

# IEEE WG on Big Data & Analytics for Transmission Systems

Register to receive more information  
and news of our activities



**Officers**  
Rafael Segundo (Chair)  
Yanli Liu (Vice-Chair)  
Emilio Barocio (Vice-Chair)  
Petr Korba (Secretary)

Subcommittee on Big Data & Analytics for Power Systems

# Agenda Meeting (3/4) 2024

- Summary of Activities Done
- Upcoming activities 2024
- Report of Subgroups
- Calendar of meetings 2024
- General Comments





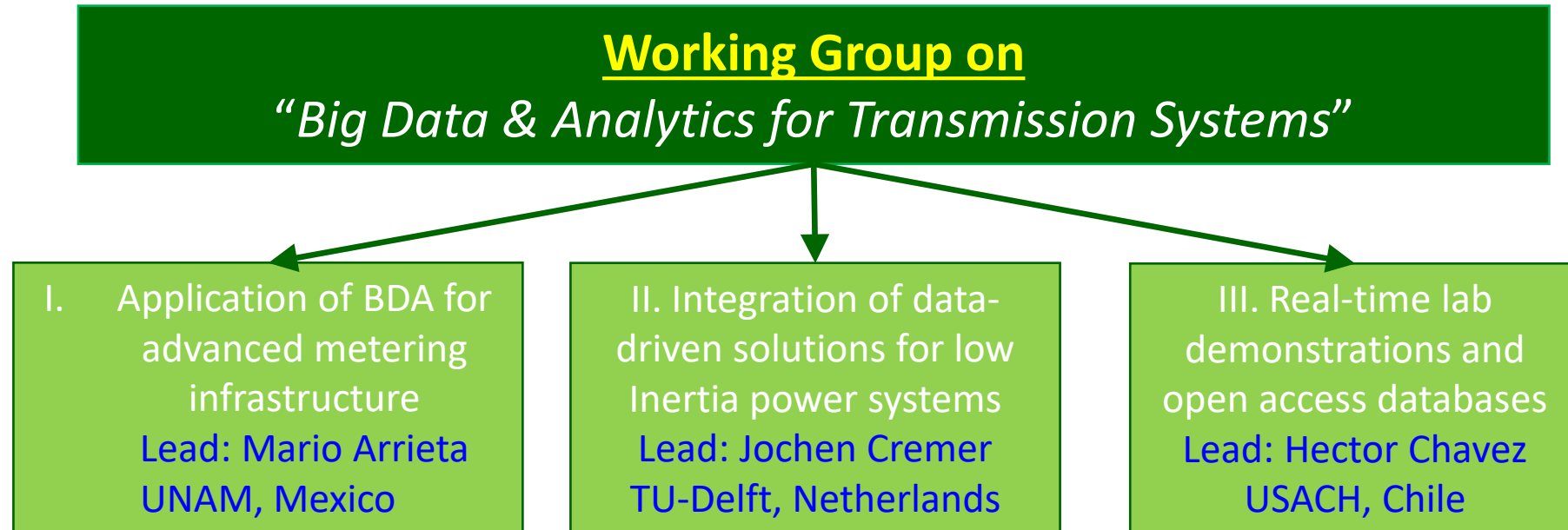
# Welcome to the WG

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# WG on BDA for Transmission Systems

Period of Time: 48 months (2023, 2024, 2025 & 2026)

Officers: Rafael Segundo (Chair), Yanli Liu, Emilio Barocio (Co-Chairs), Petr Korba (Secretary)



# 73 REGISTERED MEMBERS FROM 21 COUNTRIES



# Summary of WG activities done up today

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# Summary of WG activities 2023

## ■ 4 WG Meetings

- 2023: Jan, May, Jul (PESGM), Oct, Dec

## ■ 3 Panel Sessions in IEEE and other Conferences

- 2023
- “The role of Big data and AI for the secure operation of transmission systems”, IEEE PowerTech 2023, Belgrade, Servia
  - “Application of Big Data and AI/ML in monitoring, operations, planning and protection”, IEEE PESGM 2024, Orlando, FL, USA

## ■ 1 International Workshops

- 2023: DynPOWER, TU Delft, Netherlands, 8 speakers, 50 participants, 460 registrations [Hybrid]



# 1 Panel 2024

- Panel: *“Power system security assessment, early warning and control based on WAMS data”*

Chair: Rafael Segundo

- “Power System Rotor Angle Stability Predictive Assessment based on WAMS and Machine Learning”, Jaime Cepeda, Escuela Politécnica Nacional, Ecuador
- “Measurement accuracy of PMU-based WAMS data”, Sara Sulis, University of Cagliari, Italy,
- “Impact of Time Delays on the Performance of a Wide-Area Damping Controller Under Reduced Inertia Conditions”, Hector Chavez, USACH, Chile
- “Data-driven voltage instability detection and monitoring”, Vladimir Terzija, Newcastle University, United Kingdom





# 1 Tutorial 2024

- 21 May 2024, IEEE SGSMA, Washington DC, USA

- Tutorial: “Modern data analytic applications to assess the dynamic stability of power systems”

Instructors:

- “Time-synchronized state estimation in (micro) PMU-unobservable distribution systems”,  
Anamitra Pal, Arizona State, USA
    - “Data-driven, Reduced-order Models for Online Dynamic Security Assessments”,  
Hector Chavez, University of Santiago de Chile, Chile
    - “Identification of Inter-area modes based on Ringdown Oscillation’s Monitoring and Analytics (ROMA)”,  
Mario Arrieta Paternina ,UNAM , Mexico



# 1 Paper in 2024

21–25 July 2024, IEEE PESGM, in Seattle, Washington, USA

- Paper: “*Spatio-temporal Data-Driven and Machine Learning based Applications for Transmission Systems*”

## Spatio-temporal Data-Driven and Machine Learning based Applications for Transmission Systems

F. R. Segundo Sevilla<sup>1</sup>, Y. Liu<sup>2</sup>, E. Barocio<sup>3</sup>, P. Korba<sup>1</sup>, A. Zamora<sup>4</sup>, D. Dotta<sup>5</sup>, F. Bellizio<sup>6</sup>, H. Chavez<sup>7</sup>, H. Jóhannsson<sup>8</sup>, J. Cepeda<sup>9</sup>, J. Cremer<sup>10</sup>, J. Zhao<sup>11</sup>, M. Arrieta<sup>12</sup>, M. Paolone<sup>13</sup>, M. Ramirez<sup>1</sup>, P. Papadopoulos<sup>14</sup>, and Y. Susuki<sup>15</sup>

<sup>1</sup>ZHAW, Switzerland, <sup>2</sup>Tianjin University, China, <sup>3</sup>University of Guadalajara, Mexico, <sup>4</sup>UMICH, Mexico, <sup>5</sup>Unicamp, Brazil, <sup>6</sup>EMPA, Switzerland, <sup>7</sup>USACH, Chile, <sup>8</sup>DTU, Denmark, <sup>9</sup>CENACE, Ecuador, <sup>10</sup>TU Delft, Netherlands, <sup>11</sup>University of Connecticut, USA, <sup>12</sup>UNAM, Mexico, <sup>13</sup>EPFL, Switzerland, <sup>14</sup>University of Strathclyde, UK, and <sup>15</sup>Kyoto University, Japan

**Abstract—** This paper summarizes recent advancements on spatio-temporal data-driven and machine learning methods for static and dynamic security assessment, and their particular use cases. It is a collective effort of different research groups members of the IEEE Working Group on Big Data Analytics for Transmission Systems, to provide transmission system operators (TSOs) with innovative tools and ideas for their potential implementation. The algorithms presented here are classified as non-training and training approaches, namely spatio-temporal and machine learning based, considering as input time series from time domain simulations, and or synchrophasor data from wide-area monitoring systems. The efficacy of these algorithms is then evaluated in different IEEE benchmark models and using real system measurements from different countries.

sequentially decide under emergencies. Additionally, analyzing the spectrum from synchrophasor data, then using the dynamic wavelet transform can be combined with CNN-based classification to detect (and classify) an event. In [1], several applications of data-driven approaches were developed ranging from python toolboxes and web-based applications for ring down analysis, coherency identification and the identification of dynamical parameters over the analysis on real-power systems such as on the Mexican, USA, Chilean, Brazilian, Ecuadorian, Japanese and Swedish systems. The applications range from static SA with stratified cross-validations and estimating the global operating system state over predicting the time-domain trajectories and assessing the transient stability in real-time, then detecting events, and evaluating real-time synchrophasor data.



**Your session information is as follows:**

Session Type: **Poster Session**

Paper number: 24PESGM1328

Session title: Analytic Methods for Power Systems

Session date: Monday, July 22, 2024

Session time: 5:00 PM - 7:00 PM

# OUTSTANDING TECHNICAL REPORT Award



- The AMPS Committee has nominated our report **PES-TR104** for the **OUTSTANDING TECHNICAL REPORT Award**.

*“Application of spatio-temporal data-driven and machine learning algorithms for security assessment”, November 2022, IEEE PES Resource Center.*





# Upcoming Activities 2024

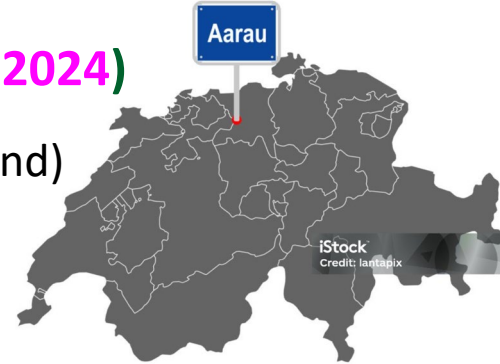
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# Special Events: International Workshop

Monday 9<sup>th</sup>, September 2024, Switzerland (Registration August 2024)

Place: Kultur and Kongresshaus, Aarau, Switzerland (Northern Switzerland)



- ABB 
- Sponsored by Typhoon HIL 
- Swiss National Science Foundation 

Hybrid Workshop

- Limited number of in-person attendees (50)
- Open to everyone online

Confirmed visit to Swissgrid Control Room

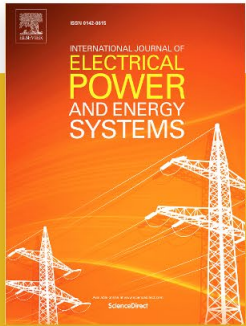
- Limited number of places available (national security)



Speakers	Affiliation	Country
Sara Sulis	University of Cagliari	Italy
Tania Lopez Garcia	Lucerne University of Applied Sciences	Switzerland
Asja Derviskadic	Swissgrid	Switzerland
Luigi Vanfretti	Rensselaer Polytechnic Institute	USA
Yoshihiko Susuki	Kyoto University	Japan
Fabrizio Sossan	University of Applied Sciences Western	Switzerland
Miguel Ramirez	ZHAW	Switzerland

# Special Events: Launch of Special Issue

- Invitation to participate in potential special issue in the IJEPES journal with focus on WG activities



International Journal of Electrical Power & Energy Systems

Open access

10.8

CiteScore

5.2

Impact Factor

- 5 guest editors ( well-known and high impact)
  - Diversity (location, gender, expertise, etc)
- Title and topics to be discussed
- More details about the call to come

# Report of Subgroups

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Pillar 1. Application of BDA for  
advanced metering infrastructure  
(Lead: Mario Paternina, UNAM, Mexico)



# 1. Application of BDA for advanced metering infrastructure (AMI) (Lead: Mario Paternina, UNAM, Mexico)

**Activity 1- 2023: Consolidate the status quo on the modal analysis (MA), data handling (DH), Clustering (C), and Inertia Estimation (IE) techniques.**

- Product: Report on state-of-the-art data-driven methods for MA, DH , C, and IE. June 2024.

**Activity 2- 2023: Creation of contents for tutorials, panels, conferences, and journals.**

- Product: Tutorial for SGSMA 24.
- Product: Special session in ROPEC 2023 (in collaboration with Pillar 3).
- Product: Participation in PES-GM 2023 and NAPS 2023.
- Product: Publications related to novel Apps of BDA for AMI.

**Additional Activity: Integration of Mexican WAMS with SANDI (Pillar 3).**

- Product: International platform for AMI.

# 1. Application of BDA for advanced metering infrastructure (AMI) (Lead: Mario Paternina, UNAM, Mexico)

**Activity 1 - 2024: Generation of web repository and test cases library to test novel Apps of BDA for AMI.**

- Product: Web repository in GitHub.

**Activity 2 - 2024: Creation of contents for tutorials, panels, conferences, and journals.**

- Product: Tutorial for the Mexican ISO (CENACE).
- Product: Special session in IEEE T&D PES Latin America 2024 (in collaboration with Pillar 3).
- Product: Participation in SGSMA 2024, PES-GM 2024 and NAPS 2024.
- Product: Publications related to novel Apps of BDA for AMI.

**Activity 3 - 2024: Increase the AMI (Pillar 3).**

- Product: 8 new sensors integrated to the advance metering infrastructure.

**Pillar meetings on June 6th, August 1st and November 21st.**

# Members

Alejandro  
Zamora

José Ortiz  
Bejar

Gabriel  
Mejía

José Antonio  
de la O

Juan Manuel  
Ramírez

Ernesto  
Vázquez

Daniel Dotta

Lucas  
Lugnani

Francisco  
Zelaya

Carlos  
Toledo

Luis  
Mendieta

Rodrigo  
Reyes

José Moreno

Manuel  
Ramos

Camila  
Castrillón

Rosa Correa

Eder Molina

Wenting Li

Alexander  
Sánchez

Vicente  
Torres

Juan Ramón  
Rodríguez

Juan Rueda

Manuel  
Andrade

Emilio  
Barocio

Maique  
Garcia

Felix Reyes

Amaranta  
Alfaro

**New members are welcome!**

Pillar 2. Integration of data-driven solutions  
for low Inertia power systems  
(Lead: Jochen Cremer, TU Delft, Netherlands)



# Integration of data-driven solutions for low Inertia power systems

Lead: Jochen Cremer, TU Delft, Netherlands

- **T1 Report on state-of-the-art data-driven methods for low inertia power systems**
  - Review the latest trends and opportunities within Machine Learning for data-driven DSA in low-inertia system
  - Key challenges for DSA in low inertia power systems



# T1 Technical report

1. Introduction (Jochen)
2. Low-inertia power systems (Panagiotis Papadopoulos)
  - Taxonomy of security/stability (Christoph, Federica, Janne)
  - Requirements (Christoph, Sara, Guglielmo)
  - Challenges for control and assessment in low inertia power systems (Guglielmo, Jose, Robert, Xiaozhe)
  - Security in low inertia power systems (Rafael, Jose, Miguel, Hector, Rahul)
  - Issues with dynamics in low inertia systems (Janne, Jose, Guglielmo, Panos, Vladimir)
3. Data-driven methods (Federica Bellizio) **[Completed!]**
  - Taxonomy (Al-Amin, Mert, Emilio)
  - Data generation historical data (Jose, Al-Amin)
  - Training of models (Jochen, Miguel, Rahul, Xiaozhe, Yoshiso)
  - Maintenance of models (Jochen, Federica)
  - Real-time models (Xiaozhe)
4. Low-inertia test networks and screening of available data (Al-Amin Bugaje)
  - Requirements (Sara, Guglielmo)
  - Availability of data (Jose, Al-Amin, Mert, Jochen, Robert)
  - Problems that can be studied (Mert, Jose)
5. Recommendations

Pillar 3. Real-time lab demonstrations and  
open access data bases  
(Lead: Hector Chavez, USACH, Chile)

## 3. Real-time lab demonstrations and open access data bases (Lead: Hector Chavez, USACH, Chile)

- SANDI: Synchrophasor Analytics Data- exchanging Initiative:  
<https://sandi.c-ses.cl/>

**Step 1:** Launch SANDI with USACH and ZHAW

**Deadline:** May 2023

**Activity:** develop a simple app for outlet PMU data to be concentrated and Analyzed

**Step 2:** Get at least 3 IEEE Regions connected

**Deadline:** Dec 2023

**Activity:** Initiate SANDI by adding more people. Organize a Panel in IEEE ROPEC in IXTAPA, MX

**Step 3:** Get at least 3 labs coordinated via internet

**Deadline :** Dec 2024

**Activity:** Expand SANDI features on simple lab coordination capabilities. Plan on a Panel Session

**Step 4:** Start Answering research questions on basis on labs coordinated via internet

**Deadline :** Dec 2026

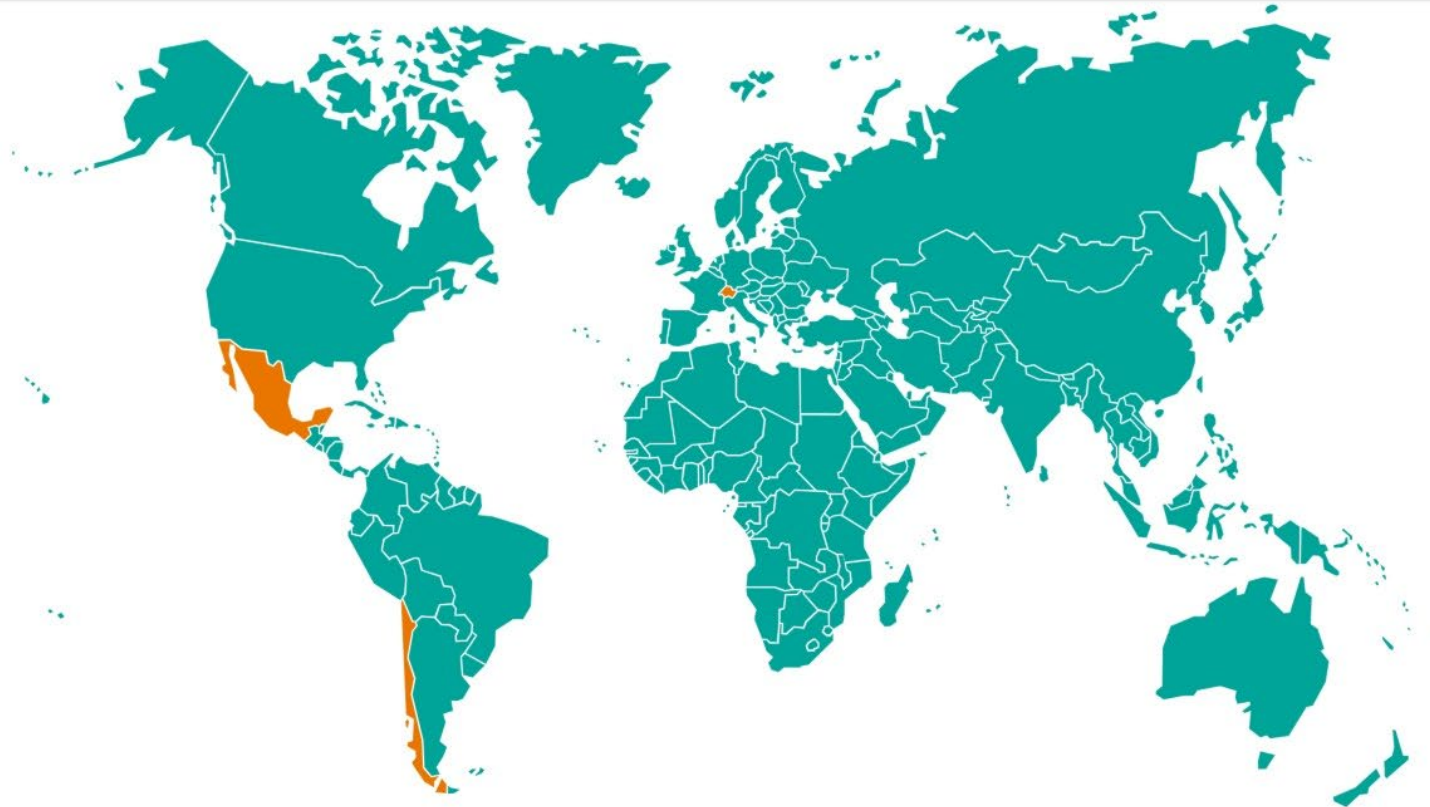
**Activity:** Consolidate SANDI for research

**Report:** Research outcomes of SuperLab 2.0 (under review)





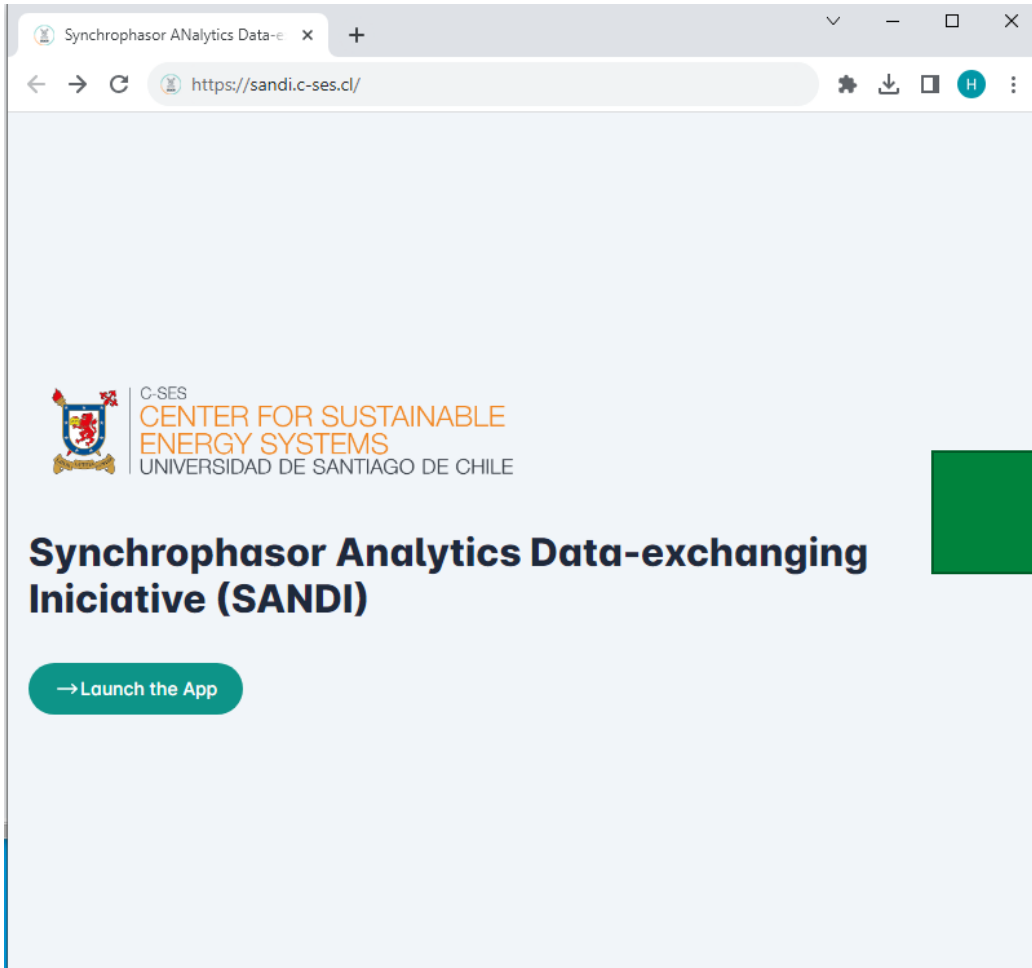
# 3. Real-time lab demonstrations and open access data bases (Lead: Hector Chavez, USACH, Chile)



<https://sandi.c-ses.cl>




# 3. Real-time lab demonstrations and open access data bases (Lead: Hector Chavez, USACH, Chile)



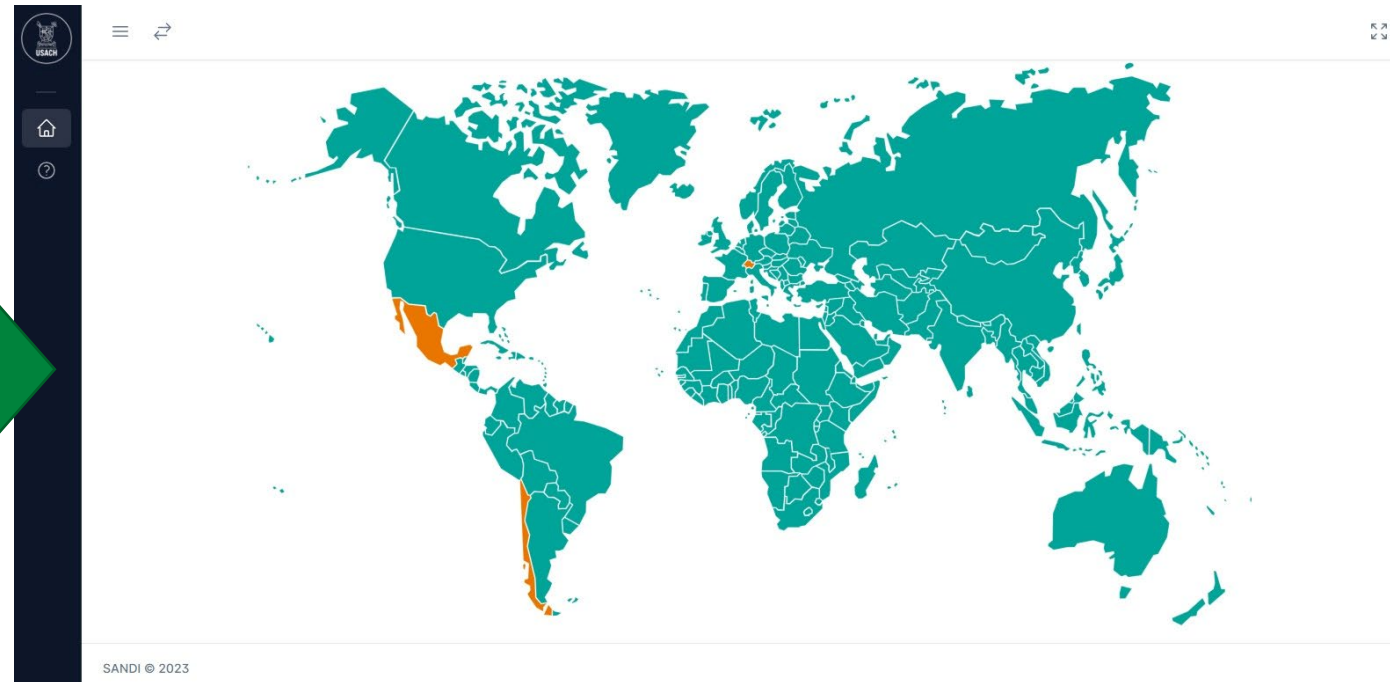
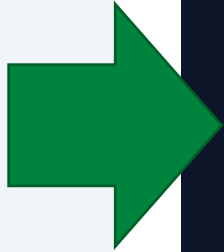
Synchrophasor ANalytics Data-e x +

← → ↻ <https://sandi.c-ses.cl/> ⚙️ ⬇️ 📄 🏠 ⋮

 C-SES  
**CENTER FOR SUSTAINABLE ENERGY SYSTEMS**  
UNIVERSIDAD DE SANTIAGO DE CHILE

## Synchrophasor Analytics Data-exchanging Initiative (SANDI)

→ Launch the App



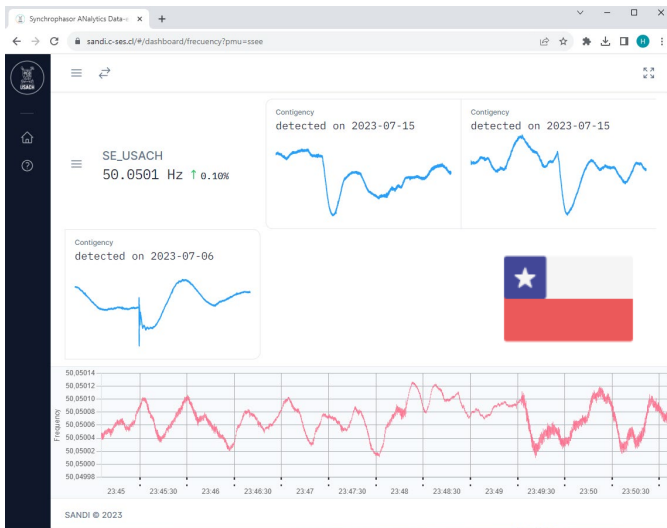
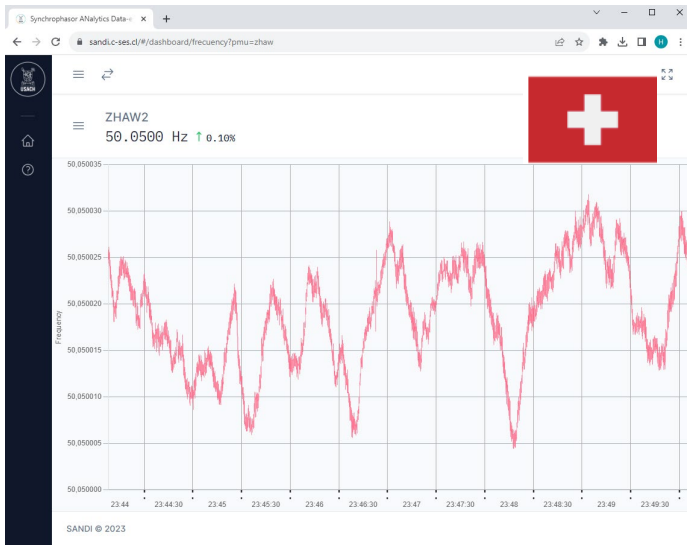
USACH

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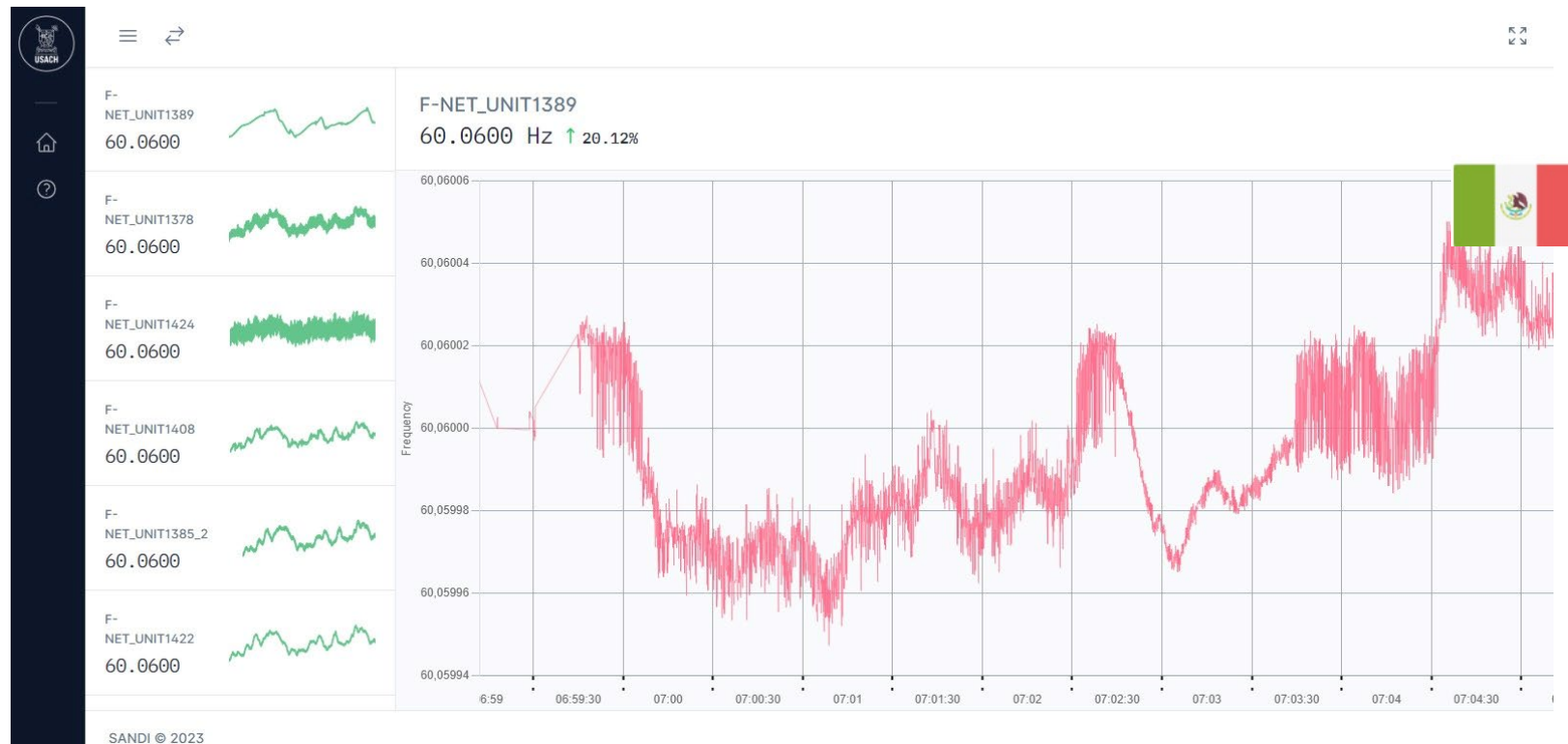
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SANDI © 2023

# 3. Real-time lab demonstrations and open access data bases (Lead: Hector Chavez, USACH, Chile)



Screenshot of real-time PMU data measurements in SANDI



## 3. Real-time lab demonstrations and open access data bases (Lead: Hector Chavez, USACH, Chile)

### Activity 3.1 Creation of contents for tutorials, panels, and didactic events

- Hosting International Conference: “The 2026 International Conference on Smart Grid and Synchronized Measurements and Analytics” [**Application Accepted!**]



**The 2026 International Conference on Smart Grid  
Synchronized Measurements and Analytics (SGSMA)**  
Santiago de Chile, Chile, *May 2026*



**Looking forward to meeting you in Chile!**



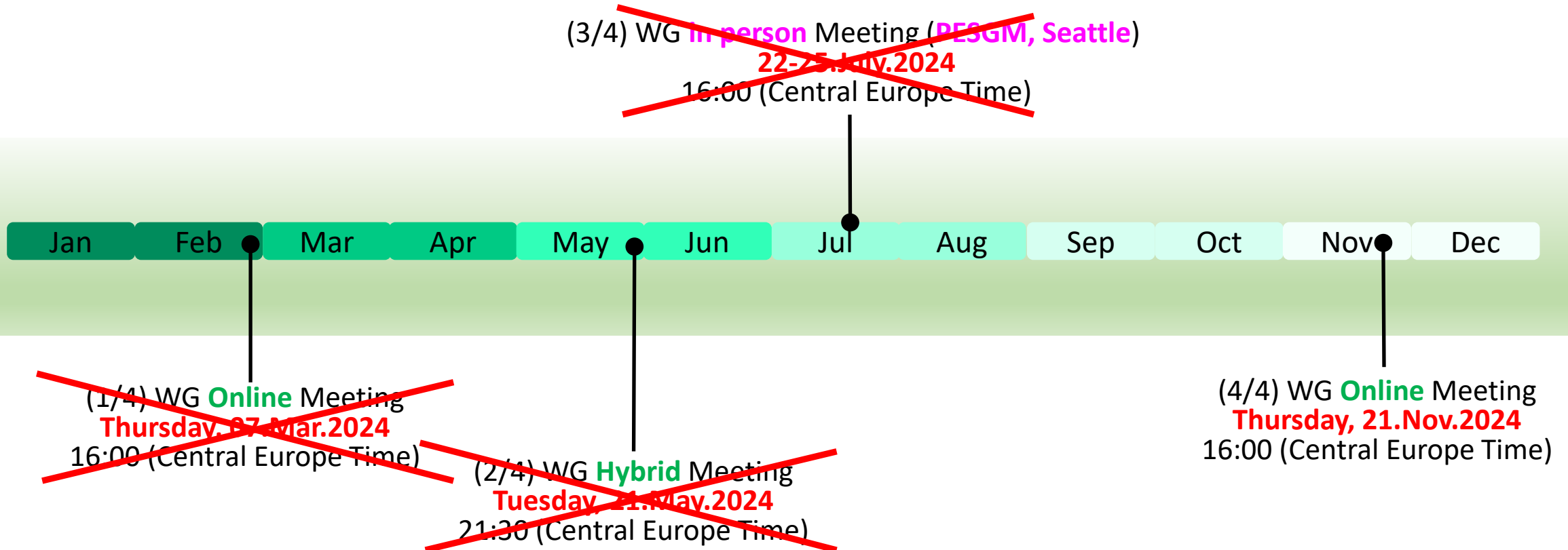
# Calendar of next meetings 2024

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# Calendar of meetings 2024

- **Outlook invitation** sent to all registered members
- Actual date of each meeting **subject to change**
- Reminder and **connection details** sent before (about one week) the actual meeting



# General Comments

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# Thank you for your attention

## Officers:

Rafael Segundo (Chair), [segu@zhaw.ch](mailto:segu@zhaw.ch)

Yanli Liu (Vice-Chair), [yanliliu@tju.edu.cn](mailto:yanliliu@tju.edu.cn)

Emilio Barocio (Vice-Chair), [emilio.barocio@cucei.udg.mx](mailto:emilio.barocio@cucei.udg.mx)

Petr Korba (Secretary), [korb@zhaw.ch](mailto:korb@zhaw.ch)

## Subtask leaders:

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Jochen Cremer, [j.l.cremer@tudelft.nl](mailto:j.l.cremer@tudelft.nl)

Hector Chavez, [hector.chavez@usach.cl](mailto:hector.chavez@usach.cl)

