



**JISDM 2022**

**5<sup>th</sup> Joint International Symposium on  
Deformation Monitoring**

**20-22 June 2022**

Polytechnic City of Innovation,  
Universitat Politècnica de València (UPV),  
Valencia, Spain

<https://jisdm2022.webs.upv.es/>  
@jisdm2022

**GUIDE**





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Local Organisers

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UNIVERSITAT  
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ESCUELA TÉCNICA SUPERIOR  
DE INGENIERÍA GEODÉSICA  
CARTOGRÁFICA Y TOPOGRÁFICA



DEPARTAMENTO DE  
INGENIERÍA CARTOGRÁFICA,  
GEODESIA Y FOTOGRAMETRÍA

Scientific & Professional Commissions

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International Federation  
of Surveyors



International Association  
of Geodesy



information from imagery

## EDITORIAL

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Dear participants,

We are glad to welcome you in Valencia for the 5<sup>th</sup> Joint International Symposium on Deformation Monitoring (JISDM 2022).

In 2019, the last edition of this Symposium concluded with an outstanding keynote entitled “On technological revolution in geospatial data acquisition, analysis and application” that anticipated future trends on deformation monitoring. However, nobody could foresee that the Covid-19 pandemic would interrupt our lives, professional activities and projects for almost two years. Naturally, it also impacted the organization of this edition, which had to be postponed for two months. Fortunately, the JISDM 2022 can be eventually held in person, which will undoubtedly contribute to a fruitful conference with open discussions and networking to promote high-quality deformation monitoring.

As is being customary, the 5<sup>th</sup> JISDM Scientific Committee called for two types of submissions, i.e. peer review and non-peer review papers, so that experts with different profiles can equally contribute to the advancement of deformation monitoring. This edition includes 90 oral and 18 poster presentations whose topics relate to technical, methodological, and practical advances in the field of deformation monitoring. The technical sessions have been organised to facilitate open discussion and promote constructive exchanging ideas.

Aside from the professional and technical activities concerning this symposium, we hope you can find the time to enjoy the city of Valencia, where culture, architecture, gastronomy, nightlife, and white sand beaches are major tourist destinations, especially at this time of the year.

We strongly acknowledge the support of the three scientific and professional commissions, FIG, IAG and ISPRS, the time and effort devoted by the members of the Scientific Committee to review the manuscripts, and we are specially grateful to all the authors for their contributions.

We hope you spend a memorable and fruitful time during this symposium in Valencia, and firmly believe that the JISDM 2022 will be as successful as the previous ones.

Valencia, June 2022

**Prof. Luis García-Asenjo Prof. José Luis Lerma**  
The 5<sup>th</sup> JISDM Organizing Committee

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## TOPICS

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### **Methods**

Methods for advanced deformation analysis and interpretation, Testing theory, Static and dynamic modeling of deformations, Quality Control/Quality Assurance and optimization techniques in deformation analysis, Photogrammetric and computer vision methods, Point cloud based spatio-temporal monitoring, Artificial intelligence and augmented reality for deformation monitoring, Innovative algorithms and data processing techniques.

### **Sensors**

Optical systems and total stations, GNSS-based monitoring, Laser scanning and LiDAR systems, Camera-based monitoring, Ground and spaceborne radar, Fiber-optics and geotechnical sensors.

### **Integration & Automation**

Sensor fusion, Geo-sensor networks, UAV and miniaturized sensors, New and low-cost sensors, Web-based smart sensing.

### **Applications**

Reference frames and geodynamics, Local and regional geodynamics, Deformation monitoring for construction engineering, Structural health monitoring, Vibration monitoring and dynamics, Big and tall structures monitoring, Monitoring of archaeological and cultural heritage, Monitoring of geohazards, Ground settlements and landslides, Bridge and tunnel applications, Dam and mining applications, Metrology and industrial applications, Applications in Geosciences at Local or Regional scale.

### **Education and Policies**

Educational aspects in deformation monitoring, Safety, health and environmental issues, Project management for deformation monitoring, Standardization and data exchange policies, Economic and social implications of deformation monitoring works.

## *Technical Tracks*

Topics are organized according to the following technical tracks:

- QC/QA and optimization techniques in deformation analysis
- New concepts for GNSS-based monitoring
- Point cloud-based space-temporal deformations
- New sensors for deformation measurements
- Terrestrial laser scanning for deformation monitoring
- New length metrology sensors and methods for deformation monitoring
- Reference frames and geodynamics
- Multi-sensor systems and new concepts for deformation measurements
- New aspects of deformation measurements with automated total stations
- Vibration monitoring and dynamics
- Ground-based and spaceborne radar
- Monitoring of dams
- Monitoring of landslides, rockfalls, and other geonatural hazards
- Deformation measurements for construction engineering
- UAV for change detection and deformation monitoring
- Novel approaches for monitoring archaeological sites and cultural heritage
- Dynamic and kinematic deformation modeling
- Web-based deformation analysis tools
- Monitoring of ground movements associated with mining activities
- Mini-symposium on advanced methods for the analysis of deformation measurements

# ORGANISERS

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## Local Organiser



UNIVERSITAT  
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Universitat Politècnica de València



ESCUELA TÉCNICA SUPERIOR  
DE INGENIERÍA GEODÉSICA  
CARTOGRÁFICA Y TOPOGRÁFICA

Higher Technical School of  
Geodetic, Cartographic  
and Surveying Engineering



DEPARTAMENTO DE  
INGENIERÍA CARTOGRÁFICA,  
GEODESIA Y FOTOGRAMETRÍA

Department of Cartographic  
Engineering, Geodesy and  
Photogrammetry

## Scientific & Professional Commissions

### International Federation of Surveyors (FIG)

Commission 6: Engineering Surveys

WG 6.1: Deformation Monitoring and Analysis

Commission 5: Positioning and Measurement

### International Association of Geodesy (IAG)

Commission 4: Positioning and Applications

### International Society for Photogrammetry and Remote Sensing (ISPRS)

WG III/5: Information Extraction from LiDAR Intensity Data



International Federation  
of Surveyors



International Association  
of Geodesy



information from imagery

## SCIENTIFIC AND LOCAL COMMITTEES

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### SCIENTIFIC COMMITTEE

**Arnoso José**, Spain  
**Baselga Sergio**, Spain  
**Bastos Luísa**, Portugal  
**Bolkas Dimitrios**, USA  
**Brzezinska Dorota**, USA  
**Capra Alessandro**, Italy  
**Catalão João**, Portugal  
**Crosetto Michele**, Spain  
**Danezis Chris**, Cyprus  
**Ding Xiaoli**, China  
**Eschelbach Cornelia**, Germany  
**García-Asenjo Luis**, Spain  
**García-Cañada Laura**, Spain  
**Georgopoulos Andreas**, Greece  
**Gikas Vassilis**, Greece  
**Gil-Cruz Antonio**, Spain  
**Gonçalves José**, Portugal  
**Hancock Craig**, UK  
**Henriques Maria**, Portugal  
**Kuhlmann Heiner**, Germany  
**Lerma José Luis**, Spain  
**Lichti Derek**, Canada  
**Lienhart Werner**, Austria  
**Masiero Andrea**, Italy

**Meng Xiaolin**, China  
**Neuner Hans**, Austria  
**Niemeier Wolfgang**, Germany  
**Núñez-Andrés Amparo**, Spain  
**Paffenholz Jens-André**, Germany  
**Poutanen Markku**, Finland  
**Prieto Juan F.**, Spain  
**Psimoulis Panos**, UK  
**Pytharouli Stella**, UK  
**Rizos Chris**, Australia  
**Roman Daniel R.**, USA  
**Rinaudo Fulvio**, Italy  
**Santos Marcelo**, Canada  
**Scaioni Marco**, Italy  
**Schwieger Volker**, Germany  
**Sousa Joaquim J.**, Portugal  
**Staller Alejandra**, Spain  
**Tari Ergin**, Turkey  
**Toth Charles**, USA  
**Wieser Andreas**, Switzerland  
**Yigit Cemal Ozer**, Turkey  
**Zang Kefei**, Australia  
**Zurutuza Joaquín**, Spain

### LOCAL ORGANISING COMMITTEE

García-Asenjo Luis  
Lerma José Luis  
Anquela Ana Belén  
Padín Jorge  
Marqués Ángel  
Garrido Natalia  
Cabrelles Miriam  
Luján Raquel  
Calderón Pedro  
Martín Ángel

## KEYNOTES

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### Dominique Missiaen



*Conseil Européen pour la Recherche Nucléaire (CERN)*

### Challenges for monitoring particle accelerators components

He graduated from the French Ecole Supérieure des Géomètres et Topographes and joined the Conseil Européen pour la Recherche Nucléaire (CERN) in 1987 where he was first in charge of the alignment of the magnets of pre-injector (LIL) of the Large Electron Positron (LEP). In 1994, the date of the approval of the construction of the Large Hadron Collider (LHC), he became responsible for the internal metrology of the LHC cryo-magnets during their assemblies. Since 1988, he was also in charge of the development and the maintenance of the survey Oracle database.

In 2004, he became the deputy of the Survey and alignment group leader, mainly in charge of the alignment of the LHC components. In 2009, he took the responsibility of for the whole section “Large Scale Metrology”, which is devoted to the alignment and positioning of all accelerators and detectors components at CERN.

In 2018, following a strong reorganization of several groups at CERN, he became the Survey Special Projects Coordinator with the responsibility of the development of a measurement train for automatic monitoring of the particle accelerators components position.

Since beginning 2021, he works for the Geographical Information System (GIS) at CERN with main activities linked to Oracle and Geospatial databases.



*Institute of Geosciences (IGEO) CSIC-UCM, Spain*

### Geodetic study of the magmatic plumbing system for La Palma 2021 eruption

José Fernández is a Research Full Professor at the Institute of Geosciences (IGEO) of the Spanish Council for Scientific Research (CSIC).

His research is developed in the field of Geodesy and its application to natural (earthquakes, volcanoes, ground instabilities) and anthropogenic hazards, both in the observation (using terrestrial and space techniques) and modelling aspects. The developed models have been applied, in combination with inversion methods (genetic algorithm, random search, etc.), for the interpretation of displacements and gravity changes in volcanic, seismic and subsidence areas. These models, and their use for the interpretation of observations, are a fundamental tool during volcanic analysis.

He has been editor of the SCI journal "Pure and Applied Geophysics" up to December 2020 and currently he is editor of "Scientific Reports" (Nature group), "Remote Sensing", and "Contributions to Geodesy & Geodesy" and member of the Editorial Advisory Board of Journal of Geodetic Science. He has participated in different Working Groups of the International Association of Geodesy.

He has participated in more than 85 research projects (national, European Union, ESA, NASA, and other Space Agencies and international organizations), being in 57 of them Coordinator, Responsible Investigator or responsible Co-researcher. He has supervised/co-supervised, 7 doctoral and 7 graduation theses, both in Spain and in European Universities.

He has organized 8 international congresses and one session at the Fall AGU Meeting in 2015, and has more than 290 presentations at international conferences, with 20 invited talks in the last 10 years.

His research results have been described in 120 publications in JCR journals. He has been the editor of 8 books. His works have more than 2400 citations, and an H index of 28 (Scopus).

## Prof. Alessandro Capra



*University of Modena and Reggio Emilia (UNIMORE), Italy*

### Geomatics for monitoring the impacts on environmental and cultural heritage

Alessandro Capra is a Full Professor of Geomatics since 2002 and pertaining at the DIEF department of the University of Modena and Reggio Emilia (UNIMORE).

He was born the 05/05/1961 in Bologna. He got his Classical high school diploma in 1980 and his master's degree in mining engineering on in 1987.

He is coordinator of Italian geodetic observatory of PNRA (Italian Research Program on Antarctica) since 1998. He was Chief Officer of SCAR (Scientific Committee on Antarctic Research) Geosciences Standing Group from 2004 to 2012 and Director of DIASS department of Polytechnic of Bari from 2003 to 2005.

He is the Editor-in-chief of Applied Geomatics (Springer Editor) since 2008. He was President of SIFET (Italian Society of Photogrammetry and Surveying) from 2010 to 2014, Director of DIMEC Department (UNIMORE) from 2010 to 2012 and Director of DIEF Department of UNIMORE from 2012 to 2018. He is president of the Association China Project since 2019 and delegate for Internationalization of UNIMORE since November 2019.

Alessandro Capra is the author and co-author of 235 scientific publications, and he presented memories at national and international symposia. He has been principal Investigator of research projects at national and international levels and responsible of applied research activities with public and private bodies. He has also performed professional activities and advising for private companies and public entities for more than thirty years.

## Prof. Werner Lienhart



*Graz University of Technology (TU Graz)*

### The role of IoT sensors and virtual reality in the planning, analysis and visualization of deformation monitoring data

Werner Lienhart is Full Professor and Head of the Institute of Engineering Geodesy and Measurement Systems (IGMS) at Graz University of Technology (TU Graz), Austria. At IGMS Werner and his team develop new geodetic and fibre optic sensors for Structural Health Monitoring (SHM).

Prior to his university position, he was product manager at Leica Geosystems at the headquarter in Switzerland. At Leica he was responsible for the development of the Galileo and GPS L5 capable receivers and the Leica imaging total stations.

Now at TU Graz Prof. Lienhart is responsible for the IGMS measurement lab, where several specific calibration facilities were set up for the calibration of interferometric, Bragg grating and distributed fibre optic sensors as well as for the testing of total stations, prisms, laser scanners and geodetic gyroscopes. He has more than 20 years of experience in practical applications of fibre optic and geodetic sensors for the monitoring of civil structures like bridges or natural phenomena like landslides.

He and his team have installed and are currently responsible for the operation of several fibre optic monitoring systems of long railway and highway tunnels as well as the monitoring of water dams, gas pipelines, reinforced earth structures and landslides.

He has published more than 120 scientific articles, holds several patents, is Vice President of the International Society for Structural Health Monitoring of Intelligent Infrastructure (ISHMII), President of the Austrian Geodetic Commission (OeGK), Vice President for West Europe of the International Society of Environmental Geotechnology (ISEG) and chair elect of Commission 6 of the International Federation of Surveyors (FIG).

# Detect the unexpected

Monitor construction sites and infrastructure for stability and risk.



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# PROGRAMME OVERVIEW

## Monday, 20 June 2022

08:30-09:00	<b>Registrations</b>	
	<b>Auditorium (Blue Box)</b>	
09:00-10:00	<b>Opening ceremony</b>	
10:00-11:00	<b>Keynote Speeches</b>	
11:00-12:30	ORAL 00 Monitoring based on deep learning and artificial intelligence	
12:30-13:30	Lunch break	
	<b>Auditorium (Blue Box)</b>	<b>Red Box</b>
13:30-15:00	ORAL 01 Monitoring of landslides, rockfalls, and other geonatural hazards	ORAL 02 QC/QA and optimization techniques in deformation analysis
15:00-15:30	Coffee break	
15:30-15:45	Sponsor presentations (Red Box)	
15:45-17:00	ORAL 03 Multi-sensor systems and new concepts for deformation measurements	ORAL 04 Monitoring of ground movements associated with mining activities – I
11:00-17:00	Poster Sesión 1 (Hallway)	
20:00	Welcome reception	

## Tuesday, 21 June 2022

	<b>Auditorium (Blue Box)</b>	<b>Red Box</b>
09:00-10:30	ORAL 05 Spaceborne radar monitoring	ORAL 06 New length metrology sensors and methods for deformation monitoring - I
10:30-11:00	Coffee break	
11:00-12:30	ORAL 07 Terrestrial laser scanning for deformation monitoring - I	ORAL 08 New length metrology sensors and methods for deformation monitoring - II
12:30-13:30	Lunch break	
13:30-15:00	ORAL 09 Deformation measurements for construction engineering	ORAL 10 GNSS-based ground deformation analysis
15:00-15:30	Coffee break	
15:30-17:00	ORAL 11 Novel approaches for monitoring cultural heritage	ORAL 12 Monitoring of ground movements associated with mining activities – II
09:00-17:00	Poster Sesión 2 (Hallway)	
20:00	Dinner	

## Wednesday, 22 June 2022

	<b>Auditorium (Blue Box)</b>	<b>Red Box</b>
09:00-10:30	ORAL 13 Laser scanning for deformation monitoring	ORAL14 Vibration monitoring and dynamics
10:30-11:00	Coffee break	
11:00-12:30	ORAL 15 New sensors for deformation measurements	ORAL 16 Advanced methods for the analysis of deformation measurements
12:30-13:30	Lunch break	
13:30-15:00	ORAL 17 UAV-based deformation monitoring	ORAL 18 Monitoring of landslides, rockfalls, and other geonatural hazards - II
09:00-15:00	Poster Sesión 3 (Hallway)	
	<b>Auditorium (Blue Box)</b>	
15:00-16:00	<b>Keynote speech</b>	
16:00-17:00	<b>Awards - Closing ceremony</b>	

## TECHNICAL SESSIONS

### Keynote speeches (Blue Box)

Monday 10:00 -11:00

**Challenges for monitoring particle accelerators components**

*Dominique Missiaen, Conseil Européen pour la Recherche Nucléaire (CERN)*

**Geodetic study of the magmatic plumbing system for La Palma 2021 eruption**

*José Fernández, Institute of Geosciences (IGEO) CSIC-UCM, Spain*

**Geomatics for monitoring the impacts on environmental and cultural heritage**

*Alessandro Capra, University of Modena and Reggio Emilia (UNIMORE), Italy*

### ORAL 00 (Blue Box) **Monitoring based on deep learning and artificial intelligence**

Monday 11:00 -12:30

*Chairs: Andreas Wieser/Roberto Pierdicca*

**[Adaptive spatial discretization using reinforcement learning](#) [Selected paper]**

*Jemil Avers Butt, Andreas Wieser*

**[A discussion on the uses of smart sensor network, cloud-computing, digital twin and artificial intelligence for the monitoring of long bridges](#)**

*Xiaolin Meng, Zejun Xiang, Yilin Xie, George Ye, Panagiotis Psimoulis, Qing Wang, Ming Yang, Yulong Ge, Shengli Wang, Jian Wang*

**[Towards an automated machine learning and image processing supported procedure for crack monitoring](#)**

*Luigi Parente, Cristina Castagnetti, Eugenia Falvo, Francesca Grassi, Francesco Mancini, Paolo Rossi, Alessandro Capra*

**[Automated damage detection for port structures using machine learning algorithms in heightfields](#) [Selected paper]**

*Frederic Hake, Paula Lippmann, Hamza Alkhatib, Vincent Oettel, Ingo Neumann*

12:30 - 13:30

LUNCH BREAK

Monday 13:30 - 15:00

Chairs: Panos Psimoulis/Josep Gili

**Volcano monitoring of the 2021 La Palma eruption by the Instituto Geográfico Nacional**

Laura García-Cañada, Elena González-Alonso, Itahiza Domínguez Cerdeña, Francisco Quirós, Héctor Lamolda, Carmen del Fresno, Anselmo Fernández-García, Antonio Jesús Molina-Arias, Alicia Felpeto, Jorge Pereda de Pablo, Jorge Domínguez-Valbuena, Pedro Torres-González, Fernando Prieto Llanos, Lucía Sáez-Gabarrón, Eduardo Díaz-Suarez, Rubén López-Díaz, David Moure-García, Stavros Meletlidis, María José Blanco, Carmen López

**MOMPA: InSAR monitoring in the Eastern Pyrenees**

Anna Barra, Ivan Fabregat, Anna Echeverria, Jordi Marturià, Qi Gao, Guido Luzi, María Cuevas, Pere Buxó, Laura Trapero, Muriel Gasc, Pedro Espin, M. Crosetto

**Forecasting post-earthquake rockfall activity [Selected paper]**

Michael J Olsen, Chris Massey, Ben Leshchinsky, Joseph Wartman, Andrew Senogles

**Rockfall monitoring: comparing several strategies for surveying detached blocks and their volume, from TLS point clouds and GigaPan pictures**

Oriol Pedraza, Alvaro P. Aronés, Càrol Puig, Marc Janeras, Josep A. Gili

**Long and close-range terrestrial photogrammetry for rocky landscape deformation monitoring**

Miriam Cabrelles, José Luis Lerma, Luis García-Asenjo, Pascual Garrigues, Laura Martínez

Monday 13:30 - 15:00

Chairs: Wolfgang Niemeier/Hans Neuner

**Quantification of the dependence of the results on several network adjustment applications**

Stéphane Durand, Michael Lösler, Mark Jones, Paul-Henri Cattin, Sébastien Guillaume, Laurent Morel

**On the Quality Checking of Persistent Scatterer Interferometry by spatial-temporal modelling [Selected paper]**

Mohammad Omidalizarandi, Bahareh Mohammadiojdan, Hamza Alkhatib, Jens-André Paffenholz, Ingo Neumann

**Transferability of an estimation procedure for distance deviations of terrestrial laser scanners from laboratory to on-site conditions**

Finn Linzer, Hans-Berndt Neuner

**Multi-epoch deformation analysis with geodetic datum invariance**

Hiddo Velsink

15:00 - 15:30

COFFEE BREAK

(Blue Box)

Sponsor presentations

Monday 15:30 – 15:45

ORAL 03 (Blue Box)

Multi-sensor systems and new concepts for deformation measurements

Monday 15:45 - 17:00

Chairs: Werner Lienhart/Xiaoli Meng

**Space Geodetic Observation and interpretation in Geodynamics and Engineering: Application examples**

José Fernández, Antonio G. Camacho, Juan F. Prieto, Joaquín Escayo, Mimmo Palano, Ignacio Marzán

[Accuracy Improvement of Mobile Laser Scanning Point Clouds using Graph-based Trajectory Optimization](#)

Felix Esser, José Angel Moraga, Lasse Klingbeil, Heiner Kuhlmann

[Integrated survey approaches for monitoring procedures during yard phases](#)

Awal Rahali, Eva Savina Malinverni, Roberto Pierdicca, Alessio Pierdicca, Gabriele Potenza, Matteo Lucesoli

[A self-acting mobile robot for monitoring floor flatness](#) [\[Selected paper\]](#)

Christoph Naab

ORAL 04 (Red Box)

Monitoring of ground movements associated with mining activities – I

Monday 15:45 - 17:00

Chairs: Wolfgang Niemeier/Damian Tondaś

[Evaluation of Synthetic Aperture Radar Interferometric Techniques for Monitoring of Fast Deformation Caused by Underground Mining exploitation](#)

Kamila Pawłuszek-Filipiak, Maya Ilieva, Natalia Wielgocka, Krzysztof Stasch

[Soil Moisture Mapping Based on Temperature-Soil Moisture Dryness Index - a case study for the tailing dam in Brumadinho, Brazil](#)

Yu Lan, Jens-André Paffenholz

[Multisensor monitoring of ground movements over large areas to conduct the change from the active underground hard coal mining ages to the post-mining era](#)

Volker Spreckels

[Set-up and application of multisensor-referencestations \(MSST\) for levelling, GNSS and InSAR in the former mining regions Saarland and Ruhrgebiet within Germany](#)

Volker Spreckels, Thomas Engel

[Early detection, permanent monitoring and documentation of critical locations at the surface in mining areas](#)

Alexander Kipp, Andreas Schlienkamp, Anna Ens

20:00 - 22:00

WELCOME RECEPTION (Hotel Only You)

# Tuesday, 21 June 2022

ORAL 05 (Blue Box)

SAR-based monitoring

Tuesday 9:00 - 10:30

Chairs: Michele Crosetto/Josep Gili

[InSAR displacement time series post-processing to back-analyze a slope failure](#)

*Dora Roque, Martino Correia, Ricardo Cabral, Steffan Davies, Tiago Cordeiro, Ana Fonseca, Paulo Barreto*

[Continuous long-term \(2016-2021\) monitoring of the surface deformations in the Upper Silesian Coal Basin, Poland](#)

*Maya Ilieva, Patryk Balak, Paweł Bogusławski, Piotr Polanin, Piotr Gruchlik, Andrzej Kowalski, Damian Tondaś, Krzysztof Stasch, Przemysław Tymków*

[Pan-European Deformation Monitoring: The European Ground Motion Service](#)

*Michele Crosetto, Lorenzo Solari, Marek Mróz*

[Registering the ground deformations at the area of the archaeological site "Solnitsata"](#)

*Hristo Nikolov, Mila Atanasova*

[Status of the new German DIN standards project "InSAR – radar interferometry for the detection of ground movements"](#)

*Volker Spreckels*

ORAL 06 (Red Box)

New length metrology sensors and methods for deformation monitoring - I

Tuesday 9:00 - 10:30

Chairs: Florian Pollinger/Joffray Guillory

[High-precision intermode-beating EDM for mitigation of atmospheric delays](#)

[\[Selected paper\]](#)

*Pabitra Ray, David Salido-Monzú, Andreas Wieser*

[Two multi-wavelength interferometers for large-scale surveying](#)

*Anni Sauthoff, Paul Köchert, Günther Prellinger, Tobias Meyer, Frank Pilarski, Stephanie Weinrich, Frank Schmaljohann, Joffray Guillory, Daniel Truong, Jakob Silbermann, Ulla Kallio, Jorma Jokela, Florian Pollinger*

[Optical distance measurements at two wavelengths with air refractive index compensation](#)

*Joffray Guillory, Daniel Truong, Jean-Pierre Wallerand*

[EDM-GNSS distance comparison at the EURO5000 calibration baseline: preliminary results](#) [\[Selected paper\]](#)

*Kinga Wezka, Luis García-Asenjo, Dominik Próchniewicz, Sergio Baselga, Ryszard Szpunar, Pascual Garrigues, Janusz Walo, Raquel Luján*

10:30 - 11:00

COFFEE BREAK

ORAL 07 (Blue Box)

Terrestrial laser scanning for deformation monitoring

Tuesday 11:00 - 12:30

Chairs: Volker Schwieger/Heiner Kuhlmann

[Real movement or systematic errors? – TLS-based deformation analysis of a concrete wall](#) [\[Selected paper\]](#)

Berit Jost, Daniel Coopmann, Christoph Holst, Heiner Kuhlmann

[Keypoint-based deformation monitoring using a terrestrial laser scanner from a single station: Case study of a bridge pier](#)

Tomislav Medic, Pia Ruttner, Christoph Holst, Andreas Wieser

[Two-epoch TLS deformation analysis of a double curved wooden structure using approximating B-spline surfaces and fully-populated synthetic covariance matrices](#)

Gabriel Kerekes, Jakob Raschhofer, Corinna Harmening, Hans Neuner, Volker Schwieger

[Selected aspects of geometrical analyses of surfaces measured using terrestrial laser scanning \(TLS\)](#)

Janina Zaczek-Peplinska, Maria Elżbieta Kowalska, Krystian Ryczko, Cezary Sekular

ORAL 08 (Red Box)

New length metrology sensors and methods for deformation monitoring - II

Tuesday 11:00 - 12:30

Chairs: Florian Pollinger/Joffray Guillory

[A Feasibility Study for Accelerated Reference Point Determination Using Close Range Photogrammetry](#)

Cornelia Eschelbach, Michael Lösler

[The European GeoMetre project – developing enhanced large-scale dimensional metrology for geodesy](#) [\[Selected paper\]](#)

Florian Pollinger, Sergio Baselga, Clément Courde, Cornelia Eschelbach, Luis García-Asenjo, Pascual Garrigues, Joffray Guillory, Per Olof Hedekvist, Tuomas Helojärvi, Jorma Jokela, Ulla Kallio, Thomas Klügel, Paul Köchert, Michael Lösler, Raquel Luján, Tobias Meyer, Pavel Neyezhnikov, Damien Pesce, Marco Pisani, Markku Poutanen, Günther Prellinger, Anni Sauthoff, Jeremias Seppä, Daniel Truong, Robin Underwood, Kinga Wezka, Jean-Pierre Wallerand, Mariusz Wiśniewski

[Monitoring Gravitational Deformations of the Wettzell 20 m Radio Telescope's Main Reflector Using a Leica RTC360](#)

Agnes Weinhuber, Alexander Neidhardt, Christoph Holst

[Validation of GNSS-based reference point monitoring of the VGOS VLBI telescope at Metsähovi](#)

Ulla Kallio, Joonas Eskelinen, Jorma Jokela, Hannu Koivula, Simo Marila, Jyri Näränen, Markku Poutanen, Arttu Raja-Halli, Paavo Rouhiainen, Heli Suurmäki

12:30 - 13:30

LUNCH

ORAL 09 (Blue Box)

Deformation measurements for construction engineering

Tuesday 13:30 – 15:00

Chairs: Xiaoli Meng/Jens-André Paffenholz

[Image segmentation of breakwater blocks by edge-base Hough transformation](#)  
[\[Selected paper\]](#)

*Fernando Soares, Vinicius Barbon*

[Identifying individual rocks within laser scans for a rigorous deformation analysis of water dams](#)

*Wolfgang Wiedemann, Christoph Holst*

[BIM approach applied to urban tunneling interferences](#) [\[Selected paper\]](#)

*Marco Trani, Silvia Longo, Monica Conti*

[Assessment of the accuracy of low-cost multi-GNSS receivers in monitoring bridge response](#) [\[Selected paper\]](#)

*Chenyu Xue, Panos Psimoulis, Qiuzhao Zhang, Xiaolin Meng*

[Deep machine learning in bridge structures durability analysis](#)

*Karolina Tomaszkiwicz, Tomasz Owerko*

ORAL 10 (Red Box)

Ground deformation analysis

Tuesday 13:30 - 15:00

Chairs: Markku Poutanen/Antonio Gil

[2D strain rate and ground deformation modelling from continuous and survey mode GNSS data in El Hierro, Canary Islands](#)

*Jose Arnoso, Umberto Riccardi, Umberto Tammaro, Maite Benavent, Fuensanta G. Montesinos, Emilio Vélez*

[Deformation Analysis with Feature Voting](#)

*Omer Bar, Gilad Even-Tzur*

[S-Wave detection using continuously operated GNSS stations: A case study of two Mw 7.1 earthquake events](#)

*Vassiliki Krey, Iordanis Galanis, Vangelis Zacharis, Maria Tsakiri*

[Imaging land subsidence in the Guadalentín River Basin \(SE Spain\) using Advanced Differential SAR Interferometry](#)

*Guadalupe Bru, Juan J. Portela, Pablo Ezquerro, M. Inés Navarro, Alejandra Staller, Marta Béjar-Pizarro, Carolina Guardiola-Albert, José A. Fernández-Merodo, Juan López-Vinielles, Roberto Tomás, Juan M. López-Sánchez*

15:00 - 15:30

COFFEE BREAK

ORAL 11 (Blue Box)

Novel approaches for monitoring cultural heritage

Tuesday 15:30 – 17:00

Chairs: Alessandro Capra/José Luis Lerma

[Static and Dynamic Monitoring of the Notre Dame de Paris Cathedral](#)

*Véronique Le Corvec, Patrick Lézin, François-Baptiste Cartiaux*

[Preserving the heritage of world's monuments through Structural Health Monitoring – A case study: the Garisenda Tower](#)

*François-Baptiste Cartiaux, Gian Carlo Olivetti, Valeria Fort, Patrice M. Pelletier*

[Multispectral imaging for the documentation of graffiti in an urban environment](#)

*Max Rahrig, José Luis Lerma*

[Concept for the integration of BIM and GIS data for monitoring land deformation around an ongoing infrastructure project](#)

*Szymon Glinka, Tomasz Owerko*

[Terrestrial Laser Scanning based deformation monitoring for masonry buildings subjected to ground movements induced by underground construction](#)

*Yiyan Liu, Sinan Acikgoz, Harvey Burd*

ORAL 12 (Red Box)

Monitoring of ground movements associated with mining activities – II

Tuesday 15:30 - 17:00

Chairs: Wolfgang Niemeier/Damian Tondaś

[Dynamic concepts to handle geodetic networks with continuous monitoring data in areas with ground movements](#)

*Wolfgang Niemeier, Dieter Tengen*

[Kalman filter for integration of GNSS and InSAR data applied for monitoring of mining deformations](#)

*Damian Tondaś, Witold Rohm, Maya Ilieva, Jan Kaplon*

[Geomonplus – Application for Storage, Allocation, Exchange, and Visualization of Historical and Actual 4d-Position-Data within Mining Areas](#)

*Steffen Bechert, Andreas Schlienkamp, Volker Spreckels*

20:00 - 23:00

GALA DINNER (*Hotel Las Arenas Sala Zeus*)

# Wednesday, 22 June 2022

ORAL 13 (Blue Box)

Laser scanning for deformation monitoring

Wednesday 9:00 - 10:30

Chairs: Jens-André Paffenholz/Roberto Pierdicca

[Supervoxel-based targetless registration and identification of stable areas for deformed point clouds](#) **[Selected paper]**

*Yihui Yang, Volker Schwieger*

[Monitoring the production process of lightweight fibrous structures using terrestrial laser scanning](#)

*Laura Balangé, Corinna Harmening, Rebeca Duque Estrada, Achim Menges, Hans Neuner, Volker Schwieger*

[Assessment of accuracy and performance of terrestrial laser scanner in monitoring of retaining walls](#)

*Ali Algadhi, Panos Psimoulis, Athina Grizi, Luis Neves*

[Extraction of key geometric parameters from segmented masonry arch bridge point clouds](#)

*Yixiong Jing, Brian Sheil, Sinan Acikgoz*

[Assessing sandy beach width variations on intertidal time scales using permanent laser scanning](#)

*Mieke Kuschnerus, Roderik Lindenbergh, Sierd de Vries*

ORAL 14 (Red Box)

Vibration monitoring and dynamics

Wednesday 09:00 - 10:30

Chairs: Vassilis Gikas/Xiaolin Meng

[Vibration monitoring of a bridge using 2D profile laser scanning: Lessons learned from the comparison of two spatio-temporal processing strategies](#)

*Nicholas Meyer, Lorenz Schmid, Andreas Wieser, Tomislav Medic*

[Dynamic monitoring of civil infrastructures with geodetic sensors](#)

*Caroline Schönberger, Werner Lienhart, Thomas Moser*

[Data fusion of MEMS accelerometer and hydrostatic leveling for structural health monitoring – the test rig investigations](#)

*Leonhard Pleuger, Mario Haupt, Jens-André Paffenholz*

[Steel bridge structural damage detection using Ground-Based Radar Interferometry \(GBRI\) vibration measurements and deep learning Convolutional Neural Networks](#)

*George Piniotis, Vassilis Gikas*

[High-rate real-time single-frequency PPP for structural motion detection in horizontal directions](#)

*Mert Bezcioglu, Baris Karadeniz, Cemal Ozer Yigit, Ahmet Anil Dindar, Burak Akpinar*

10:30 - 11:00 COFFEE BREAK

Wednesday 11:00 - 12:30

Chairs: Werner Lienhart/Volker Schwieger

[Bridge deformations during train passage: monitoring multiple profiles using concurrently operating MIMO-SAR sensors](#)

Andreas Baumann-Ouyang, Jemil Avers Butt, Andreas Wieser

[Drill Bit Grading using LiDAR and Imagery on the Apple Smart Devices](#)

Fengman Jia, Derek D. Lichti, Roman Shor, Arsh Khawaja, Min Kang, Max Kepler

[Monitoring of underwater animal forests: geometry and biometry](#)

Paolo Rossi, Cristina Castagnetti, Stefano Cattini, Giorgio Di Loro, Francesca Grassi, Luigi Parente, Sara Righi, Luigi Rovati, Roberto Simonini, Alessandro Capra

[Low-cost GNSS RTK receiver in structure monitoring under demanding conditions](#)

Przemysław Kuras, Daniel Janos, Łukasz Ortyl

Wednesday 11:00 - 12:30

Chairs: Wolfgang Niemeier/Luis García-Asenjo

[Classical Concepts for Deformation Monitoring - Strategies, Status and Limitations](#)

Wolfgang Niemeier

[Design, establishment, analysis and quality control of a high-precision reference frame in Cortes de Pallás \(Spain\)](#) [\[Selected paper\]](#)

Luis García-Asenjo, Laura Martínez, Sergio Baselga, Pascual Garrigues, Raquel Luján

[GLOMON-Monitoringportal for storage, management, advanced processing and intelligent visualization of GNSS- and other sensors data](#)

Michael Schulz, Florian Schäfer, Jürgen Ruffer

[Investigation of space-continuous deformation from point clouds of structured surfaces](#) [\[Selected paper\]](#)

Elisabeth Ötsch, Corinna Harmening, Hans Neuner

12:30 - 13:30

LUNCH BREAK

ORAL 17 (Blue Box) UAV-based deformation monitoring

Wednesday 13:30 - 15:00

Chairs: Craig Hancock/José Luis Lerma

[Comparison of TLS and sUAS point clouds for monitoring embankment dams](#)

Dimitrios Bolkas, Matthew O'Banion, Jakeb Prickett, Gregory Ellsworth, Gerald Rusek, Nicholas Lawler, Hannah Corson, David Williams, Brett Anderton

[Planning UAV surveys: can we rely on wind forecasts?](#)

Maria Henriques, Dora Roque

[The potential of UAV-based Laser Scanning for Deformation Monitoring – Case Study on a Water Dam](#)

Ansgar Dreier, Heiner Kuhlmann, Lasse Klingbeil

[PS-InSAR and UAV technology used in the stability study of Ankang expansive soil airport](#)

Jinzhao Si, Shuangcheng Zhang, Yufen Niu

[4D point cloud analysis of the September 2020 Mediane impact on Myrtos beach in Cephalonia, Greece](#)

Emmanuel Vassilakis, Alike Konsolaki, Stelios Petrakis, Evangelia Kotsi, Christos Fillis, Stelios Lozios, Efthymios Lekkas

ORAL 18 (Red Box)

Monitoring of landslides, rockfalls, and other geonatural hazards - II

Wednesday 13:30 – 15:00

Chairs: Vassilis Gikas/M. Amparo Núñez-Andrés

[ADATools: a set of tools for the analysis of terrain movement maps obtained with SAR Interferometry](#)

Oriol Monserrat, Anna Barra, Cristina Reyes-Carmona, María Cuevas, Marta Bejar-Pizarro, José Navarro, Roberto Tomas, Jorge Pedro Galve, Lorenzo Solari, Roberto Sarro, Rosa María Mateos, José Miguel Azañon, Gerardo Herrera, Bruno Crippa

[Monitoring the spatiotemporal variability of beach mesoforms by analyzing Sentinel-2 images](#)

Josep E. Pardo-Pascual, Carlos Cabezas-Rabadán, Jesús Palomar-Vázquez, Alfonso Fernández Sarria

[Hydrological-Driven Landslide in Northwestern China Measured by InSAR Time Series Analysis](#)

Qianyou Fan, Shuangcheng Zhang, Yufen Niu

[Implementation of a fixed-location time lapse photogrammetric rock slope monitoring system in Castellfollit de la Roca, Spain](#)

Gerard Matas, Albert Prades, M. Amparo Núñez-Andrés, Felipe Buill, Nieves Lantada

[First Experiment of Long-Range Panoramic Images on a High-Precision Geodetic Reference Frame](#)

Peyman Javadí, José Luis Lerma, Luis García-Asenjo

## Keynote speech (Blue Box)

*Wednesday 15:00 -16:00*

**The role of IoT sensors and virtual reality in the planning, analysis and visualization of deformation monitoring data**

*Werner Lienhart, Graz University of Technology (TU Graz), Austria*

15:00 - 17:00

CLOSING CEREMONY

## POSTER SESSIONS

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### [Deformation analysis in landslides NE Bulgaria using GNSS data complemented by InSAR for better interpretation results](#)

Mila Atanasova, Hristo Nikolov, Ivan Georgiev, Anton Ivanov

### [Current State of Multi-constellation and multi-frequency Precise Point positioning](#)

Fernando Chacón, Leire Anne Retegui, Antonio Herrera, M Clara de Lacy

### [Point displacements during classical measurements – a practical approach to pseudo epochs between measurements](#)

Robert Duchnowski, Patrycja Wyszowska

### [Analysis of the Lisbon metropolitan area using the P-SBAS service of the Geohazards Exploitation Platform \(GEP\)](#)

Jorge P. Galve, Cristina Reyes-Carmona, Anna Barra, Marta Béjar-Pizarro, Oriol Monserrat, Ricardo Garcia Campus, Jose Luis Zezere, Paulo Sergio de Figueiredo Ferreira, Sara Alexandra Figueira Damaso, Susana Isabel Magro Siborro, Rosa M. Mateos, José Miguel Azañón

### [Crustal velocity field in Baza and Galera faults: A new estimation from GPS position time series in 2009 - 2018 time span](#)

Antonio J Gil, M Jesús Borque, Manuel Avilés, M Clara de Lacy, Jesús Galindo-Zaldívar, Pedro Alfaro, F.J. García-Tortosa, Alberto Sánchez-Alzola, Iván Martín-Rojas, Iván Medina-Cascales, Patricia Ruano, Víctor Tendero, Asier Madarieta-Txurruka, Sergio Blanca, Moisés Madrigal, Fernando Chacón, Lucía Miras

### [High-rate Real-Time PPP For Dynamic Motion Detection In Vertical Direction](#)

Baris Karadeniz, Mert Bezcioglu, Cemal Ozer Yigit, Ahmet Anil Dindar, Burak Akpinar

### [Experimental Assessment of the Accuracy of a Ground-Based Radar Interferometer \(GBRI\) in a fully controlled laboratory environment](#)

George Piniotis, Vassilis Gikas

### [Deformation monitoring with robotic total stations. Pushing the limits](#)

Josep Raventós, Enric Sans

### [Monitoring embankment dams from space using satellite radar interferometry: Case studies from RemoDams project](#)

Antonio M. Ruiz-Armenteros, José Manuel Delgado-Blasco, Matus Bakon, Francisco Lamas-Fernández, Miguel Marchamalo-Sacristán, Antonio J. Gil-Cruz, Juraj Papco, Beatriz González-Rodrigo, Milan Lazecky, Daniele Perissin, Joaquim J. Sousa

### [Monitoring instabilities by MT-InSAR in a mesa placed town \(Arjona, Guadalquivir valley, South Spain\)](#)

Antonio Miguel Ruiz-Armenteros, Mario Sánchez-Gómez, José Manuel Delgado-Blasco, Matus Bakon, Ana Ruiz-Constán, Jesús Galindo-Zaldívar, Milan Lazecky, Miguel Marchamalo-Sacristán, Joaquim J. Sousa

### [Permanent terrestrial LiDAR monitoring in mining, natural hazard prevention and infrastructure protection – Chances, risks, and challenges: A case study of a rockfall in Tyrol, Austria](#)

Daniel Schröder, Katharina Anders, Lukas Winiwarter, Daniel Wujanz

### [Structural analysis of monitoring results of long-span roof structures](#)

Roman Shults

**Monitoring of land subsidence in the city of Recife/Brazil using Sentinel-1 SAR interferometry**

*Wendson de Oliveira Souza, Antonio Miguel Ruiz-Armenteros,  
Jaime Joaquim da Silva Pereira Cabral*

**CGPS Crustal velocity field in the Iberian Peninsula**

*Fernando Chacón, M Clara de Lacy, Manuel Avilés, Antonio J Gil*

**Pathological diagnostic tool based on the combination of different disciplines. Management of the preservation of cultural heritage. Application in the structural consolidation of rock structures**

*Jorge Juan Romo-Berlana, Manuel Sánchez-Fernández, José Juan de Sanjosé-Blasco,  
Fernando Berenguer-Sempere*

**Sensitivity analysis of control networks in terms of minimal detectable displacements**

*Krzysztof Książek, Sławomir Łapiński*

**Assessing vertical terrain displacement from TLS data by applying  $M_{split}$  estimation – theoretical analysis**

*Patrycja Wyszowska, Robert Duchnowski*

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## USEFUL INFORMATION

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### Symposium venue

The symposium is held in the Polytechnic City of Innovation (CPI).



The CPI is the Science Park of the Universitat Politècnica de València (UPV). The Science Park is conceived as a space to connect university, business and society in order to streamline the generation of knowledge-intensive activities. The CPI aims to contribute to capitalise the UPV's knowledge generating impact by transferring its results and contributing to socio-economic development.

### Address

Universitat Politècnica de València  
Camino de Vera, s/n – Buildings 8B-8E  
46022 Valencia

The specific location of the venue is shown in this interactive map  
Coordinates in WGS84:

N: 39° 28' 56.53"

W: 0° 20' 36.88"

Tel. (+34) 96 387 70 00

### Accessibility

The Polytechnic City of Innovation is located just a few minutes walking distance from the Mediterranean Sea. Visitors can get to the venue by public transport using the following bus or tram services:

#### By public transport: the following buses or trams serve the CPI:

- (Av. del Cid – PG. Marítim) 93: (stop 1918 )
- (Av del Cid – Est. Cabanyal/PG. Marítim) 98: (stop 1918)
- Tram lines 4 and 6: (stop Serrería)
- 



## SOCIAL EVENTS

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### Welcome reception

*Monday, 20 June 2022 – 20:00*

Hotel **Only You Valencia**, located in the historic center.



### Gala dinner

*Tuesday, 21 June 2022 – 20:00*

Hotel **Las Arenas**, located by the sea.



## ACKNOWLEDGEMENTS

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Dear participant,

We are really grateful for you to attend the 5<sup>th</sup> Joint International Symposium on Deformation Monitoring (JISDM 2022).

We express our gratitude to the sponsors (*Topcon, Leica Geosystems, Institut Cartogràfic Valencià, Càtedra de Geomàtica Valenciana, and Diputació de València*) as well as endorsers (*Instituto Geográfico Nacional, Colegio de Ingenieros en Geomática y Topografía y Colegio de Ingenieros de Caminos, Canales y Puertos de la Comunidad Valenciana*).

We expressly acknowledge the key role of the three international co-organisers (International Federation of Surveyors, International Association of Geodesy, and International Society of Photogrammetry and Remote Sensing).

Finally, we want to recognize the remarkable work done by the members of the Scientific Committee to contribute their time to review the manuscripts submitted to the symposium.

We hope you enjoy your stay in Valencia.

**Prof. Luis García-Asenjo Prof. José Luis Lerma**

## SPONSORS

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## CONTACT

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**JISDM 2022**

**5<sup>th</sup> Joint International Symposium on Deformation  
Monitoring**

**20-22 June 2022**

Polytechnic City of Innovation,  
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