributions of all the Chairs, Technical Program Committee members and external reviewers. Their efforts were pivotal in realising this ambition by upholding a comprehensive three-stage review process of all the submitted papers.

In the **first** stage, abstracts were assessed regarding their scope and quality/interest. Of the **323** abstracts (from 45 countries and all continents) submitted, **5.9%** (19 abstracts) were rejected. The Authors of the remaining abstracts were invited to submit the corresponding full paper.

In the **second** stage, **215** full papers were submitted. They were thoroughly evaluated by **105** Technical Program Committee members and **593** external reviewers, averaging **5.4** reviews per paper.

In the **third stage**, the Technical co-Chairs evaluated the revised full papers and the corresponding response letters.

Following this thorough review process, **113** full papers were accepted for presentation. The SEST 2022 acceptance rate from abstract submission to full paper acceptance (disregarding the full papers not submitted) was **48%**.

Alongside the main technical program, which comprises 18 paper presentation sessions, we also have the privilege of hosting five outstanding Keynote Speakers. They are all world-renowned experts in their field, and they will discuss the most pressing and timely topics in their keynote addresses. Moreover, we are pleased to facilitate special sessions organised by four EU Horizon 2020 project consortia, through which their latest research results will be disseminated. Lastly, a special session will provide an overview of the technical and regulatory developments in the Dutch electricity system.

I would also like to acknowledge the support of our industrial partners, Netbeheer Nederland and OPAL-RT Technologies. Not only did their financial contributions facilitate the conference's organisation, but their involvement in organising demo sessions enriched the conference program.

I firmly believe that the diverse technical program of SEST 2022 will provide many opportunities to discuss and reflect on current and future engineering challenges of smart energy system design and operation.

Finally, after two consecutive years of having to organise SEST as a virtual event, I hope that you will enjoy this year's in-person edition of the conference by actively participating in the technical sessions, taking advantage of the social program to expand your network and, ultimately, go back home with pleasant memories of Eindhoven and the Netherlands.

I wish everyone a productive conference.

Nikolaos Paterakis
General Chair of SEST 2022

Chairs

General Chair

NIKOLAOS PATERAKIS
EINDHOVEN UNIVERSITY OF TECHNOLOGY
THE NETHERLANDS

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Technical and Social Program Locations

As shown on the following map, all the locations are conveniently located in the center of Eindhoven and have an easily accessible entrance. SEST 2022 signs will be placed for additional guidance.

1. TU/e Auditorium
2. Conference Venue
3. Kazerne Restaurant
4. Eindhoven Centraal Railway Station
5. Eindhoven Airport

Conference Venue

The technical program of SEST 2022 (parallel sessions, keynote addresses and special/demo sessions) will take place at the **Aristo Meeting Center Eindhoven**.

Address: Vestdijk 30, 5611 CC Eindhoven

Daily lunch and coffee breaks will also be served in this location.

Sessions will take place in rooms **1.02**, **1.03** (first floor) and **2.08** (second floor). An interactive floor plan of the venue can be found at aristo.nl/en/aristo-eindhoven/ (scroll down to find "Virtual reality tour").

The conference venue is part of the Heuvel shopping center, where different shops and services can be found.

Information for Participants

Registration

The registration desk is located on the first floor of the Aristo Meeting Center, outside the plenary room (1.02-1.03). Registration will be possible on:

Monday 8:00-17:00

Tuesday 8:00-17:00

Wednesday 8:00-12:00

Attendees and accompanying persons will receive an identification badge. The badge must be displayed to join the coffee breaks, lunches, welcome reception, and conference dinner. Participants are kindly requested to visibly carry their badges during the conference.

Local Time

In September, the local time is CEST (Central European Summer Time). All times indicated in this booklet are local.

Attendance certificates

Participants can request an electronic attendance certificate by sending an e-mail to sest2022eindhoven@gmail.com from the e-mail address used during registration. Attendance certificates will be available within two weeks after the conference. Note that attendance certificates are not issued in case of no-shows.

Conference proceedings

All registered participants can access the conference proceedings online during the conference. Instructions about accessing the conference proceedings will be communicated via the registration platform aanmelder. Contact the registration desk if you have not received this information.

SEST 2022 Social Media

We recommend that you follow our Twitter (@2022Sest) and LinkedIn (linkedin.com/in/sest2022) accounts. Announcements during the conference will be posted there.

Coffee breaks and lunch

Lunch will be served in the restaurant area of the Aristo Meeting Center (first floor). Refreshments will be available at special spots on the first and second floor during the whole day (there is no consumption limitation). Special dietary requirements are accommodated according to the information provided during registration. In case of allergies or special dietary requirements please consult the explanatory labels. If in doubt, please ask the staff.

Note that the Welcome Reception (Auditorium, TU/e campus) and the Conference Dinner (Restaurant Kazerne) will take place at two different locations (see pages 51 and 52).

Other Services

Internet access

Free internet access is offered at all the locations.

Useful contacts

European emergency number: 112
Police: 0900-8844
Conference office: +31 (0)40 2474000 (9:00 - 17:00)

Parking

Aristo Meeting Center is part of the Heuvel shopping centre that has its own 24/7 garage with plenty of spots (Q-park Heuvel P1, Vestdijk 30, 5611 CC Eindhoven). If you intend to park for more than 2.5 hours, we recommend paying your ticket at the Aristo reception desk for a better rate.

If you are driving to the Welcome Reception, there are paid parking spots behind the TU/e Auditorium. For more information, visit www.tue.nl/en/our-university/tue-campus/accessibility.

Several parking options are also within walking distance from the restaurant Kazerne (Conference Dinner). For more information, visit kazerne.com/en/visit.

Information for Presenters

All the technical sessions will take place at the Aristo Meeting Center. The rooms are equipped with a laptop (Microsoft Windows) and a projector. Microsoft PowerPoint and Adobe Acrobat are available. Therefore, the Authors should prepare their presentation as a .pptx or .pdf file (it is recommended to prepare both).

Parallel sessions have a total duration of 90 minutes. Presenting authors should be in the designated room at least 15 minutes before the beginning of the session to meet the session chair and provide their presentation file by using a USB stick. Each presentation should not exceed 10 minutes, followed by around 3 minutes of Q&A and discussion. Please respect the allotted time; otherwise, the session chair may have to interrupt you.

Note that the presentation of an accepted paper is a prerequisite for its inclusion in the final conference proceedings.

Presentation certificates

Presenting authors can request an electronic presentation certificate by sending an e-mail to sest2022eindhoven@gmail.com, indicating the ID of the paper. Attendance certificates will be available within two weeks after the conference.

SEST 2022 Reviewer Recognition

To recognize the voluntary contribution of the external reviewers to the success of the SEST 2022 review process, three SEST 2022 Outstanding Reviewer Award winners will be announced by the Technical Chairs during the Opening Session.

SEST 2022 Best Paper Awards

The Authors of all the accepted papers are eligible for receiving one of the three SEST 2022 Best Paper Awards. The awards will be presented during the Conference Dinner.

SEST 2022 Best Presentation Awards

On the advice of Session Chairs, a limited number of SEST 2022 Best Presentation Awards will be presented during the Closing Session.

Program at a glance

MONDAY 5/9	
8:00	Registration Opens
8:45-9:15	Opening Session
9:15-10:30	Special Session 1
10:30-11:00	Coffee Break
11:00-12:30	Parallel Sessions 1-3
12:30-13:30	Lunch
13:30-15:00	Special Sessions 2-3
15:00-15:30	Coffee Break
15:30-17:00	Parallel Sessions 4-6

TUESDAY 6/9	
8:00	Registration Opens
9:00-11:00	Keynote Address 1 Keynote Address 2 Keynote Address 3
11:00-11:30	Coffee Break
11:30-13:00	Parallel Sessions 7-9
13:00-14:00	Lunch
14:00-15:30	Special Sessions 4-5
15:30-16:00	Coffee Break
16:00-17:30	Parallel Sessions 10-12

WEDNESDAY 7/9	
8:00	Registration Opens
9:00-10:30	Keynote Address 4 Keynote Address 5
10:30-11:00	Coffee Break
11:00-12:30	Parallel Sessions 13-15
12:30-13:30	Lunch
13:30-15:00	Parallel Sessions 16-18
15:00-15:30	Coffee Break
15:30-16:30	Demo Session
16:30-17:00	Closing Session

SOCIAL PROGRAM			
18:30-20:30	Welcome Reception	**19:00-23:00**	Conference Dinner

Keynote Addresses

On Tuesday and Wednesday, consecutive keynote addresses will take place in the plenary room (Rooms **1.02** and **1.03**, first floor). Each keynote address will have a duration of 30-35 minutes, followed by 10-15 minutes of discussion.

TUESDAY 6/9, 9:00-11:00

"Charging infrastructure and the charging options for electric vehicles" – **Emil Levi**

"How to localise cascading line failures: tree partitioning vs controlled islanding" – **Janusz Bialek**

"New models and paradigm shifts: past, present, and future of smart energy systems" – **Paulo Ribeiro**

WEDNESDAY 7/9, 9:00-10:30

"The Dutch grid operators' approach towards addressing actual challenges resulting from the energy transition" – **Han Slootweg**

"The Smart Transformer providing service to the electric network and addressing the reliability challenges through power routing" – **Marco Liserre**

EMIL LEVI LIVERPOOL JOHN MOORES UNIVERSITY, UNITED KINGDOM

"Charging infrastructure and the charging options for electric vehicles"

ROOM: 1.02-1.03 TIME: 9:00-9:40

ABSTRACT

Meeting the 2050 CO_2 reduction targets necessitates the acceleration of the development and adoption of electric vehicles (EV). This requires removing one major obstacle, the so-called range anxiety, related to the insufficient existing charging infrastructure. After a brief overview of the current state of electrified transportation, the presentation will look at recent progress in the EV uptake worldwide and the current state of the charging infrastructure. Next, various types of charging solutions will be addressed, suited to the different charging levels defined in the current standards. This will include battery charging using wired Level 1 chargers that connect to the single-phase grid outlets, and Level 2 charging that connects the battery through a power electronic converter to the three-phase grid. Solutions for the two charging options depend on the placement of the charger – off-board or on-board, and non-integrated or integrated. Some of the power electronic converter schemes required for these chargers will be introduced. Fast or Level 3 chargers remove the long waiting times for full charging and are perceived as the dominant near-to-mid-term solution.

BIO

Emil Levi received his Dipl. Ing. degree in Electrical Engineering in 1982 from the University of Novi Sad and Masters and PhD degrees in 1986 and 1990, from the University of Belgrade (Yugoslavia). In the period from 1982 until 1992 he worked in the Department of Electrical and Electronic Engineering at the University of Novi Sad. He joined Liverpool John Moores University in 1992 and is since 2000 Professor of Electric Machines and Drives. Emil is a Fellow of IEEE and the recipient of the Cyril Veinott award of the IEEE Power and Energy Society for 2009 and the Best Paper Award of the IEEE Transactions on Industrial Electronics for 2008. In 2014, he received the "Outstanding Achievement Award" from the European Power Electronics Association. He served as Co-Editor-in-Chief of the IEEE Trans. on Industrial Electronics (2009-2013) and currently serves as the Editor-in-Chief of the IEEE Trans. on Industrial Electronics (2019-2024) and the IET Electric Power Applications (since 2010). Emil is with the Electric Machines and Drives Research Group at the Liverpool John Moores University, which is widely regarded as a centre of excellence for research in the areas of multiphase electric machine and power electronic converter modelling and control. The work of the Group is characterised by a high level of international collaboration, and it regularly accommodates academics from leading European Universities for research stays.

JANUSZ BIALEK **NEWCASTLE UNIVERSITY, UNITED KINGDOM**

"How to localise cascading line failures: tree partitioning vs controlled islanding"

ROOM: 1.02-1.03 TIME: 9:40-10:20

ABSTRACT

Controlled islanding (CI) is a defence mechanism against cascading failures when the network is split into a number of self-sustained islands to prevent the proliferation of outages. The proposal is to replace CI by tree partitioning (TP) whereby some of the tie-lines connecting the clusters are retained in such a way that the cluster-level graph forms a tree. As power transfers between clusters forming a tree depend only on cluster power imbalances, but not on the internal cluster topology, line trips in one cluster will not affect power flows in any other cluster. Hence TP achieves the same localisation effect as CI but keeps the clusters connected so that inter-cluster power transfers can still take place and reduce any necessary load shedding. Fewer lines are cut, which reduces the shock to the system, and there is no need to re-synchronize the clusters after the emergency. Test results performed on the 118 node IEEE test network have confirmed the usefulness of the methodology.

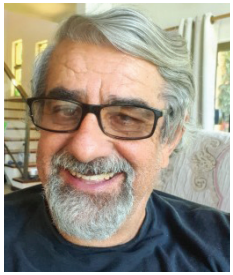
BIO

Professor Janusz Bialek (FIEEE) was born and educated in Poland gaining MEng (1977) and PhD (1981) degrees in Electrical Engineering from Warsaw University of Technology. Since 2019 he has been Professor of Power and Energy Systems at Newcastle University, UK. Previously he held Chair Professor positions at the University of Edinburgh (2003-2009), Durham University (2009-2014) and Skoltech (2014-2022). Janusz's main research interest is in the application of advanced mathematical methods to address techno-economic problems connected with the transformation of the power supply industry to a low-carbon economy. His background is in power systems, but his research is interdisciplinary and he collaborates closely with economists, mathematicians, statisticians, physicist and social scientists. He has published widely on integration of renewable generation in power systems, smart grids, power system dynamics, preventing electricity blackouts and power markets. Janusz has been Principal Investigator and Co-Investigator of multi-million research grants funded by Engineering and Physical Sciences Research Council (EPSRC, UK), Electrical Power Research Institute (EPRI, USA), Russia's Ministry of Education and Science, and UK power industry.

PAULO RIBEIRO FEDERAL UNIVERSITY OF ITAJUBÁ, BRAZIL

"New models and paradigm shifts: past, present, and future of smart energy systems"

ROOM: 1.02-1.03 TIME: 10:20-11:00



ABSTRACT

The deregulation of the energy market, combined with the emerging transmission, distribution, and information technology, provided strategic opportunities for new knowledge, developments, and services for the power grid. The new evolving context created over the last four decades a revolution within the electrical energy sector. These changes have many times produced incremental improvements, and other times new models and wide-ranging paradigm shifts. Widespread integration of renewables, advances in power electronics and signal processing, together with the ample use of artificial intelligence have created unthinkable transformations. The unfolding of the electric grid model is not simple progress from error to truth. No model is a catalog of ultimate realities, and none is a mere fantasy. The presentation will highlight some of these transitions from both technological and philosophical perspectives.

BIO

Paulo Ribeiro received his B.S.E.E. from the Federal University of Pernambuco, Brazil, and the Ph.D. degree from the University of Manchester, Manchester, U.K., in 1985. He was a Research Fellow with the NASA Glenn Research Centers, Cleveland, OH, USA, Electric Power Research Institute (EPRI), USA, and Erskine Fellow with the University of Canterbury, New Zealand, and with the Brazilian Institute of Electric Energy (INERGE), Brazil. He taught full-time and worked in the industry in the USA for over 23 years. He also taught at the Technological University of Eindhoven, The Netherlands. He spent 8 years as a Transmission System Planning Engineer in Brazil. He is currently a Full Professor of electrical engineering with the Federal University of Itajubá. He has authored or co-authored more than 350 papers, book chapters, and 4 books. His current research interests include power electronics, and power quality, transmission and distribution systems, renewable and distributed generation, energy storage, smart grids, engineering education, and philosophy of technology. Dr. Ribeiro is a Fellow of IEEE and IET.

HAN SLOOTWEG ENEXIS BV AND EINDHOVEN UNIVERSITY OF TECHNOLOGY, THE NETHERLANDS

"The Dutch grid operators' approach towards addressing actual challenges resulting from the energy transition"

ROOM: 1.02-1.03 TIME: 9:00-9:45

ABSTRACT

The Dutch grid operators are facing major challenges, mainly caused by the accelerating energy transition. The number of regions where grid capacity is not sufficient to enable all developments initiated by customers and other stakeholders is increasing. This leads to network capacity shortages for both feed in and demand in low, medium and high voltage grids that need to be addressed and mitigated. To this end, new approaches such as non-firm connection contracts and market based congestion management are used. Application of such concepts requires accurate forecasting of power flows, distribution automation, and improved controllability by grid operators. In the presentation, these topics will be treated in more detail and both scientific and practical challenges will be discussed.

BIO

Han Slootweg is a part-time professor in Smart Grids with the research group Electrical Energy Systems at the TU/e department of Electrical Engineering. His main affiliation is with distribution network operator Enexis, where he is the Director of Asset Management. Han is strongly involved in the development of the energy system and focuses on the function of gas and electricity networks in the sustainable energy system of the future. His research interests are grid automation and digitization, architectures and benefits of various Smart Grid concepts, integrated energy systems, network planning and optimization under uncertainty and generation and load forecasting. Han received his MSc degree in Electrical Power Engineering in 1998 from Delft University of Technology (The Netherlands) with the distinction 'cum laude'. In 2003, he obtained his PhD from the same university with his thesis 'Wind Power; Modelling and Impact on Power System Dynamics'. The same year he also received his MSc degree in Business Administration and started working at Enexis. In 2009, he was appointed as part-time professor in Smart Grids at the Electrical Energy Systems group at the Eindhoven University of Technology. He has (co-)authored more than 200 publications.

MARCO LISERRE KIEL UNIVERSITY, GERMANY

"The Smart Transformer providing service to the electric network and addressing the reliability challenges through power routing"

ROOM: 1.02-1.03 TIME: 9:45-10:30

ABSTRACT

The Smart Transformer (ST) is a power electronics-based transformer with control and communication functionalities, which can avoid or defer costly LV and MV network reinforcement. The ST allows hybrid and meshed network operation with variable voltage profile, being able to effectively integrate storage and offer grid services. The ST structure must be modular to provide scalability and higher availability through fault tolerance and reconfigurability to secondary substations. A complex modular structure could result in efficiency and reliability challenges due to the higher number of components compared to a non-modular one. Innovative modulation and control techniques allow implementing power routing which can transform this possible weakness into a strength, while graph theory allows a holistic modelling of the ST. These features are proven via prototypes built using SiC devices. The keynote summarizes the main achievements of projects such as the ERC Consolidator Grant "HEART", the German governmental Copernicus Initiative "ENSURE", and the LV-Engine project led by Scottish Power.

BIO

Marco Liserre received the MSc (1998) and PhD (2002) degrees in Electrical Engineering from the Bari Polytechnic. He has been Associate Professor at Bari Polytechnic and since 2012 Professor in reliable power electronics at Aalborg University. Since 2013 he is Full Professor and holds the Chair of Power Electronics at Kiel University. At Kiel University he is leading a team of 25 researchers, a Power Electronics Laboratory, a Medium Voltage Laboratory and a Laboratory on Batteries and Energy Conversion. He will be leading the research group "Electronic Energy Systems" at Fraunhofer ISIT, which will employ 20 researchers. Notably, in 2013 he was awarded an ERC Consolidator Grant for the project "The Highly Efficient And Reliable smart Transformer (HEART), a new Heart for the Electric Distribution System". He has published more than 600 technical papers and a book, with more than 45000 citations. Marco Liserre is listed in ISI Thomson report "The world's most influential scientific minds" since 2014. He is fellow of the IEEE and member of IAS, PELS, PES and IES. He has received the IES 2009 Early Career Award, the IES 2011 Anthony J. Hornfeck Service Award, the 2014 Dr. Bimal Bose Energy Systems Award, the 2017 IEEE PELS Sustainable Energy Systems Technical Achievement Award and the 2018 IEEE-IES Mittelmann Achievement Award (the highest award of the IEEE-IES).

Parallel Sessions

		ROOM	SESSION	TITLE	CHAIR
MONDAY 5/9	11:00-12:30	1.02	1	Electric Mobility I	João Catalão
		1.03	2	Power Electronic Systems & Applications I	Kyriaki-Nefeli Malamaki
		2.08	3	Energy Storage	Gerardo Osório
	15:30-17:00	1.02	4	Electricity Markets	Hrvoje Pandžić
		1.03	5	Power System Planning & Operation I	Juan Camilo López
		2.08	6	Data Analytics	Gianfranco Chicco
TUESDAY 6/9	11:30-13:00	1.02	7	Microgrids	Christina Papadimitriou
		1.03	8	Power System Planning & Operation II	Georgios Tsaousoglou
		2.08	9	Power Electronic Systems & Applications II	Daniele Bosich
	16:00-17:30	1.02	10	Demand Side Management	Mohamed Lotfi
		1.03	11	Multi-energy Systems	Andrea Mazza
		2.08	12	Power System Dynamics, Control & Power Quality I	Vladimir Ćuk
WEDNESDAY 7/9	11:00-12:30	1.02	13	Distributed Energy Resources	Koen Kok
		1.03	14	Electric Mobility II	Akın Taşcıkaraoğlu
		2.08	15	Power System Planning & Operation III	Juan Giraldo
	13:30-15:00	1.02	16	Forecasting	Tarek AlSkaif
		1.03	17	Power System Protection, Security and Reliability	Pedro Vergara
		2.08	18	Power System Dynamics, Control & Power Quality II	Vladimir Ćuk

SESSION 1 (MONDAY, SEPTEMBER 5)

Electric Mobility I

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18 **On the Integration of Electric Vehicles into German Distribution Grids through Smart Charging**

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27 **A Markov chain model of a distribution grid with electric vehicles and solar power**

Sanne van Kempen and Bert Zwart

49 **Distribution System Planning Considering Non-Utility-Owned Electric Vehicle Charging Stations**

Mario A. Mejia, Leonardo H. Macedo, Gregorio Muñoz-Delgado, Javier Contreras and Antonio Padilha-Feltrin

153 **An optimal solution for a smart charging station of light electric vehicles**

Ferran Pinsach Batet, Roger Valdés Martín, Lucia Igualada and Cristina Corchero

133 **An Online Truthful Algorithm for Menu-Based Scheduling in Electric Vehicle Charging Networks**

Angeliki Mathioudaki, Georgios Tsaousoglou, Emmanouel Varvarigos and Dimitris Fotakis

5 **Profitable Vehicle-to-Grid Services with Minimal Battery Degradation using Deep Reinforcement Learning**

Panagiotis Loulakis, Georgios Tsaousoglou and Emmanouel Varvarigos

282 **A Power Hardware-In-the-Loop Laboratory Setup to Study the Operation of Bidirectional Electric Vehicles Charging Stations**

Andrea Mazza, Enrico Pons, Ettore Bompard, Giorgio Benedetto, Paolo Tosco, Marco Zampolli and Rémi Jaboeuf

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36 **Experimental Validation of the Parallel Operation of Grid-Forming Converters and Synchronous Generators in Temporary Islanded Microgrids**

Alexander Winkens, Isabella Contu, Phillip Linnartz and Andreas Ulbig

279 **Active harmonic filtering of islanded converter interfaced generation considering the thermal limits**

Francisco Jesús Matas-Díaz, Manuel Barragán-Villarejo, José María Maza-Ortega, Georgios C. Kryonidis, Kyriaki-Nefeli Malamaki and Charis S. Demoulias

95 **A Double-Switch High Gain DC-DC Converter Based on Coupled-Inductors**

Sohrab Abbasian, Mohammad Farsijani and Hossein Hafezi

201 **Converter Modelling Aspects at the Boundary between EMT and RMS Domain**

Ananya Kuri, Rainer Zurowski, Gert Mehlmann and Matthias Luther

285 **Decoupled Control to Improve DC-Link Dynamics of Energy-Storage-Equipped STATCOM**

Hikmat Basnet, Tomi Roinila, Hossein Hafezi, Roosa Sallinen and Minh Tran

152 **Multilevel Inverter based Battery System Operation using a Decentralized Controller**

Florian Schwitzgebel, Johannes Buberger, Manuel Kuder, Dominic Karnehm, Nina Sorokina, Andreas Wiedenmann, Ali Mashayekh, Richard Eckerle and Thomas Weyh

135 **Power Flow Control by Serial DC/DC Converters in DC Grids**

Julian Saat, Sebastian Stein, Marcel Kuhlmann and Andreas Ulbig

SESSION 3 (MONDAY, SEPTEMBER 5)

Energy Storage

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164 **Co-simulation Framework for Optimal Operation of Pumped Hydro Storage and Wind Power**

Eivind Jamessen, Marthe Fogstad Dynge, Knut Styve Hornnes, Magnus Korpås and Ümit Cali

314 **Investment Planning of Hydrogen Storage Units in a Distribution System Considering Intense Ramping Issue**

Sajjad Fattaheian-Dehkordi, Ali Abbaspour, Mahmud Fotuhi-Firuzabad and Matti Lehtonen

51 **Management of Energy Storage in Transactive Energy Communities**

Ana Soares, Gonçalo Gonçalves and Pedro Moura

112 **Re-Thinking the Definition of Self-Sufficiency in Systems with Energy Storage**

Jan Martin Zepter, Jan Engelhardt, Tatiana Gabderakhmanova and Mattia Marinelli

20 **A Decentralized Control Strategy for Voltage Regulators and Energy Storage Devices in Active Unbalanced Distribution Systems**

Bahman Ahmadi, Juan S. Giraldo, Gerwin Hoogsteen, Marco E. T. Gerards and Johann L. Hurink

74 **State-of-Charge Estimation of Lithium-Ion Batteries Using Machine Learning Based on Augmented Data**

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SESSION 4 (MONDAY, SEPTEMBER 5)

Electricity Markets

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Mahdieh Shamsi and Paul Cuffe

192 **Multi-market Participation of a Renewable Power-to-Hydrogen Facility with Battery Storage**

Nikolina Čović, Ivan Pavić, Hrvoje Pandžić and Ivan Andročec

68 **Day-ahead Energy and Balancing Capacity Bidding Considering Balancing Energy Market Uncertainty**

Ivan Pavić, Hrvoje Pandžić and Tomislav Capuder

318 **Intra-day Electricity Market Bidding for Storage Devices using Deep Reinforcement Learning**

Flin Verdaasdonk, Sumeyra Demir and Nikolaos G. Paterakis

239 **Synergies between Distribution Use-of-System Tariffs and Local Flexibility Markets**

Panagiotis Pediaditis, Dimitrios Papadaskalopoulos, Nikos Hatziargyriou and Charalampos Ziras

138 **Risk Assessment of Local Forward Markets in a Transactive Energy System**

David Toquica, Fatima Amara, Kodjo Agbossou, Nilson Henao, Juan C. Oviedo and Luis Rueda

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Power System Planning & Operation I

ROOM: 1.03 TIME: 15:30 – 17:00 CHAIR: JUAN CAMILO LÓPEZ

28 **Dynamic Robust Transmission Network Expansion Planning in Renewable Dominated Power Systems Considering Inter-Temporal and Non-Convex Operational Constraints**

Álvaro García-Cerezo, Luis Baringo and Raquel García-Bertrand

121 **FlexPlan: testing an innovative grid planning tool using European wide regional cases**

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205 **An Adjustable Robust Optimization Approach for the Expansion Planning of a Virtual Power Plant**

Ana Baringo, Luis Baringo and José M. Arroyo

278 **State Estimation in Unbalanced Smart Grids**

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71 **Real Time Co-Simulation of Electromechanical and Electromagnetic Power System Models**

Christian Scheibe, Ananya Kuri, Lorenz Graf, Ravinder Venugopal and Gert Mehlmann

237 **Data-Driven Characterisation of Distribution Systems for Modelling and Control Applications**

Carlo Viggiano, Paul Trodden, Eduardo Caicedo and Wilfredo Alfonso

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168 **Synthetic Ground Truth Generation of an Electricity Consumption Dataset**

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178 **Modeling and Application of Probabilistic Electrical Household Loads in Distribution Grid Simulations**

Chris Martin Vertgewall, Christoph Hölscher, Luis Böttcher, Julian Bigalke and Andreas Ulbig

310 **Categorisation of Low-Voltage Three-Phase Electricity Users**

Gianfranco Chicco, Daniele Bonansinga and Pietro Colella

197 **Implementation of the online distributed voltage control based on containers**

Edoardo De Din, Manuel Pitz, Ferdinanda Ponci and Antonello Monti

29 **Evaluating Voltage Estimation in a Nanogrid Using Digital Twin Models and Real-Time Smart Meter Data**

Javier Lopez-Lorente, Charalambos M. Xydas, George Makrides and George E. Georghiou

232 **Robust Topology Identification in Distribution Networks Enabled by Latent Low-Rank and Sparse Embedding Feature Extraction**

Mohammad Jafarian and Andrew Keane

SESSION 7 (TUESDAY, SEPTEMBER 6)

Microgrids

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241 **Clustering approaches to select Multiple Design Options in multi-objective optimization: an application to rural microgrids**

Davide Fioriti, Davide Poli, Pablo Duenas Martinez and Andrea Micangeli

230 **Internal Model-based Voltage Control for DC Microgrids Under Unknown External Disturbances**

Amir Basati, Jingxuan Wu, Josep M. Guerrero and Juan C. Vasquez

215 **Voltage Containment and Reactive Power-Sharing in Microgrids: Centralized and Distributed Approaches**

Babak Abdolmaleki and Gilbert Bergna-Diaz

288 **Experimental validation of a real-time distributed model-less control for DC microgrids**

E.A. Rodríguez-Gonzalez, J.C. Olives-Camps, F.P. García-Lopez, A. Rodríguez del Nozal, J.M. Mauricio and J.M. Maza-Ortega

213 **Kalman filter-based power compensation strategy for Microgrids under uncertain disturbance**

Jingxuan Wu, Amir Basati, Shuting Li, Josep M. Guerrero and Juan C. Vasquez

231 **On Dynamics of Communication-Based Distributed Consensus Control in Islanded Microgrids**

Igor Sowa and Antonello Monti

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44 **Power Flow Analysis in Unbalanced Distribution Networks Considering High Photovoltaic Production**

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229 **Real-time Identification of Load and Upstream Network Models in Distribution System Operation**

Alireza Nouri and Andrew Keane

1 **A Tariff Structure for Reliability of Power Supply Levels in Congested Low Voltage Networks**

Pau Brossa Rodriguez, Georgios Tsaousoglou, Wouter F. van den Akker and Nikolaos G. Paterakis

281 **Characterization of the Impact of Capacity Limitation Services on Distribution Networks**

Zhe Chen, Charalampos Ziras and Henrik W. Bindner

156 **Assessing the Provision of Ancillary Services Considering BES Capacity Degradation**

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238 **Equipment Hardening Strategies to Improve Distribution System Resilience against Wildfire**

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147 **Automation of Modular Multilevel Converter Topology Evaluation including Thermal Monitoring**

Andreas Wiedenmann, Wolfgang Grupp, Tobias Högerl, Johannes Buberger, Florian Schwitzgebel, Manuel Kuder, Richard Eckerle, Thomas Weyh and Antje Gieraths

21 **A High Performance Simulation Framework for Battery Modular Multilevel Management Converter**

Dominic Karnehm, Nina Sorokina, Sebastian Pohlmann, Ali Mashayekh, Manuel Kuder and Antje Gieraths

16 **The WBM Reconfiguration to Prevent the Instability on DC Shipboard Microgrids**

Andrea Alessia Tavagnutti, Daniele Bosich and Giorgio Sulligoi

296 **Investigation of Three-level Dual Output T-type NPC for EV Application**

Dhawal Dwivedi, Indrasis Roy and K. A. Chinmaya

280 **A Novel Boost-SEPIC based Three-Port DC-DC Converter for Solar PV Integrated E-Boat Applications**

Amritanshu Ruhela and K. A. Chinmaya

53 **A Real-Time Control Approach for Multi-Source Input Non-Isolated Bidirectional DC-DC Converter**

Rakesh Thapliyal, Sourav Bose and Prakash Dwivedi

312 **Single-Phase Compact Active Rectifier with 31-Level Voltage Resolution using Modified Packed U-Cell Topology and Model Predictive Control**

Mohammad Babaie and Kamal Al-Haddad

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Demand Side Management

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209 **Optimal Scheduling for Local Energy Communities Using Stochastic and Robust Optimization**

Emely Cruz-De-Jesús, José L. Martínez-Ramos and Alejandro Marano-Marcolini

179 **Physics-Informed Neural Network Model for Flexibility Modeling of Electric Water Heaters**

Surya Venkatesh Pandiyan and Jayaprakash Rajasekharan

234 **The Efficacy of Different Technologies on Grid-independency of a Small Energy Community With Varying Goals and Comfort Levels**

Thomas Swarts, René Benders and Johan Morren

89 **Optimal Operation of a Smart Multi-Energy System Considering Demand Response**

Najmuddin Noorzad, Akın Taşcıkaraoğlu, Sırrı Sunay Gürleyük, Ozan Erdinç and João P. S. Catalão

105 **Improving Climate Resilience and Thermal Comfort in a Complex Building through Enhanced Flexibility of the Energy System**

Seyedmohammad Hosseini, Parisa Hajialigol, Mohammadreza Aghaei, Silvia Erba, Vahid Nik and Amin Moazami

185 **Load Analysis for Evaluating Flexibility Needs in the Planning of an Industrial Distribution Grid**

Susanne Sandell, Daniel Bjerkehagen and Iver Bakken Sperstad

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118 **Technical and Economical Effects of Supply of Synthetical Methane on the Electrical Infrastructure in Germany**

Cristian Monsalve, Jonas Pemsel, Steffen Nicolai, Stefan Klaiber and Peter Bretschneider

12 **The Role of Hydrogen Electrolysers in the Frequency Containment Reserve: A Case Study in the Iberian Peninsula up to 2040**

Fernando J. Ribeiro, João A. Peças Lopes, Francisco S. Fernandes, Filipe J. Soares and André G. Madureira

22 **Developing a hydrogen seasonal storage strategy to support security of supply and carbon neutrality**

Bruno Henrique Santos, João Peças Lopes, Leonel Carvalho, Manuel Matos and Inês Alves

140 **Multi-Agent Based Control Framework for an Integrated Community Energy System**

Joshua Fitzpatrick, Alireza Lorestani, Jorge Chebeir, Mehdi Narimani and James S. Cotton

32 **Enhancing demand-side flexibility for Heat Booster Substations in Ultra-Low Temperature District Heating systems**

Aneesh Chandra Nunna, Yi Zong and Jan Eric Thorsen

311 **Operational Strategies for Serving the Multi-Energy Demand**

Cristian Piran, Andrea Mazza and Gianfranco Chicco

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158 **Harmonic Mitigation in Low-Voltage Distribution Networks: Sensitivity Analysis**

Kyriaki-Nefeli Malamaki, Georgios C. Kryonidis and Charis S. Demoulias

212 **A phase-compensated harmonic suppression method for virtual synchronous generator system in distorted grid**

Shuting Li, Bingchen Jiang, Jingxuan Wu, Josep M. Guererro and Juan C. Vasquez

207 **Analysis of the Converter-Driven Stability of Q(V)-Characteristic Control in Distribution Grids**

Sebastian Krahmer, Stefan Ecklebe, Peter Schegner and Klaus Röbenack

223 **Quantifying the Severity of Short-term Instability Voltage Deviations**

Aleksandar Boričić, Jose Luis Rueda Torres and Marjan Popov

243 **Enhancing Resilience During Islanding Events Through Price-Responsive Loads**

Thabiso Mabote, Luis Badesa and Eduardo Cotilla-Sanchez

249 **Impact of P-Q Control based PV Generator on Memory-Polarized Mho Relay**

Asha Radhakrishnan, Indla Rajitha Sai Priyamvada and Sarasij Das

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305 **Comparative study of MPPT metaheuristics for PV systems under partial shading conditions**

H.G.G. Nunes, D.M.R. Duarte, J.A.N. Pombo, S.J.P.S. Mariano and M.R.A. Calado

34 **Estimating PV Curtailed Power as a Voltage Support Service using Data-Driven Approaches**

Gijs Verhoeven, Pedro P Vergara, Edgar Mauricio Salazar Duque and Koen Kok

295 **Discussion on time resolution effect on the matching of PV generation and demand based on mean and variance**

Sebastian Martin, Juan A. Sarria and Jose A. Aguado

299 **Mitigating intraday wind generation uncertainty with HVDC systems**

Vaishally Bhardwaj, Hakan Ergun and Dirk Van Hertem

99 **Distributed Reinforcement Learning for Real-Time Batteries Control Using Lagrangian Decomposition**

Eleni Stai, Ognjen Stanojev, Riccardo de Nardis di Prata and Gabriela Hug

184 **Pre-positioning of Movable Energy Resources for Distribution System Resilience Enhancement**

Mukesh Gautam and Mohammed Benidris

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198 **Integration of a V2G charging station in a smart Prosumer household via a cloud-based energy management system considering ToU tariffs**

Bernhard Grasel, Carlos Serôdio, Pedro Mestre, José Baptista, Manfred Tragner and Hermann Reisenbauer

228 **Assessment of EV charging strategies and their effect on residential grids using co-simulation**

Ravi Shankar Singh, Guillermo Mier, Theo Bosma, Marcel Eijgelaar, Gabriël Bloemhof and Ganesh Sauba

97 **Optimal Charging and Discharging Operation of Mobile Charging Stations**

Abdullah Kürşat Aktar, Akın Taşcıkaraoğlu and João P. S. Catalão

188 **Network-Aware Online Charge Control with Reinforcement Learning**

Andrey Poddubnyy, Phuong Nguyen and Han Slootweg

196 **Optimal Management of Mobile Charging Stations in Urban Areas in a Distribution Network**

Muhammed Ali Beyazıt and Akın Taşcıkaraoğlu

40 **An IoT-based Smart Charging Algorithm Considering Local Distributed Energy Resources and V2G Technology**

Lucas Zenichi Terada, Juan Camilo López, Cindy P. Guzmán, Marcos J. Rider and Luiz C. P. da Silva

86 **Comparison of Supraharmonic emission measurement methods using real signals of a V2G charging station and a PV power plant**

Bernhard Grasel, Manuel J. Cabral S. Reis, José Baptista and Manfred Tragner

SESSION 15 (WEDNESDAY, SEPTEMBER 7)

Power System Planning & Operation III

ROOM: 2.08 TIME: 11:00 - 12:30 CHAIR: JUAN GIRALDO

3 **Mitigating the Impacts of EVs Charging Infrastructure on Dutch Residential Grids**

Waleed S. Nasr, Pedro P. Vergara and Bas Kruimer

8 **Studying the Impact of Smart Meter Placement on Low-Voltage Grid State Estimation**

Haoyang Zhang and Thierry Zufferey

52 **A Bi-level Model for the Resilient Operation of Distribution Systems using a Matheuristic Nested Decomposition**

Leonardo L. Gomes, Juan S. Giraldo and Carlos A. Castro

62 **Optimal Gain-scheduled POD for Power Systems with Hybrid HVDC Links**

Otavio Bertozzi, Harold R. Chamorro, Omar Kotb, Eduardo Prieto-Araujo and Shehab Ahmed

128 **Combined MV-LV Power Grid Operation: Comparing Sequential, Integrated, and Decentralized Control Architectures**

Sen Zhan, Johan Morren, Wouter van den Akker, Anne van der Molen, Nikolaos G. Paterakis and J. G. Slootweg

246 **Construction of Multi-period TSO-DSO Flexibility Regions**

Luis Lopez, Alvaro Gonzalez-Castellanos and David Pozo

14 **On the Practical Use of Generalized Adaptive Partition Methods: Application to the Stochastic Unit Commitment Problem**

Alvaro Gonzalez-Castellanos, Luis Lopez and David Pozo

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Forecasting

ROOM: 1.02 TIME: 13:30 - 15:00 CHAIR: TAREK ALSKAIF

47 **Online Model-based Functional Clustering and Functional Deep Learning for Load Forecasting Using Smart Meter Data**

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222 **Electrical Load Forecasting Utilizing an Explainable Artificial Intelligence (XAI) Tool on Norwegian Residential Buildings**

Eilert Henriksen, Ugur Halden, Murat Kuzlu and Umit Cali

96 **Estimation of Residential PV Power Generation Using Panel Azimuth Information**

Gussan Mufti, Markos Asprou and Christos Panayiotou

106 **A Neural Network-based Methodology for Non-Intrusive Energy Audit of Telecom Sites**

Simone Eiraudo, Luca Barbierato, Roberta Giannantonio, Edoardo Patti, Lorenzo Bottaccioli and Andrea Lanzini

225 **Data-driven predictive control method for building heating systems : experimental validation**

Makram Abdellatif, Julien Chamoin and Didier Defer

302 **Are deep learning models more effective against traditional models for load demand forecasting?**

Mayank Jain, Tarek AlSkaif and Soumyabrata Dev

SESSION 17 (WEDNESDAY, SEPTEMBER 7)

Power System Protection, Security and Reliability

ROOM: 1.03 TIME: 13:30 – 15:00 CHAIR: PEDRO VERGARA

172 **Analysing the Long-Term Impact of the Energy Transition on Medium Voltage Network Assets**

Joni Hermans, Viktor Beelen, George Rouwhorst and Han Slootweg

127 **Complete FEM-based model of a bulk-glass optical current transformer**

André Oppegård, Mohammad Khalili Katoulaei and Irina Oleinikova

206 **Optimal Recloser-Fuse and Distribution Network Protection Coordination including Distributed Generation Relays**

Vassilis C. Nikolaidis, Dimitrios Desiniotis, Vasileios A. Papaspiliotopoulos, Aristotelis M. Tsimtsios and George N. Korres

182 **Extended Gap Analysis: an Approach for Security Assessment of Critical Infrastructures**

Adam Bartusiak, Jörg Lässig, Steffen Nicolai and Peter Bretschneider

242 **Real-Time Detection of Cyber-Attacks in Modern Power Grids with Uncertainty using Deep Learning**

Mostafa Mohammadpourfard, Fateme Ghanaatpishe, Yang Weng, Istemihan Genc, Mehmet Tahir Sandıkkaya

264 **Objectives, Requirements and Implementation of a Service Restoration Algorithm for AC-DC Distribution Grids**

Alberto Dognini, Ferdinanda Ponci and Antonello Monti

SESSION 18 (WEDNESDAY, SEPTEMBER 7)

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64 **Data-based model validation for locating the source of forced oscillations due to power plant governors**

Sigurd Hofsmo Jakobsen, Xavier Bombois and Salvatore D'Arco

17 **System Stability and Short Circuit Contribution as Discordant Targets in Cascade Connected DC Microgrids: a Design Procedure**

Andrea Vicenzutti, Daniele Bosich, Andrea Alessia Tavagnutti and Giorgio Sulligoi

308 **Investigations of the Virtual Impedance Control Mode of Synchronverter in the Power Swing**

Francisco M. Gonzalez-Longatt, Jose Luis Rueda, Peter Palensky and Harold Chamorro

224 **Performance Assessment of Synchronized Phasor Measurement-Based Parameter Estimation for Distribution Networks**

Daniele Carta, Andrea Benigni, Carlo Sitzia, Paolo Attilio Pegoraro and Sara Sulis

84 **A user-friendly tool for allocation of emission limits considering frequency-dependent impedance**

Tor Inge Reigstad, Bendik Nybakk Torsæter, Henrik Kirkeby, Bjørn Inge Oftedal, Thor Holm and Henning Taxt

81 **Network Reconfiguration for Enhanced Operational Resilience using Reinforcement Learning**

Michael Abdelmalak, Mukesh Gautam, Sean Morash, Aaron F. Snyder, Eliza Hotchkiss and Mohammed Benidris

Special Session 1

MONDAY, 5/9 ROOM: 1.02-1.03 TIME: 9.15-10:30

DUTCH ELECTRICITY SYSTEM DEVELOPMENTS IN A EUROPEAN CONTEXT

KOEN KOK
EINDHOVEN UNIVERSITY OF TECHNOLOGY

Challenges and opportunities for AI in the Dutch and European Electricity System

In this presentation, Koen Kok will present opportunities and challenges related to the use of AI in the electricity system, from electricity trade, via semi-autonomous energy systems to TSO-DSO interactions.

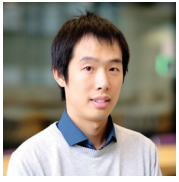
Prof.dr. J.K (Koen) Kok is Professor of Intelligent Energy Systems at the Electrical Energy Systems group of the Eindhoven University of Technology (TU/e). He is the Program Director of the MegaMind research programme, combining power systems engineering, data science and law to develop a techno-regulatory transition pathway for the electricity ecosystem on the level of the distribution grid. Further, Kok is involved in a wide variety of technology research projects aimed at applying intelligent software systems to tackle challenges posed by the energy transition on the short to longer term.

SASKIA LAVRIJSSEN
TILBURG LAW SCHOOL,
TILBURG UNIVERSITY

Smart Energy Systems in the European Clean Energy Package and the NL draft Energy Act

In this presentation, Saskia Lavrijssen reflects how the draft Energy Act, which will implement the European Clean Energy Package, impacts the transition to (local) smart energy systems. She discusses which regulatory strategies and regulations will be adopted and to what extent they will accelerate the energy transition in a just way, focusing on the issue of system integration, empowerment of prosumers and the role of new technologies such as hydrogen and virtual energy storage.

Prof.dr. S.A.C.M. (Saskia) Lavrijssen is Professor of Economic Regulation and Market Governance of Network Industries at the Tilburg Law School of Tilburg University since 2015. She is heading the Tilburg Institute of Law, Technology and Society (TILT). Before that, she was affiliated to the Faculty of Law at the University of Amsterdam as professor of Energy Law. Throughout her career, Saskia Lavrijssen has specialized in EU law, competition law, economic regulation, energy law, data protection law, national constitutional and administrative law and issues of good market supervision and regulation.



TONY XIANG
ALLIANDER

Power Grid Model: a high-performance steady-state power system calculation library

After years of challenging work, Alliander has released Power Grid Model (github.com/alliander-opensource/power-grid-model), an open-source Python/C++ library for steady-state power system calculation. To face the challenges of the energy transition, many statistical and/or machine learning methods are applied for power system analysis, which usually requires power system calculations (preferably in parallel) for a substantial number of simulation cases/scenarios. Using efficient C++ implementation, our library provides a significant single-thread performance boost compared to existing open-source solutions, let alone its native multi-threading support. It has already been successfully deployed in various applications inside Alliander. By making this project open-source, we hope to bring its benefits to industrial applications and academic research outside Alliander, as well as to build a community-driven ecosystem that will spark rich collaboration and attract many contributors. In this session we will give a short presentation of the library.

Dr. Tony Xiang is Lead Scientific Engineer at the Dutch DSO Alliander. He leads and performs scientific software engineering and data science projects related to the smart operation of distribution grids.

Special Session 2

MONDAY, 5/9 ROOM: 1.02 TIME: 13:30-15:00

CHALLENGES AND SOLUTIONS FOR A PAN-EUROPEAN ELECTRICITY MARKET INTEGRATION TO ACCOMMODATE GRID SERVICES AND NEEDS OF THE FUTURE

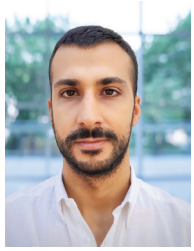
ONENET
one network for Europe
onenet-project.eu

The electrical grid is moving from a fully centralized to a highly decentralized system, forcing grid operators to radically adjust current operations to accommodate the smart grid of the future. The two major associations of grid operators in Europe, ENTSO-E and EDSO, have put together a unique consortium with the goal to define a unified European vision for an integrated energy system, supporting a new generation of grid services with a seamless near real-time integration of all actors, across countries, maximizing consumer participation while respecting the technical constraints of the grid.

OneNet, being the largest Horizon2020 research project in the field of TSO-DSO-Consumer market integration, involves 72 partners from 23 countries. The key elements of the project are 1) a common market design for Europe, including harmonized products, services and market models, 2) definition of a common IT architecture, and 3) verification of the unique integrated solutions in large multi-country field tests. This special session aims to highlight the scope, challenges, and achieved advancements along these key dimensions.

AGENDA

SESSION CHAIR: ANIBAL SANJAB (VITO)



MATTEO TRONCIA
IIT - UNIVERSIDAD PONTIFICIA COMILLAS

A unified vision for European market design: integration challenges, flexibility services, products, and interoperability

IVELINA STOYANOVA
RWTH AACHEN UNIVERSITY

Requirements for a stable, secure, and interoperable European system – solutions for a smooth technical integration of grid operation and market solutions

ANIBAL SANJAB
VITO

TSOs-DSOs cooperation and coordination for an efficient and grid-impact aware procurement of system services

LUCIANA MARQUES
VITO

European flexibility market integration: market distortions and proposed solutions

OPEN Q&A

Special Session 3

MONDAY, 5/9 ROOM: 2.08 TIME: 13:30-15:00

GREEN ENERGY HUBS FOR LOCAL INTEGRATED ENERGY COMMUNITIES OPTIMIZATION: THE ENEURON PROJECT

Local energy communities (LECs) are collective energy actions involving citizen participation in the energy system and resulting in benefits for members of the local community. The EU-funded eNeuron project intends to develop innovative tools for the optimal design and operation of LECs, integrating distributed energy resources and multiple energy carriers at different levels. By promoting the Energy Hub concept as a conceptual model to control and manage multi-carrier and integrated energy systems, the project proposes solutions that promote tangible sustainability and energy security benefits for all stakeholders in LECs.

This special session objective is to provide an overview of the eNeuron project innovative approach & solutions and share first results with the R&I community.

eneuron
optimising local energy communities

eneuron.eu

AGENDA

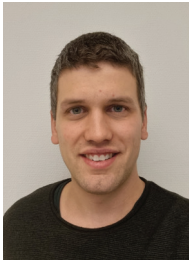
SESSION CHAIR: CHRISTINA PAPADIMITRIOU (EINDHOVEN UNIVERSITY OF TECHNOLOGY)

CHRISTINA PAPADIMITRIOU
TU/E, TECHNICAL PROJECT COORDINATOR

The eNeuron project and objectives

ANDREI MORCH
SINTEF

The multi-carrier Local Energy Communities concept: challenges, barriers, recommendations



MAGNUS ASKELAND
SINTEF

Optimal planning and operation of multi-carrier systems: the eNeuron approach

MOSÈ ROSSI
UNIVPM

Use Cases and Pilots of eNeuron

OPEN Q&A

Special Session 4

TUESDAY, 6/9 ROOM: 1.02 TIME: 14:00-15:30

EFFICIENT INTERACTION BETWEEN ENERGY MARKETS AND GRID MANAGEMENT SYSTEMS UNDER HIGH RES PENETRATION SCENARIOS

FLEXGRID

flexgrid-project.eu

The H2020 research project FLEXGRID aims at answering to the following critical questions:

- How can DSOs deal with the new operational challenges caused by a large share of distributed renewable generation?
- How can system operators avoid costly grid reinforcement by efficiently utilizing flexibility?
- How can we develop economically sustainable business models for the emerging smart grid ecosystem realizing win-win contexts for all involved stakeholders?
- How can small energy prosumers participate in emerging flexibility markets?
- How can we best align the various roles and unique interests of the energy market stakeholders?
- How can a novel Distribution Level Flexibility Market (DLFM) be best integrated in the existing regulatory framework and interact with existing transmission network level markets?

During the Special Session, FLEXGRID's vision to bridge the gap between reliable grid operation and flexibility market efficiency will be discussed emphasizing on market-aware distribution grid operation and network-aware energy market operation issues. The Special Session will annotate the most important FLEXGRID research findings and respective business-related insights.

AGENDA

SESSION CHAIR: GEORGIOS TSAOUSOGLOU (ICCS/NTUA)

ELENA LEAL LORENTE
ETRA

FLEXGRID Automated Trading Platform demonstration and results

FILIP PRÖSTL ANDRÉN
AIT

Validating FLEXGRID results in pilot experiments and under real-life conditions

MATEA PAVIĆ
HOPS

Long-term economic analysis of TSO using DN-level flexibility through a distribution level flexibility market

FARHAN FARRUKH
SIN

Business cases, value propositions and impact analysis for flexibility initiatives in Europe

KONSTANTINOS STERIOTIS
ICCS/NTUA

Co-optimization of distributed renewable energy and storage investment decisions in a TSO-DSO coordination framework

OPEN Q&A

Special Session 5

TUESDAY, 6/9 ROOM: 2.08 TIME: 14:00-15:30

FLEXIBILITY IN FUTURE POWER DISTRIBUTION NETWORKS: LEARNINGS FROM H2020 EUNIVERSAL PROJECT

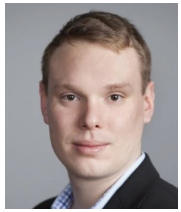
EUniversal UMEI

euniversal.eu

Integration of flexibility in distribution network is crucial for reliable operation of future power networks with large share of high simultaneity factor distributed generation and loads. The primary goal of EUniversal is to implement the Universal Market Enabling Interface (UMEI) concept by bringing forward a universal, open, adaptable and modular approach to interlink active system management with electricity markets and foster the provision of flexibility services, also acknowledging the activation needs of and the coordination requirements with other commercial parties and TSOs.A set of market-oriented flexibility services from DERs will be implemented to answer DSOs' needs in a cost-effectively way, supporting the energy transition. Also, a set of tools to improve observability, control and operation of distribution networks in real-time are developed. Three different DEMO sites, located in Portugal, Germany and Poland, are developed to validate the project solutions to show the universality of the concept and to support the roadmap for their further deployment and dissemination.

AGENDA

SESSION CHAIR: DIRK VAN HERTEM (KU LEUVEN)



DAVID BRUMMUND
MITNETZ

The EUniversal project and the UMEI

DIRK VAN HERTEM
MD UMAR HASHMI
KUL/ENERGYVILLE

Realizing academic concepts in a practical smart grid demo: two case studies

JANKA VANSCHOENWINKEL
VITO/ENERGYVILLE

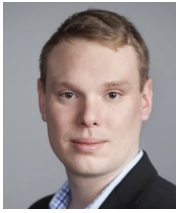
Market based flexibility procurement by DSOs: insights from the EUniversal project

GERD KÜPPER
ENGIE

Characterizing future flexibility needs: insights from a quantification exercise

MATHAIOS PANTELI
MOHAMED LOTFI
UNIVERSITY OF CYPRUS

Flexibility and resilience in future distribution networks



DAVID BRUMMUND
MITNETZ STROM

Low voltage control - experiences from the German demonstrator of EUniversal

OPEN Q&A

Demo Session by OPAL-RT TECHNOLOGIES

PRESENTER
ISMAIL RKIOUI
FIELD APPLICATION ENGINEER

WEDNESDAY, SEPTEMBER 7, 2022

ROOM: 1.02-1.03 TIME: 15:30-16:30

Real-time simulation is enabling the world's visionaries to make innovative ideas a reality. OPAL-RT empowers engineers and researchers with accessible, cutting-edge, real-time simulation technology to accelerate the development of better products and more reliable energy transmission. Since 1997, industries including automotive, aerospace, power electronics and power generation have increasingly turned to OPAL-RT, transforming the company into a world leader in real-time simulation and Hardware-in-the-Loop (HIL) testing equipment for electrical, electro-mechanical and power electronics systems.

This session includes two demonstrations, followed by an open Q&A round.

Demo 1: Real-time simulation of a microgrid (MIL)
This demo shows a microgrid connected to a three-phase distribution system, simulated in real-time with a time-step of 50 µs. The microgrid model consists of a three-phase 10 kW wind turbine, a 5 kW solar panel, a 10 kW energy storage system and three 5 kW variable loads. The user can vary the renewable generation inputs (wind speed and solar irradiation), set the load and battery set points. The set points, wind and solar data can also be read from profile files. The microgrid operation mode can be changed from grid connected to islanded (and vice versa) in runtime.

Demo 2: Simulation of a power system with a protection relay in-the-loop (HIL)
This demo shows a transmission line connecting two AC networks. A fault can be applied to the line, and a protection relay can isolate the fault by opening two breakers at each end of the line. The protection strategy is implemented in an Arduino microcontroller, which monitors the currents through the transmission line and trips the breakers in case of an overcurrent. The connection between the Arduino and the simulated power system is achieved with analog and digital I/Os.

Social Program

Welcome Reception (Monday evening)

The welcome reception will be hosted at the main hall of the **Auditorium**, which is located on the campus of the Eindhoven University of Technology (15-20 minute walk from the Aristo Meeting Center). Drinks and snacks will be served.

Address: Auditorium 5612, 5612 AZ Eindhoven

Coordinates: 51°26'52.6"N 5°29'04.4"E

Conference Dinner (Tuesday evening)

The Conference Dinner will be hosted at the restaurant **Kazerne** (5-10 minute walk from the Aristo Meeting Center). You can join from 19:00 for a welcome with drinks at the bar. Seated dinner will start at around 19:30. The event will last until approximately 23:00.

Upon arrival, please inform the restaurant staff about dietary preferences and allergies.

If you were informed that your paper has been nominated for a Best Paper Award, we kindly request that at least one of the co-authors attends the dinner (included with your registration).

Address: Paradijslaan 8, 5611 KN Eindhoven

SEST Series

	2018	2019	2020	2021	2022
Location	Seville, ES	Porto, PT	Istanbul, TR (online)	Vaasa, FI (online)	Eindhoven, NL
Technical co-sponsors	IEEE IES	IEEE PES, IES	EEE PES, IES, IAS	IEEE PES, IES, IAS, PELS	IEEE PES, IES, IAS, PELS
Accepted papers	110	170	101	124	113
Reviews/paper	3.7	4.2	5.6	5.7	5.4
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Netbeheer Nederland

The Dutch association of energy grid operators

Transforming and optimising the energy system to current and future societal needs and challenges requires smart solutions. The Dutch energy grid operators strive for an accessible, reliable, and affordable energy system. A system that enables the transition to a sustainable and just energy system.

netbeheernederland.nl

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SEST 2022