Management Committee Meeting (MC6)

CA18203 - Optimising Design for Inspection, Cardiff - UK

27th September 2022

10am – 12.30pm (Local Time)

3. Agenda (1/2)

1. Welcome to participants (RP)
2. Verification of the presence of two-thirds of the Participating COST Countries or, if applicable, a quorum (All)
3. Agenda (RP)
4. Actions from last meeting (RP)
5. Update from the Action Chair (RP)
6. Update from Communications Officer (PD)
7. Update from Grant Holder (RU)

3. Agenda (2/2)

8. Update from COST Association (RP)
9. Update from Workgroup Leads
10. Scientific planning for Next Grant Period
11. AOB
12. Location and date of next meeting
13. Summary of MC decisions
14. MC Closing

1. Welcome to Participants

Name: Rhys Pullin

Organization: Cardiff University, Wales

Email: pullinr@cardiff.ac.uk

Management Committee Meeting (MC6)

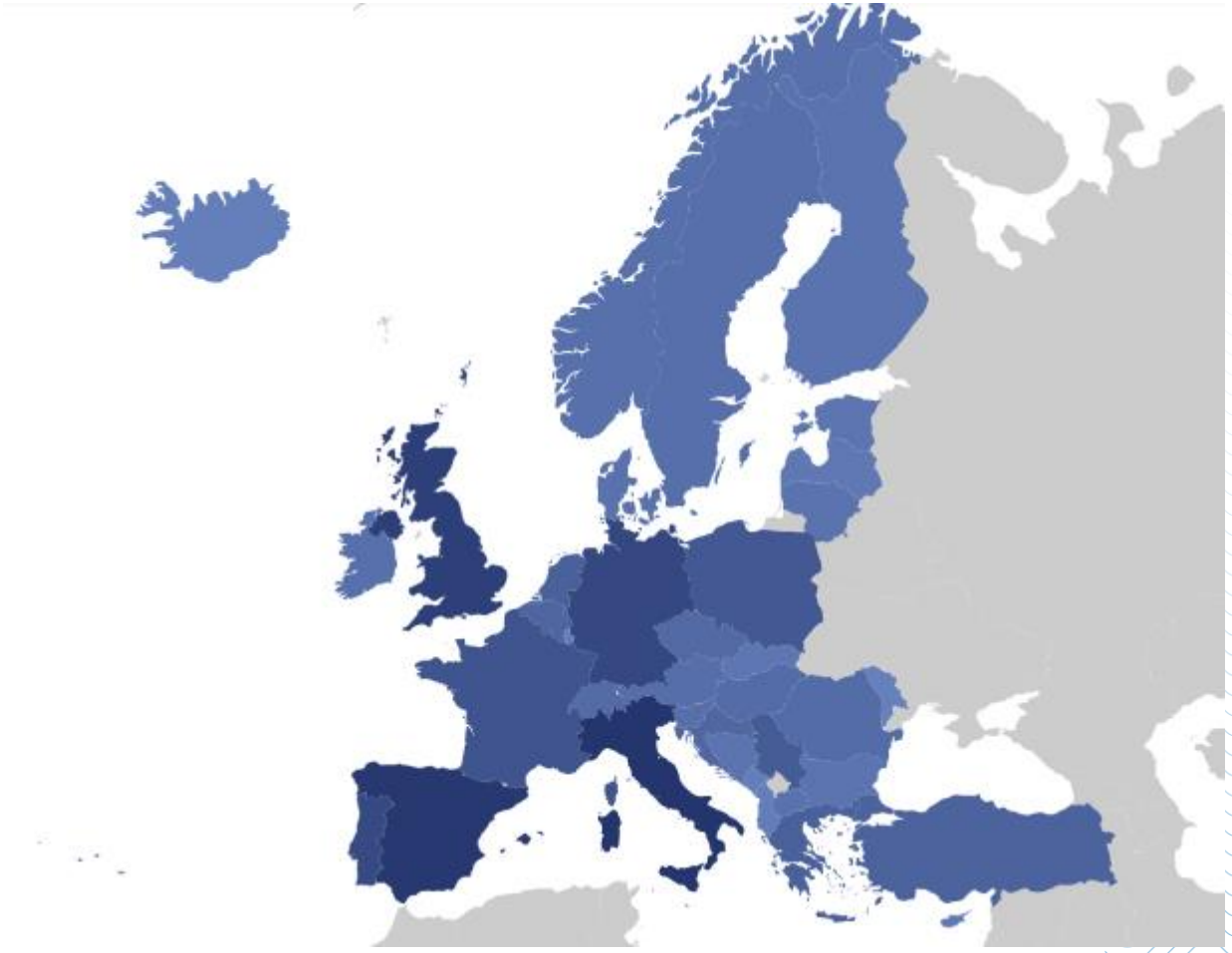
1. Welcome to New Participants

2. Quorum?

Management Committee Meeting (MC6)

2. Quorum?

- Bosnia and Herzegovina, Belgium, Bulgaria, Cyprus, Czech Republic, Germany, Estonia, Greece, Spain, France, Croatia, Ireland, Iceland, Italy, Lithuania, Latvia, North Macedonia, Netherlands, Poland, Portugal, Romania, Serbia, Sweden, Slovenia, Turkey, Israel and United Kingdom.



3. Adoption of Agenda

Management Committee Meeting (MC6)

3. Agenda (1/2)

1. Welcome to participants (RP)
2. Verification of the presence of two-thirds of the Participating COST Countries or, if applicable, a quorum (All)
3. Adoption of Agenda (RP)
4. Actions from last meeting (RP)
5. Update from the Action Chair (RP)
6. Update from Communications Officer (PD)
7. Update from Grant Holder (RU)

3. Agenda (2/2)

8. Update from COST Association (RP)
9. Update from Workgroup Leads
10. Scientific planning for Next Grant Period – Ideas Submitted!
11. AOB
12. Location and date of next meeting
13. Summary of MC decisions
14. MC Closing

4. Actions from Last Meeting

Management Committee Meeting (MC6)

4. Actions from Last Meeting (RP)

Budget completed as part of MC – Grant Period Document to be completed and submitted	RP/RU
Training School in France – Provide details of Training to School for GPD	RT
Determine registration process for TS	RP/RT
MC Location in Cardiff date TBC based on EJ/CB STSM	RP
Early invitation for VISA	RP
Thomas Kek temporary lead	CG
Transfer of budgets (from meetings) 10,000 Euros to STSM, 20,000 Euros to virtual meeting	RU
Accept two MC proposals	ALL

4. Actions from Last Meeting (RP)

Budget completed as part of MC – Grant Period Document to be completed and submitted	RP/RU
Training School in France – Provide details of Training to Sch… …SPD	RT
Determine registration process for TS	RP/RT
MC Location in Cardiff date TBC based on … …TSM	RP
Early invitation for VISA	RP
Thomas Kek temporary …	CG
Transfer of bud… …om meetings) 10,000 Euros to STSM, 20,000 Euros to virtual …	RU
Accept two MC proposals	ALL

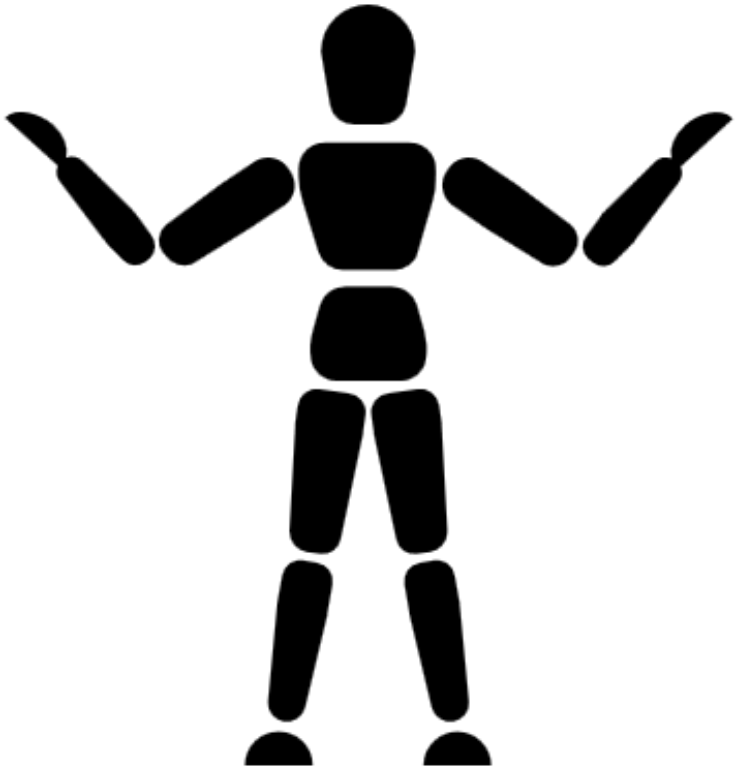
ALL COMPLTED ☺

5. Update from the Action Chair

Management Committee Meeting (MC6)

Action Status

- Start Date: 2nd October 2019
- End Date: 1st April 2024
- CSO Approval Date: 4th June 2019
- Entry into Force: 4th July 2019
  - MC Meeting 1: October 2019
  - MC Meeting 2: February 2020
  - MC Meeting 2.5: October 2020
  - MC Meeting 3: March 2021
  - MC Meeting 4: October 2021
  - MC Meeting 5: September 2022
  - MC Meeting 6: September 2023
- Science Officer: Sara Silvestre
- Administrative Officer: Milena Stoyanova



Objectives - Challenge

- Advance Europe's position of strength in the Aerospace Industry through the development of optimised intelligent structures integrated at the design inception phase through the creation of an interdisciplinary network of experienced and early career researchers working towards a common goal

Objectives – Research Coordination

- Development of a common understanding and definition of the subject matter: Produce, define and publish state of the art documents for main research strands: optimisation, damage detection, energy harvesting, wireless communications, signal processing and data management.
- Coordination of experimentation and performance assessment of technology: Identify universal parameters for testing the aspects of an aerospace SHM system. These standards will be documented and published to encourage global acceptance to allow cross laboratory comparisons within.

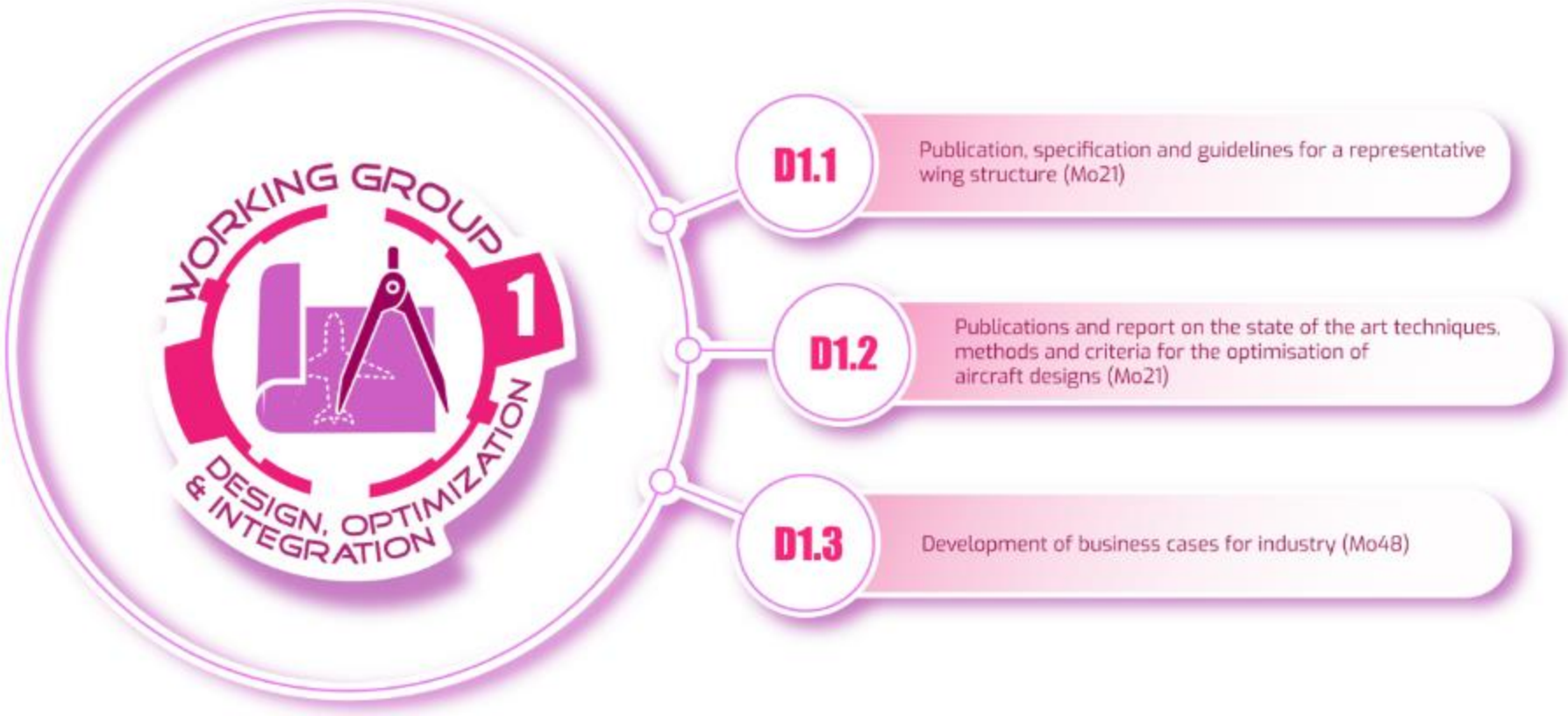
Objectives – Research Coordination

- Coordination of information seeking, identification, collection and/or data curation: Coordinate, compare and bring together results of related research with the aim of defining optimised approaches to improve the monitoring and management of EU aerospace structures.
- Input to stakeholders: Develop strong academic/industrial links with major aerospace companies, supply chain and SMEs to ensure creation, adoption and transfer of developed network knowledge.
- Dissemination of research results to the general public or to stakeholders.

Objectives – Capacity Building

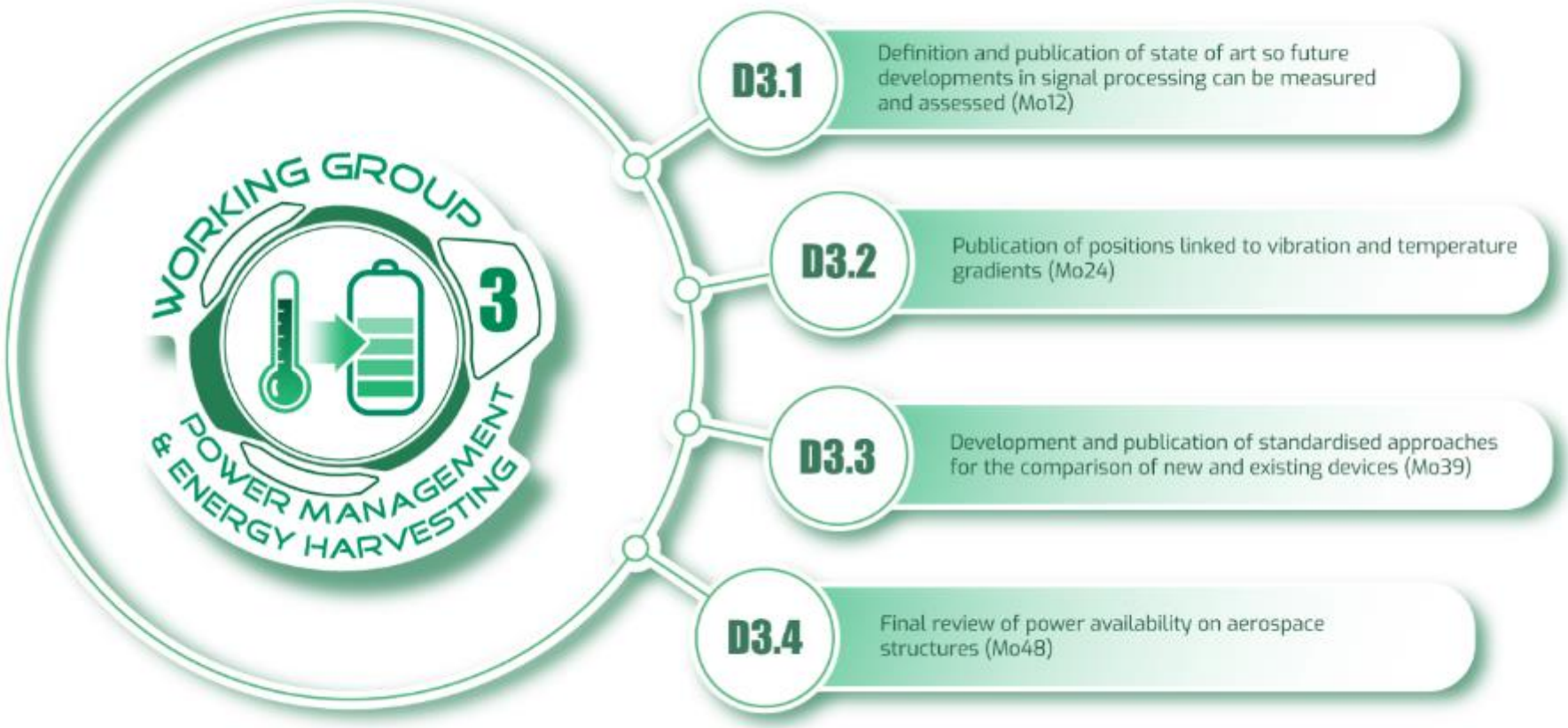
- Create bridges between academia and industry stakeholders in international networks that cover aerospace structures, damage detection, energy harvesting, wireless communication and optimisation.
- Build critical mass through the training and development of highly skilled professionals in this Action's research area and in new emerging related technologies.
- Foster the sharing and cross fertilisation of research across the related research areas (Mechanical and Electrical Engineering, Computer Science, Mathematics, Materials Science and Industry), which are highly complementary, but currently separate.

Deliverables

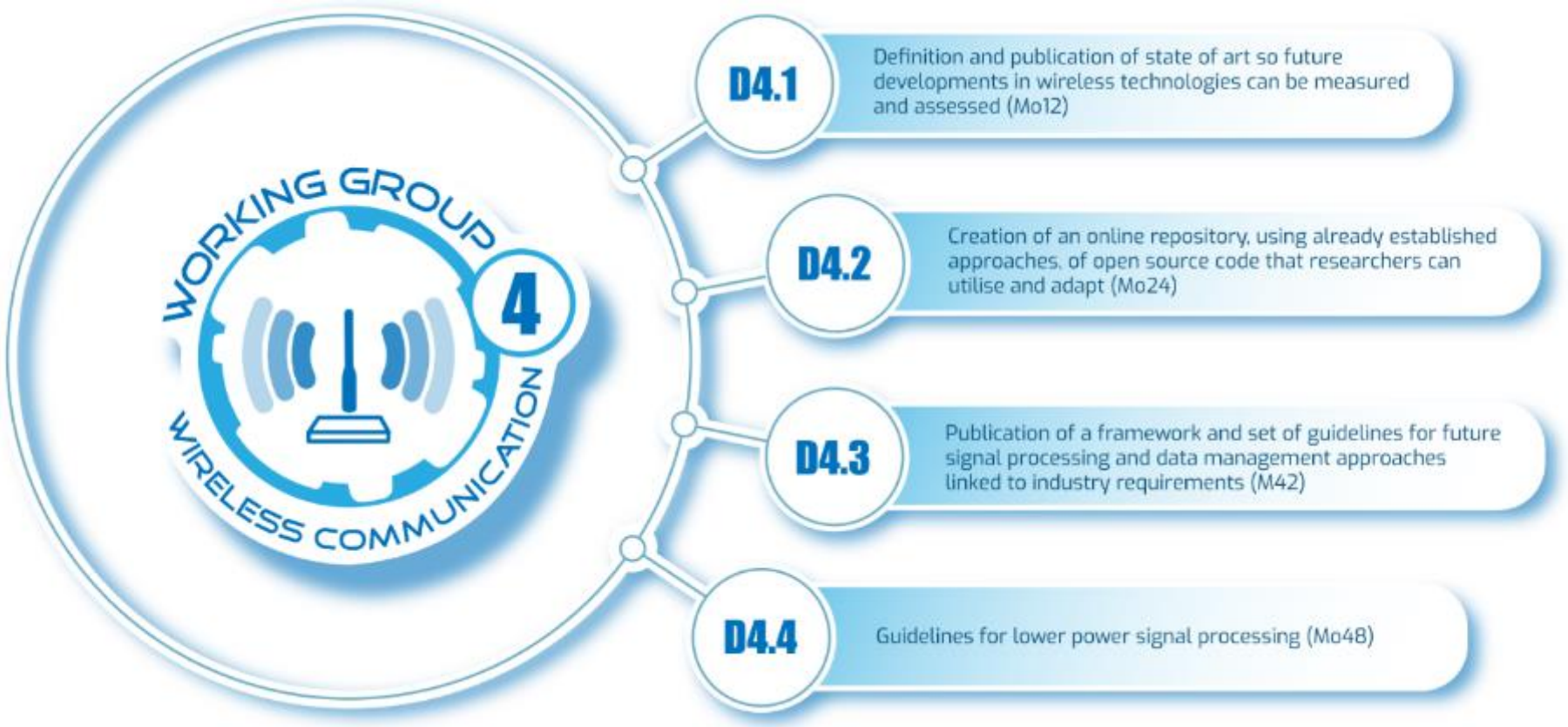


Deliverables

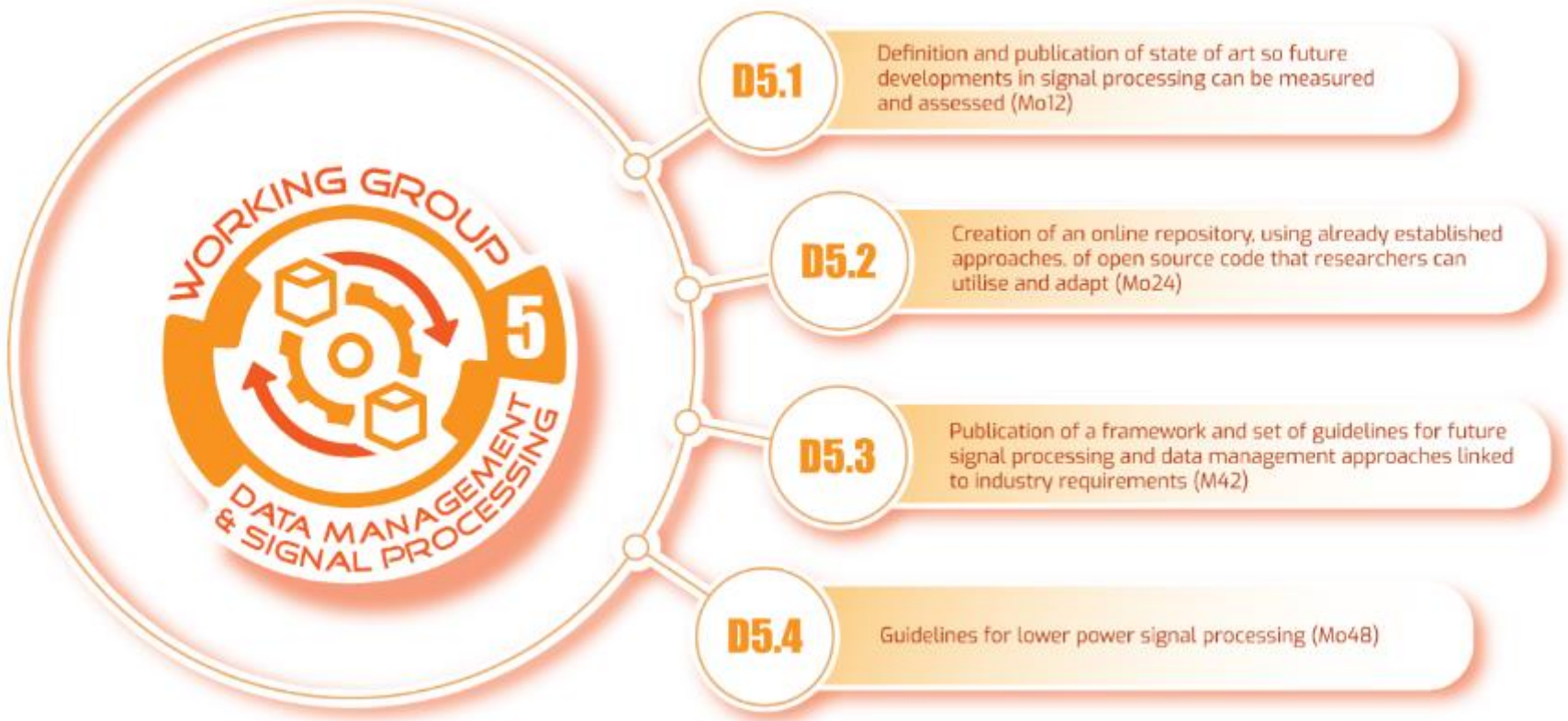
Deliverables



Deliverables



Deliverables



Best Grant Period… So Far?

- One MC Meeting (Today)
- Six core group meetings
- One budget extension
- One six-month grant extension
- Two completed training schools
  - INSA and INSIGNIA
- One Dissemination Grant
- Two ITC Grants
- Four STSM Grants

Grant Summary

CA18203	Mitra Vesović	ITCG	Modeling Heat - Flow prototype dryer using ANFIS optimized by PSO	Grant letter sent	1000.00	19/10/2023 21/10/2023
CA18203	Dominika Ziaja	STSM	Damage Detection and Localization in Multilayered CFRP Panels assisted with Numerical Analysis of Guided Waves	Grant letter sent	2500.00	09/09/2023 22/09/2023
CA18203	Martin Misson	ITCG	Deep feature extraction of acoustic emission signals during biocomposite low-cycle loading	Grant letter sent	1500.00	13/08/2023 16/08/2023
CA18203	Petar Gljušćić	STSM	Kinetic energy harvester development and testing	Paid	2500.00	17/06/2023 07/07/2023
CA18203	Paweł Dymora	STSM	Dynamic Self-Reconfiguration Algorithms in Wireless Sensor Networks for Structural Health Monitoring	Paid	2000.00	03/06/2023 17/06/2023
CA18203	Mirosław Mazurek	STSM	Dynamic Self-Reconfiguration Algorithms in Wireless Sensor Networks for Structural Health Monitoring	Paid	2000.00	03/06/2023 17/06/2023
CA18203	Rhys Pullin	DCG	Acoustic Approaches for Monitoring Composite Aerospace Structures	Report approved	1800.00	30/05/2023 14/09/2023

STSM Example – Petar Gljuscic

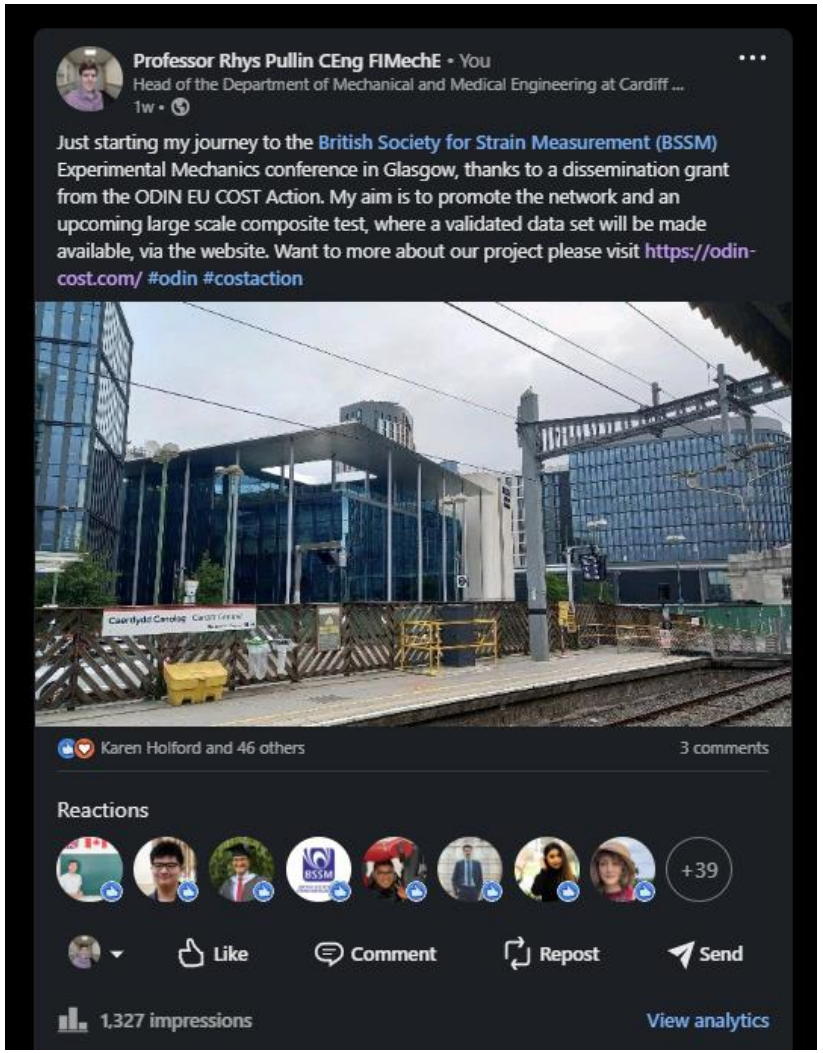
- STSM @ VUT Brno
  - Strengthening VUT-RITEH collaboration within the COST action
  - Sharing of latest results and ideas
  - Extending expertise in new research areas (EM EH)
  - Discussion of future work in the field of EH and its SHM applications
  - Brainstorming on novel ideas and applications

STSM Example - Paweł Dymora

- Presentation of the Department of Complex Systems in Rzeszow University of Technology and possibilities of cooperation within the WG3 and WG4 working groups. Characteristics of the laboratory and simulation environments used in SHM/NDT/NDE applications.
- Analyzing the possibility for the use of Process Mining and Process Discovery mechanisms in discovering data flow and process patterns in WSN (also in IoT/IoE networks.
- Analysis of currently used wireless communication technologies and routing algorithms in wireless sensor networks (IoT/IoE).
- Investigation of the feasibility of implementing selected solutions in a real environment.
- Delivering a public lecture at the Brno University of Technology entitled: PhD. Eng. Paweł Dymora - Selected aspects of the virtual reality (VR) technology application in aircraft pilot training process, NDT/NDE and Industry 4.0 education (08.06.2023).

Dissemination Grant

- DG @ International Conference on Experimental Mechanics
  - Presented wing box structure test data (tomorrow)
  - Provided guidance on how to work on new test data
  - Promoted COST and ODIN
  - Used LinkedIN to further enhance visit



Virtual Mobility Grant - I

Applicant name: Muhammed Latif Bekci

Virtual Mobility Grant

Mr. Bekci prepared a review on the current problems and expectation from sensors used in aeronautics which is in parallel with the aims mentioned in Working Group 2 deliverable D2.1 and D2.3

D2.1: Report/publications on the power consumption of current processing approaches and methods for delivering improvement in damage detection.

D2.3: Strategic plan identifying routes to TRL 9 and also including state of art so future developments can be measured and assessed.

Virtual Mobility Details

Title: **Sensors for Damage Detection in Aeronautics: Challenges and Expectations**

Start and end date: 12/10/2022 to 23/10/2022

Content

In this study, **a survey performed on damage detection sensors that are used for structural parts of aircrafts** performed in the context of Optimised Design for Inspection (ODIN) project of the European Cooperation in Science and Technology (COST) is presented.

Sensors for Damage Detection in Aeronautics: Challenges and Expectations

- Abstract
- Introduction
- Aircraft Crashes due to Sensors
- Non-Destructive Inspection (NDI) Methods for Aircrafts
- Structural Health Monitoring
- Discussion and Conclusion
- Acknowledgements
- References

The next step is to extend current survey and prepare a joint review paper with the participants from CA 18203.

Virtual Mobility Grant - II

Applicant name: Ömer Necati CORA

Virtual Mobility Grant - II

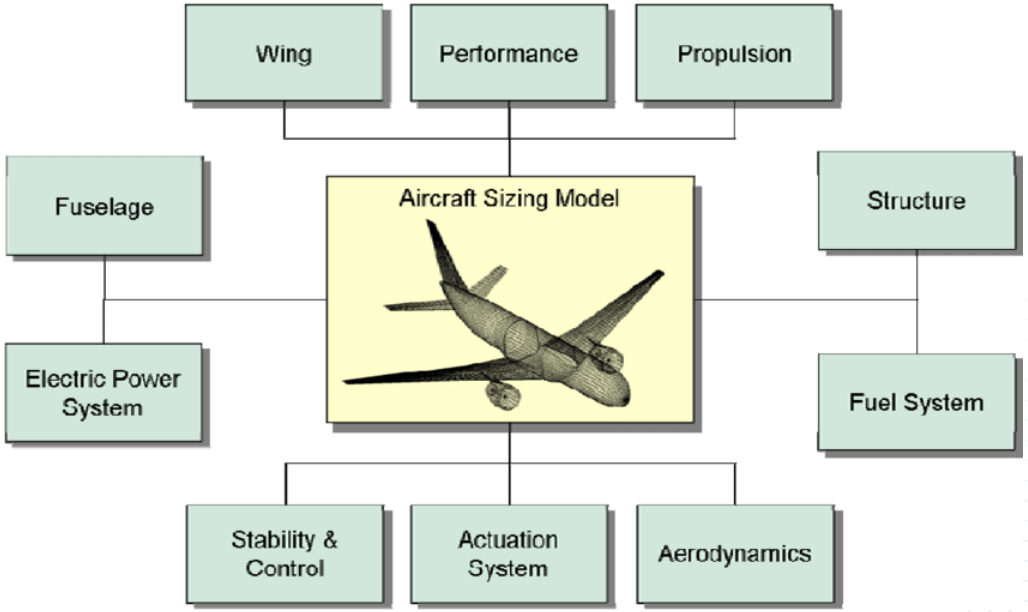
A Report as part of WG-1, D1.2

D1.2: Publications and report on the state of the art techniques, methods and criteria for the optimisation of aircraft designs.

On the Techniques, Methods, and Criteria for the Optimisation of Aircraft Structures

Ömer Necati CORA

Department of Mechanical Engineering, Karadeniz Technical University, Trabzon, 61080, TÜRKİYE



The complete aircraft design framework by Amadori et. al, 2008

This report intended to provide an overview on optimisation techniques, methods and criteria that are used for aircraft and part designs. Ultimate goal is to convert the report into a review paper.

Lecture at Training School on Design and Optimisation

April 2023, INSA Rouen, France

Based on the work of Virtual Mobility Grant, and in parallel with D1.2, a lecture was given at the Training School on Optimisation, Design and Integration at INSA Rouen, France in April 12, 2023.

COST Action CA18203 - Optimising Design for Inspection

Training School on

Optimisation, Design and Integration

An Overview on Aircraft Design and Aircraft Structure Optimisation

Ömer Necati CORA,
Karadeniz Technical University, Trabzon, Türkiye

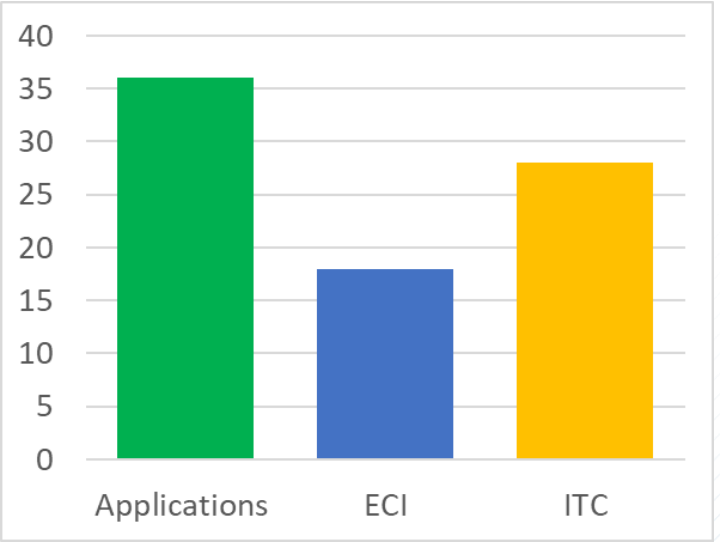
April 12, 2023, Wednesday
National Institute of Applied Sciences of Rouen
(INSA Rouen Normandie)

Lecture at Training School on Inspection, SIGNal processing Identification and Analysis (INSIGNIA)

September 20, 2023, Ohrid, North Macedonia

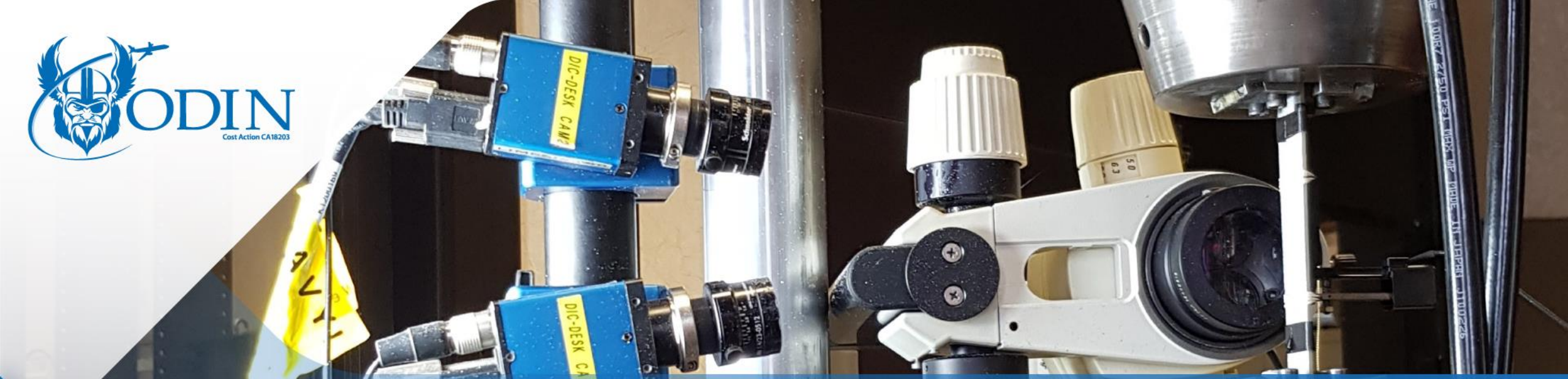
Training Schools - INSA

- **Day 1, 12.04.23**
  - 9h30 -10h Welcoming coffee
  - 10h - 11h30 The Fundamentals of Optimization, Eduardo Souza de Curzi
    - 12h-13h30 Lunch
  - 13h30 - 16h with a coffee break in the middle An Overview on Aircraft Design and Aircraft Structure Optimisation, Ömer Necati CORA
- **Day 2, 13.04.23**
  - 10h-13h00 with a coffee break in the middle Bio-inspired design and optimization, Renata Troian
    - 13h-14h30 Lunch
  - 14h30 - 16h30 WP Discussions, Round table Questions, and Answers
  - 19h30 Dinner in the center of Rouen
- **Day 3, 14.04**
  - 9h30-12h30 with a coffee break Reliability analysis and reliability-based design optimization : theory and applications. Younes Aoues
    - 12h-13h30 Lunch
  - Visit of Rouen 14h30



Training Schools - INSIGNIA

- **Day 1, 18.09.23**
  - 9h30 -10h Welcoming coffee
  - 10h - 12h30 – General Discussion on Signal Processing and Current Challenges
    - 12.30h – 13.30h lunch
  - 13h30 – 16.30h – Key-note presentations
  - 16.30h – 19h – Visit to Ohrid
- **Day 2, 19.09.23**
  - 9h30 -10h Welcoming coffee
  - 10h – 13h Session One
    - 13h-14h30 Lunch
  - 14h30 - 16h30 Session Two
  - 19h30 Dinner at Hotel Granit
- **Day 3, 20.09.23**
  - 9h30 -10h Welcoming coffee
  - 10h -12h30 Session Three
    - 12h-13h30 Lunch
  - Visit of Ohrid and Networking



6. Update from Science Communication Coordinator (PD)

Name: Petar I. DIMITROV

Organization: Air Traffic Researcher, North Macedonia

Email: dipetar@outlook.com

Management Committee Meeting (MC6)

10.10

Reimbursement information:

- The expenses related to your participation in this event will be reimbursed in line with the COST Rules of Reimbursement available here: https://www.cost.eu/travel_reimbursement_rules/ .
- You will be able to submit your reimbursement claim only after the event. In addition, you shall estimate your reimbursement via the invitation link provided above.
- During the event, please sign the Attendance List.
- The deadline to submit your reimbursement claim online is 15 days after the event via your invitation link.
- Please ensure that you register in e-COST the same e-mail address as in your invitation and that your bank details are up to date.
- Following national and/or institutional regulations, you may be requested to provide original supporting documents.

Reimbursement

Submit online via the invitation link,

immediately

(together with the supporting documents (i.e. ticket).

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Country and organisations table

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Dissemination or Communication Product		COST logotype (A)	EU emblem + text (B)	Acknowledgment (C)	Boilerplate (D)	COST Website (E)
Scientific publication in Open Access	Articles in scientific journals	X	X	V	X	X
	Books	V	V	V	V	V
Action Website		V	V	X	V	V
Action logo		X	X	X	X	X
Dissemination Materials	Leaflets, brochures, flyers, infographics, training materials, reports	V	V	V	V	X
	Action posters, roll-ups	V	V	X	X	X
Multimedia* content	Videos, animations, multimedia presentations	V	V	V	V	V
Information materials**	Pens, notepads, usb sticks, bookmarks, t-shirts, bags,...	V	X	X	X	X

https://www.youtube.com/watch?v=_2btH2MkId0

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ca18203-optimised-design-for-inspection

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Channels
coremanagementgroup
general
mccommitee
random
wg1
Add channels

Direct messages
Slackbot

We have many photos that can be shared.
And yes, I agree, let's make Slack our primary tool instead of exchanging e-mails unnecessarily.

Tuesday, July 5th

1
4 replies Last reply 3 months ago

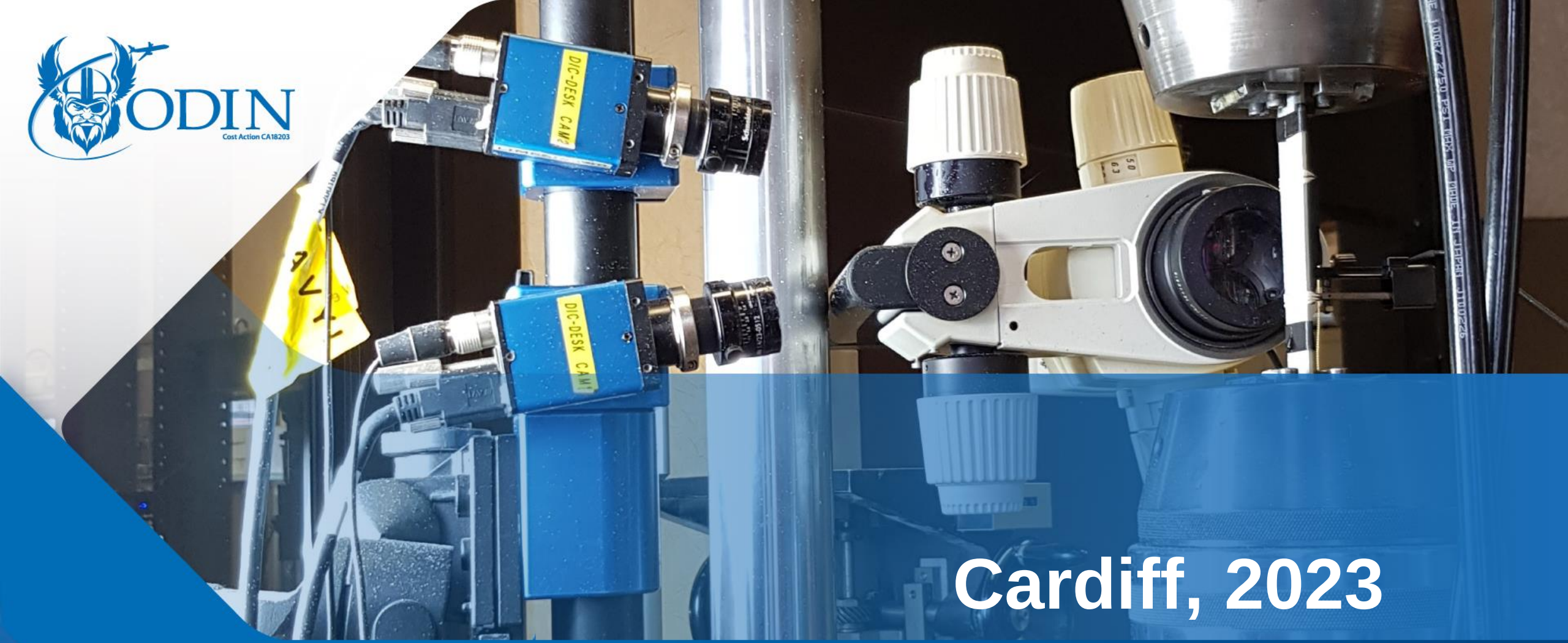
Sunday, July 10th

Petar I. DIMITROV 1:50 PM
Group photo - https://odin-cost.com/wp-content/uploads/2022/07/GroupPhoto_TS2022.jpg
(229 kB)

More pictures of the third day of the TS here:
https://drive.google.com/drive/folders/1rK544GJEYRv7CMEi7R7Gaka6qBDYXgwa?usp=sharing (edited)

Message #ca18203-optimised-design-for-inspection

COST is supported by the EU Framework Programme Horizon 2020



Cardiff, 2023

Petar DIMITROV,
Science Communication Coordinator

dipetar@outlook.com

Acknowledging Cost Funding

(A) COST logotype

(B) EU emblem and text

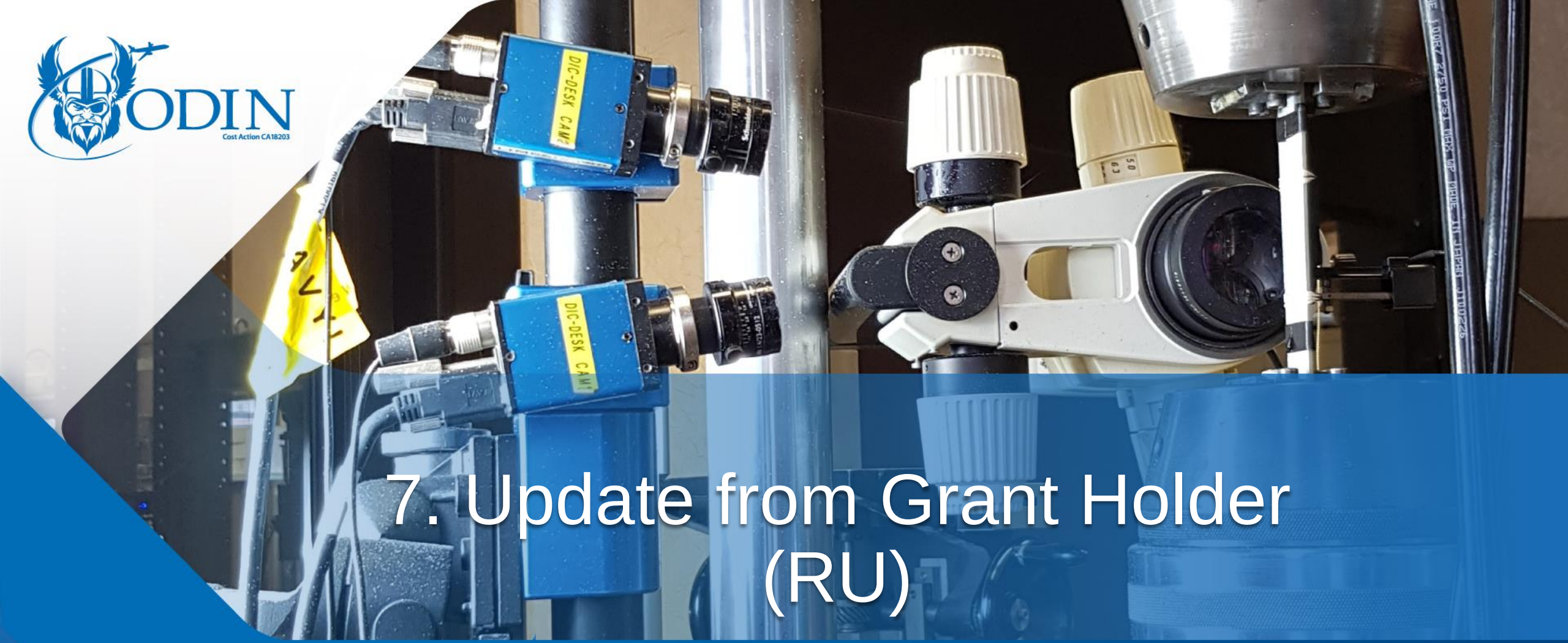
Acknowledging Cost Funding

(C) Acknowledgment text

*This article/publication is based upon work from COST Action **CA18123 (ODIN – www.odin-cost.com)**, supported by COST (European Cooperation in Science and Technology).*

(D) Boilerplate

COST (European Cooperation in Science and Technology) is a funding agency for research and innovation networks. Our Actions help connect research initiatives across Europe and enable scientists to grow their ideas by sharing them with their peers. This boosts their research, career and innovation.



7. Update from Grant Holder (RU)

Name: Rúnar Unnþórsson

Organization: University of Iceland, Iceland

Email: runson@hi.is

Management Committee Meeting (MC6)

Current Budget

	Grant budget	Actuals & Accruals	With forecast
Meetings	43.480,0		32.952,0
Training Schools	78.240,0	41.641,0	60.766,0
Short Term Scientific Mission Grant (STSMG)	7.000,0	9.000,0	9.000,0
Virtual Mobility Grants (VMG)	3.000,0		
Total Inclusiveness Target Countries Conference Grant (ITC CG)	3.300,0	1.500,0	2.500,0
Dissemination Conference Grant (DCG)	1.250,0	1.800,0	1.800,0
Dissemination and Communication Products	2.000,0		
Other Expenses Related to Scientific Activities (OERSA)	500,0		500,0
Virtual Networking Support Grant	0,0		
Networking expenditure	**138.770,0**	**53.941,0**	**107.518,0**
FSAC 15% of Eligible Networking expenditure	20.815,5	8.091,2	16.127,7
Eligible Costs	**159.585,5**	**62.032,2**	**123.645,7**

Funds available to spend globally: EUR **31.252,0**

8. Update from COST Association (SS)

Management Committee Meeting (MC6)

9. Update from Working Groups

Management Committee Meeting (MC6)

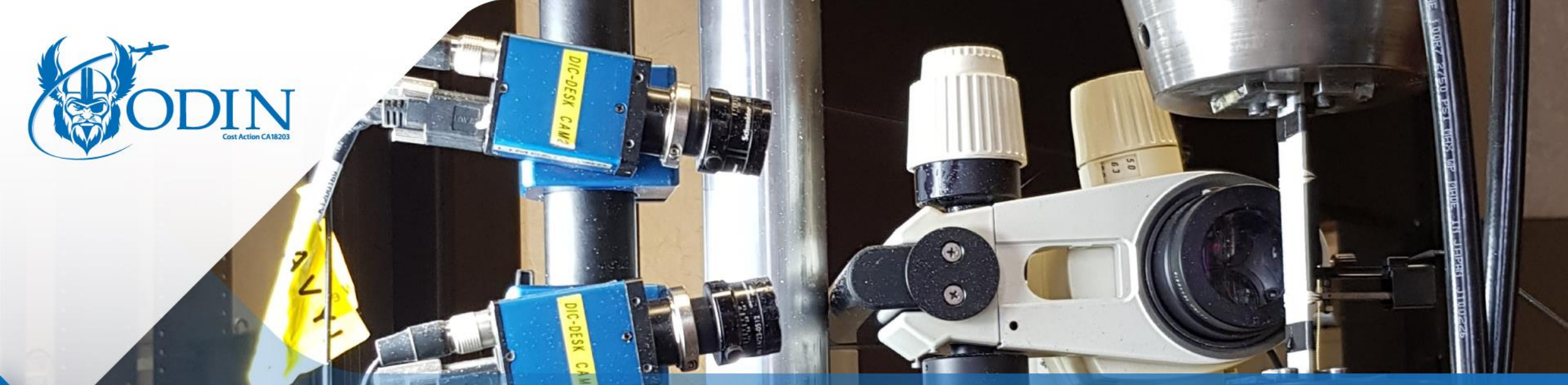
Working Groups One

Name: Chiara Bisagni

Organization: Delft University of Technology, Netherlands

Email: c.bisagni@tudelft.nl

Management Committee Meeting (MC6)



WG1
Management Committee Meeting
September 27, 2023

Name: Chiara Bisagni

Organization: TU Delft (Netherlands) and Politecnico di Milano (Italy)

Email: c.bisagni@tudelft.nl; chiara.bisagni@polimi.it

Outline

- WG1 Status
- Joint Publication: Analysis of Representative Wing Structure
- Other Publications
- Next Steps

Outline

- WG1 Status
- Joint Publication: Analysis of Representative Wing Structure
- Other Publications
- Next Steps

WG1 Design, Optimisation and Integration

This group will encompass industrial aerospace design engineers and experts, mathematicians, computer scientists and optimisers with the objective to analyse the requirements for integrating SHM systems at the inception of an aerospace design.

A significant challenge for this group is to ensure that specific aerospace requirements are communicated effectively and efficiently to the SHM system designers.

WG1 Tasks

T1.1: Increase industry participation through promotion and dissemination at trade shows, utilising existing participant contacts and the establishment of a social network ODIN group.

T1.2: Establish design criteria, based on industry requirements for a representative wing structure element. This will include geometry, loading, temperature etc. These criteria will be disseminated widely to increase network/WG1 participation. The data can then be used as the starting point for firstly optimisation due to loading and subsequently for an SHM system.

T1.3: Development of optimisation strategies and guidelines for systems and structures and design of demonstrator wing section.

T1.4: Dissemination of work group findings including industry guidelines through conference, trade shows, workshops and industrial seminars.

WG1 Deliverables

D1.1: Publication, specification and guidelines for a representative wing structure (Mo21) *Completed*

D1.2: Publications and report on the state of the art techniques, methods and criteria for the optimisation of aircraft designs (Mo21) *Almost completed*

D1.3: Development of business cases for industry (Mo48) *Almost completed*

Outline

- WG1 Status
- Joint Publication: Analysis of Representative Wing Structure
- Other Publications
- Next Steps

Joint Publication

C. Bisagni [a,*], A. Raimondo [a], I. Atanasovska [b], M. Milic [c], R. Troian [d], G. Frulla [e], A. Polla [e], Ö.N. Cora [f], M.L. Bekci [f], B. Henriques [g], M.F.S.F. de Moura [g], F. Almudaihesh [h], S. Grigg [h]

[a] Faculty of Aerospace Engineering, Delft University of Technology, Delft, the Netherland
[b] Mathematical Institute of the Serbian Academy of Sciences and Arts, Belgrade, Serbia
[c] Faculty of Mechanical Engineering, University of Belgrade, Belgrade, Serbia
[d] Institut National des Sciences Appliquées de Rouen, Laboratory of Mechanics, Rouen, France
[e] Politecnico di Torino, DIMEAS, Torino, Italy
[f] Department of Mechanical Engineering, Karadeniz Technical University, Trabzon, Turkey
[g] Department of Mechanical Engineering, University of Porto, Porto, Portugal
[h] School of Engineering, Cardiff University, Cardiff, UK

7 countries!

Composites Part C: Open Access 8 (2022) 100264

Contents lists available at ScienceDirect

Composites Part C: Open Access

journal homepage: www.sciencedirect.com/journal/composites-part-c-open-access

Comparison of numerical analyses of a composite wing component subjected to 4-point bending

C. Bisagni [a,*], A. Raimondo [a], I. Atanasovska [b], M. Milic [c], R. Troian [d], G. Frulla [e], A. Polla [e], Ö.N. Cora [f], M.L. Bekci [f], B. Henriques [g], M.F.S.F. de Moura [g], F. Almudaihesh [h], S. Grigg [h]

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[b] Mathematical Institute of the Serbian Academy of Sciences and Arts, Belgrade, Serbia
[c] Faculty of Mechanical Engineering, University of Belgrade, Belgrade, Serbia
[d] Institut National des Sciences Appliquées de Rouen, Laboratory of Mechanics, Rouen, France
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ARTICLE INFO

Keywords:
Aerospace composite structure
Wing structure
Numerical benchmark

ABSTRACT

In this paper, a comparison between six finite element models of a representative wing structural component performed in the context of Optimised Design for Inspection (ODIN) project of the European Cooperation in Science and Technology (COST) is presented. Six partners from six different countries involved in the project received the drawing of the structure, the material properties, the loading and boundary conditions. Each partner, based on their background and experience in numerical analyses, developed a finite element model with different levels of details and accuracy and performed a blind prediction of the structural behaviour of the wing component. The numerical results are presented and compared with the experimental test data conducted at Cardiff University.

1. Introduction

Over the past decades, the advancements in analytical and computational methods, such as the Finite Element (FE) method, have led to developing of increasingly accurate models for the structural analysis. The exponential growth of computational capabilities supported by advanced algorithms have provided researchers with several software packages and numerical techniques to accurately predict the behaviour of complex structures with reasonable computational times. Despite the availability of such a variety of numerical tools and techniques, the blind prediction of the structural response of aeronautical structures in composite materials still represents a significant challenge. Several round-robin and benchmark exercises have been organised over the years to evaluate the state-of-the-art in this area.

For example, the Polymers and Composites Task Group of the European Group on Fracture organised three round-robin exercises to determine mode I and mode II interlaminar fracture toughness of glass and carbon fibre-reinforced thermoset and thermoplastic composites [1–3]. Soden and Hilton organised an exercise aimed to compare the predicting capabilities of the failure theories for available glass and carbon fibre-reinforced thermoset composites directly with each other and against experimental data [4,5]. More recently, the US Air Force Research Laboratory performed benchmark exercises for composite progressive damage analysis methods using unnotched and open-hole composite coupons under both static and fatigue loading [6,7].

Most of the works found in the literature relates to comparative studies on coupons or small specimens, while there is a lack of research dealing with larger and more complex structures. This study presents a preliminary comparison of different FE modelling techniques to predict the structural response of a relatively complex representative wing structure made of metals and composite materials.

Only a few studies can be found in literature regarding numerical analysis of composite wing structures, and they present different levels of detail. Parametric finite element models of wing structures have been performed, considering the design and optimisation with strength and buckling constraints [8] or stiffness and aeroelastic constraints [9,10]. A

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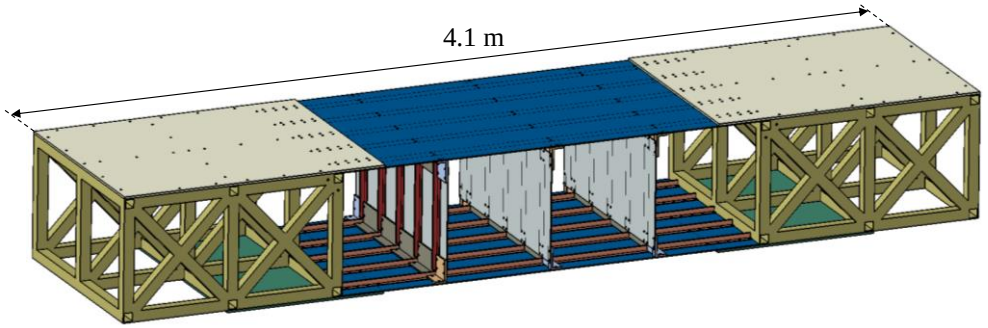
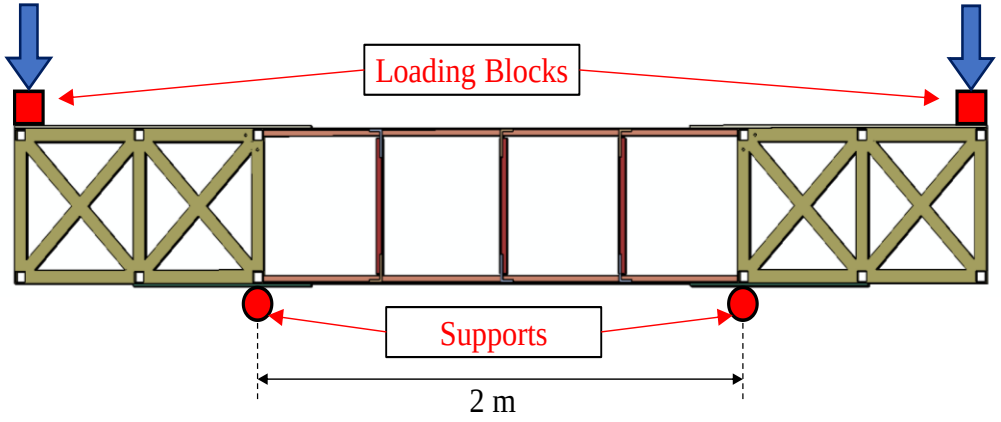
Available online 9 April 2022

Analysis of Wing Structure Element

- We had a close collaboration between the 6 partners involved in the analyses and Cardiff University, who manufactured the representative wing structure element and performed the test.
- CAD drawings were distributed and material properties were identified.
- Analysis were conducted by the 6 partners before the test and they helped to decide number and position of instrumentation.

Finite Element Models

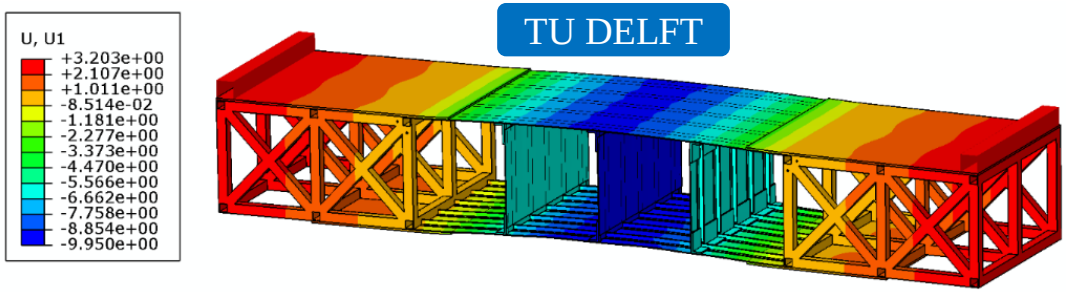




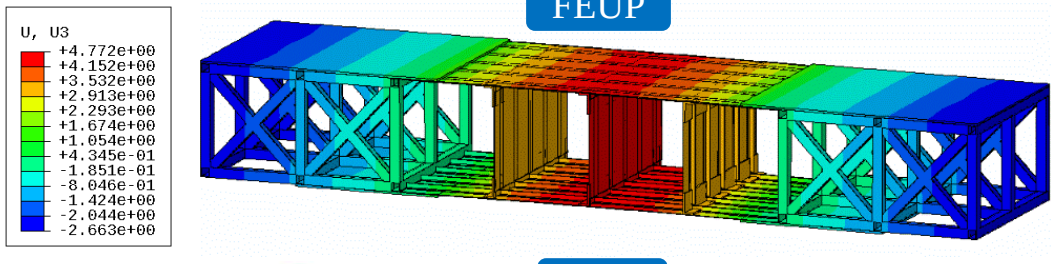
Partner	FE Code	Type of Analysis	Load/Displace-ment controlled	Type of Elements	Number of Elements	Symmetry Conditions
TU DELFT	ABAQUS 2019	Dynamic Implicit	Displacement	Shell/Solid	300000	No
FEUP	ABAQUS 6.11	Static Implicit	Displacement	Shell/Solid	180000	No
KTU	ANSYS 2020 R2	Static Implicit	Load	Solid	560000	No
BELGRADE	ANSYS Mechanical APDL 2019 R3	Static Implicit	Load	Shell/Beam	4000	Yes
POLITO	LS DYNA R11.1	Quasi-static Explicit	Load	Shell/Beam	880364	No
INSA	LS DYNA R9.1.0	Quasi-static Implicit	Load	Shell	2400	Yes

Deformed Shapes at 300 kN

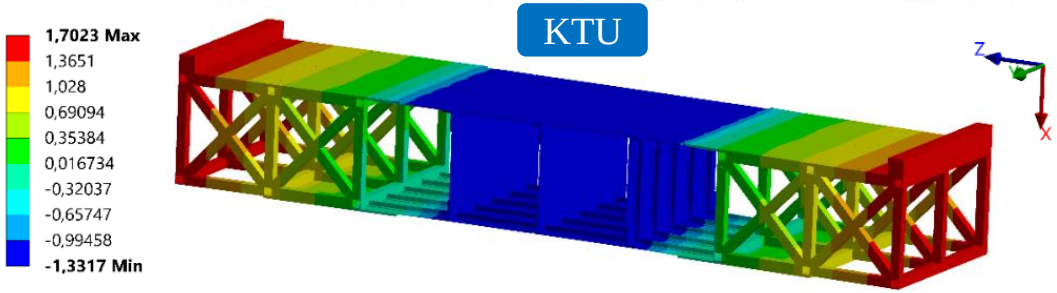
TU DELFT



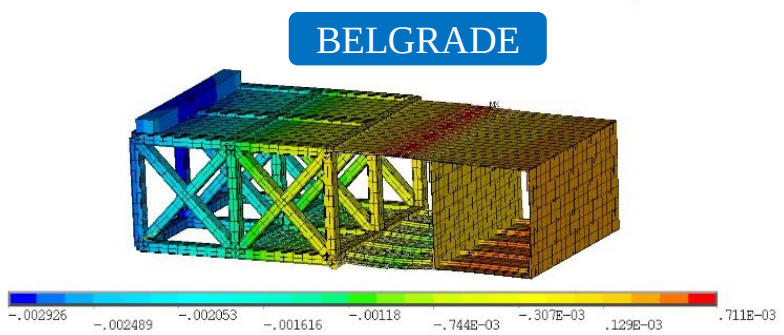
FEUP



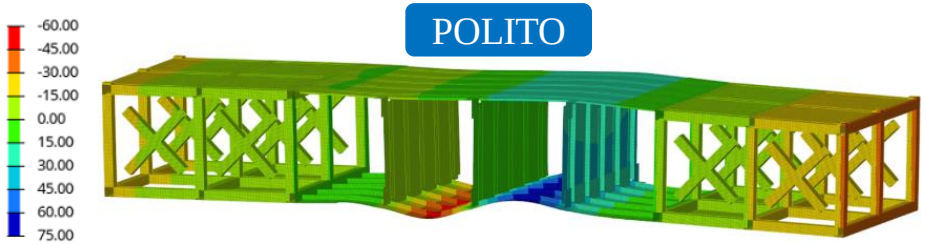
KTU



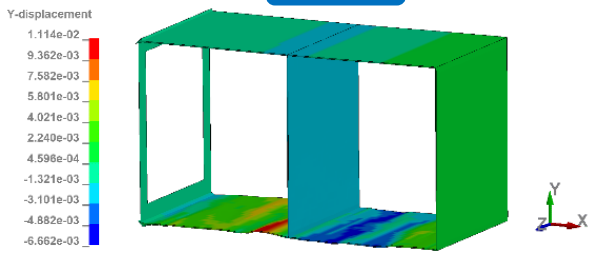
BELGRADE



POLITO



INSA



Outline

- WG1 Status
- Joint Publication: Analysis of Representative Wing Structure
- Other Publications
- Next Steps

Other Publications

- Ömer Necati CORA received a **Virtual Mobility Grant.**
- He wrote a report as part of WG-1, D1.2:

On the Techniques, Methods, and Criteria for the Optimisation of Aircraft Structures

Ömer Necati CORA

Department of Mechanical Engineering, Karadeniz Technical University, Trabzon, 61080, TÜRKİYE

- This report intended to provide an overview on optimisation techniques, methods and criteria that are used for aircraft and part designs.
- The report will be soon converted into a review paper.

Other Publications

- Etienne BELLANGER will defend his **Master thesis** on October 18 at TU Delft, with the title “Optimization of a representative wing component using a Genetic Algorithm”.

Outline

- WG1 Status
- Analysis of Representative Wing Structure Element
- Joint Publication
- Next Steps

Next Steps

1. A test of the optimised wing element will be conducted at Cardiff during the COST meeting.

2. The idea is to write a joint publication that focus on optimisation strategies, with test results and in collaboration with WG2 (D1.2).

3. The data of the wing structure test, together with the modelling and simulation published in the joint paper, will be a good business case for industry (D1.3).

Working Group Two

Name: Ghazi Droubi

Organization: Robert Gordon University, Scotland

Email: m.g.droubi@rgu.ac.uk

Management Committee Meeting (MC6)

WG 2 Tasks

- T2.1: Identify state of the art SHM damage detection systems, including sensing technologies, reliability/durability and data acquisition. Develop standard approaches/tests for validating an SHM system. This will lead to a strategic plan than can lead to an SHM at TRL9;

- T2.2: Identify signal processing, power requirements (WG3) data management (with WG5) requirements needed for identified damage detection techniques;

- T2.3: Sharing of best practices and data sets through a common EU framework/online data bases and websites

INSIGNIA Training School - Ohrid

- The outputs of this training school will be:
  - Lecture slides on website;
  - Booklet of presentation summaries/abstracts on website;
  - Links to key papers used as part of any sessions;
  - Promotional images and videos;

Key Points

- We have been waiting on information pack for Cardiff test plan to be shared with interested people in my WG.
  - Will complete asap (sorry)
- Github as a platform to share data and upload signal processing algorithms was investigated but no decision was reached.
  - Discussion to continue

Working Group Three

Name: Zdenek Hadas

Organization: Brno University of Technology

Email: zdenek.hadas@vut.cz

Management Committee Meeting (MC5)

Working Group 3

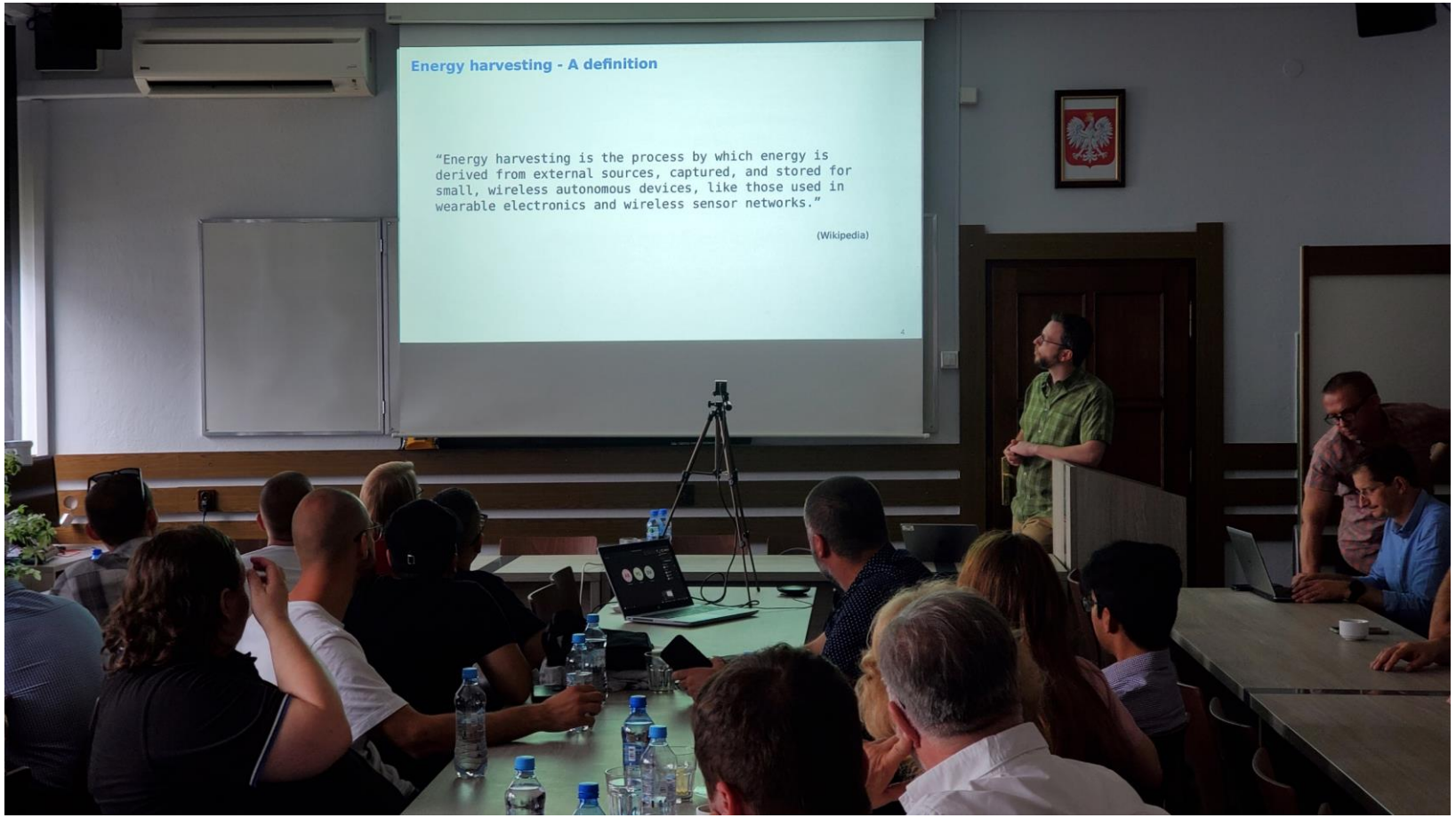
Name: Zdenek Hadas

Organization: Brno University of Technology, Czech Republic

Email: zdenek.hadas@vut.cz

Management Committee Meeting

WG3
Power management and energy harvesting



Energy Harvesting

- Thermoelectrics
- Electromagnetic Vibration Resonators
- Piezoelectric Vibration Resonators
- Piezoelectric patches/skin
- Motion energy harvesting
  - Reluctance
  - Triboelectrics
- …
- Low power electronics

- ??? Energy harvesting metamaterials

WG3 Power management and energy harvesting

T3.1 Review of approaches, power delivery, power densities, power ranges, opportunities to embed, environmental requirements, costs for harvesting power from available sources in an aircraft structure ✓

T3.2 Design standardized testing procedures based on industrial inputs to allow comparison of leading research work ✓

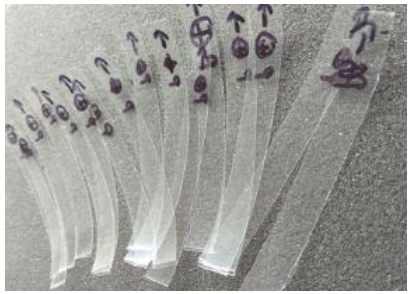
T3.3 Identification of the possible design considerations and requirements to enable and maximize the use of energy harvesting systems in various locations on an aircraft structure ✓

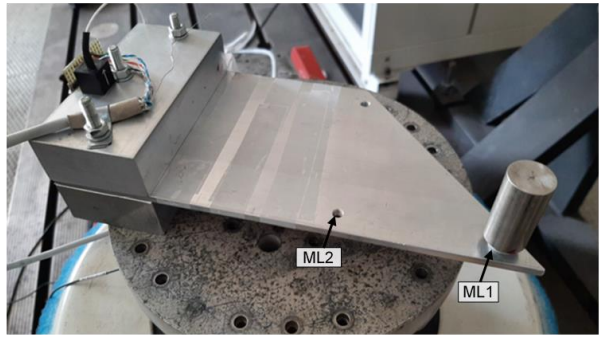
T3.4 Identification of further exploitation routes for energy harvesting ✓

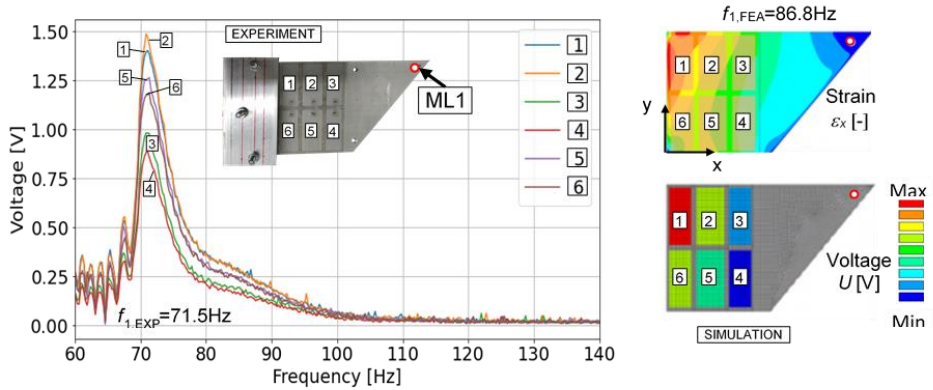
- Integration of system across WGs …

PVDF skin for sensing and harvesting applications

- fabrication, modeling, simulation, experiment – Hadas & Mrlik

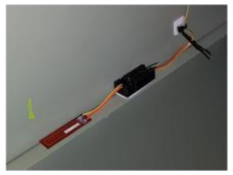


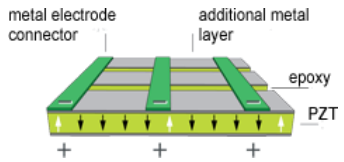




PVDF skin for sensing and harvesting applications

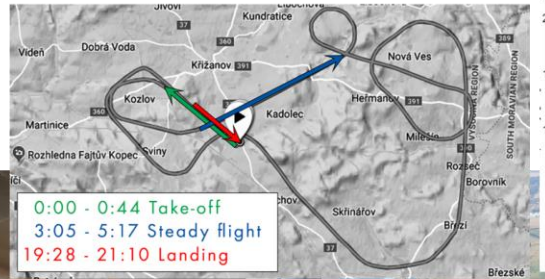
- Proposal of project with Romana – small aircraft test

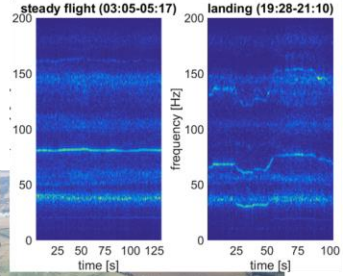




CAAT

Test flight





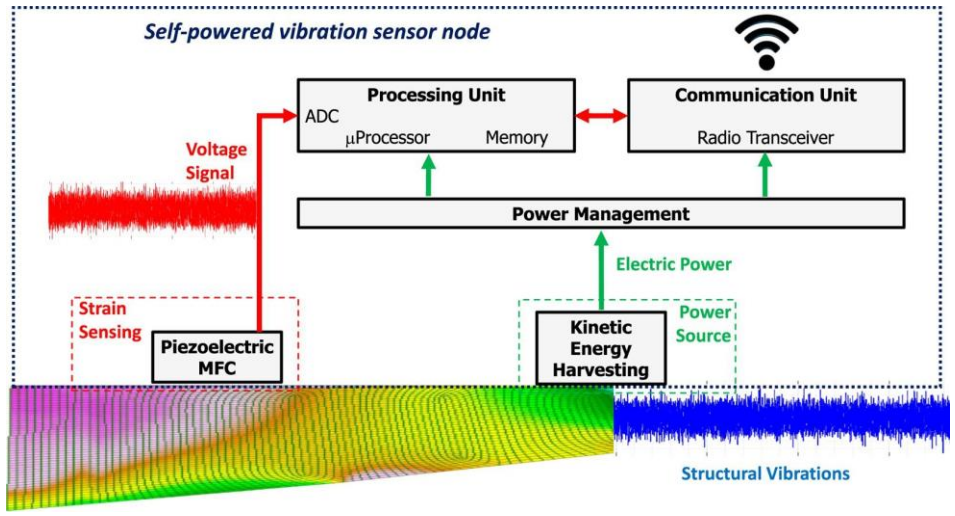
Integration of EH and sensing system

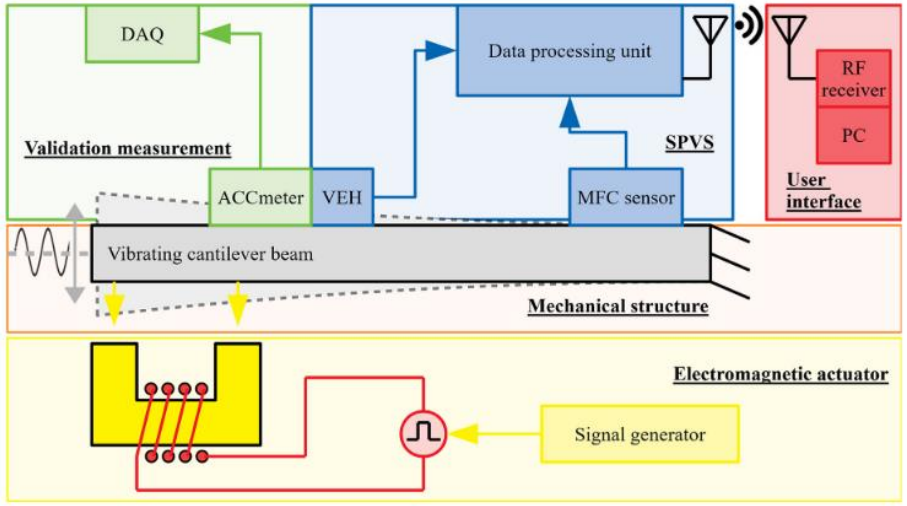
ELSEVIER

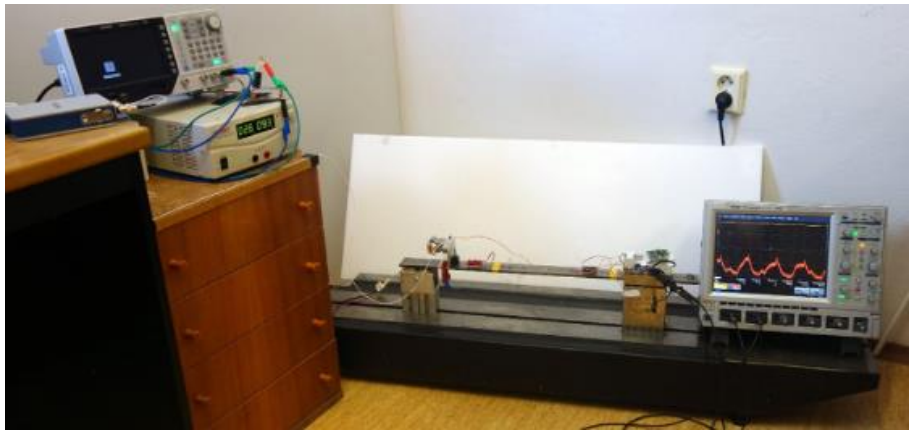
Mechanical Systems and Signal Processing
Volume 160, November 2021, 107890

Development and experimental validation of self-powered wireless vibration sensor node using vibration energy harvester

Ondrej Rubes, Jan Chalupa, Filip Ksica, Zdenek Hadas



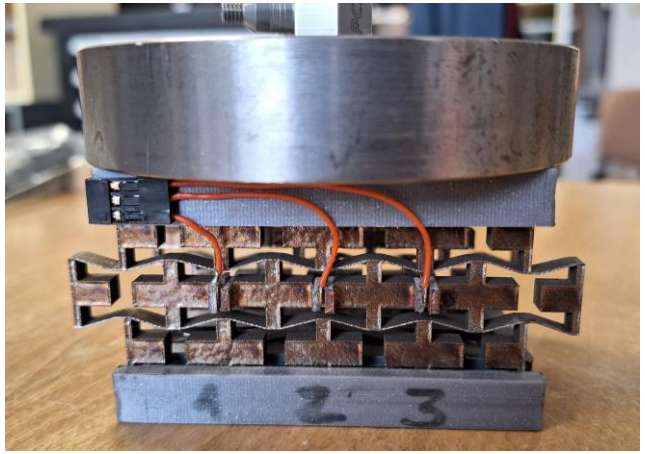


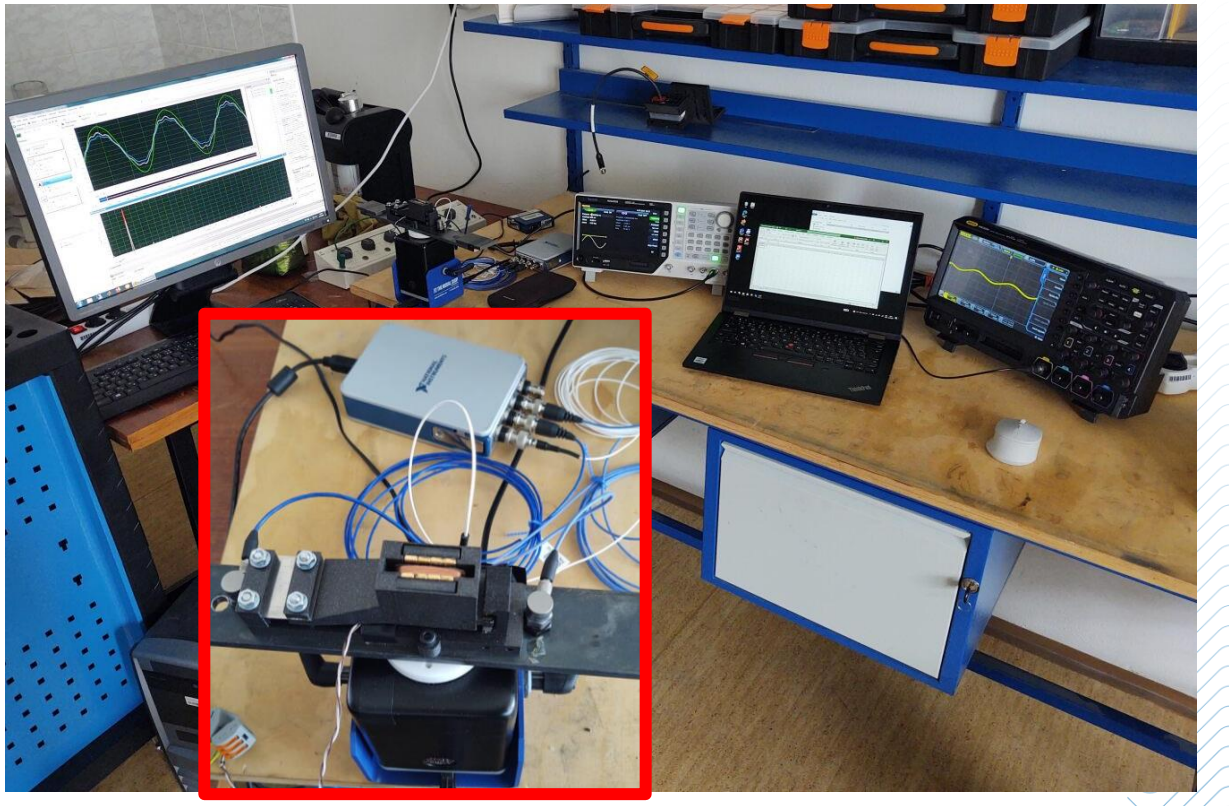


D3.3 Testing procedure of kinetic energy harvesters

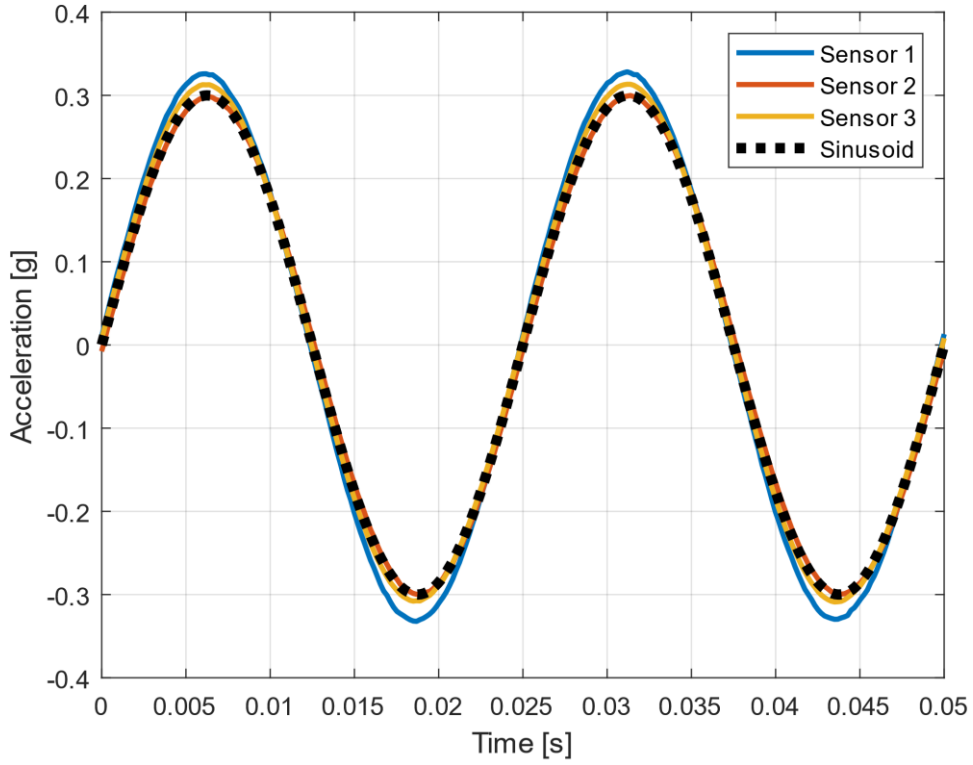
(piezoelectric, electromagnetic, structural harvesters)

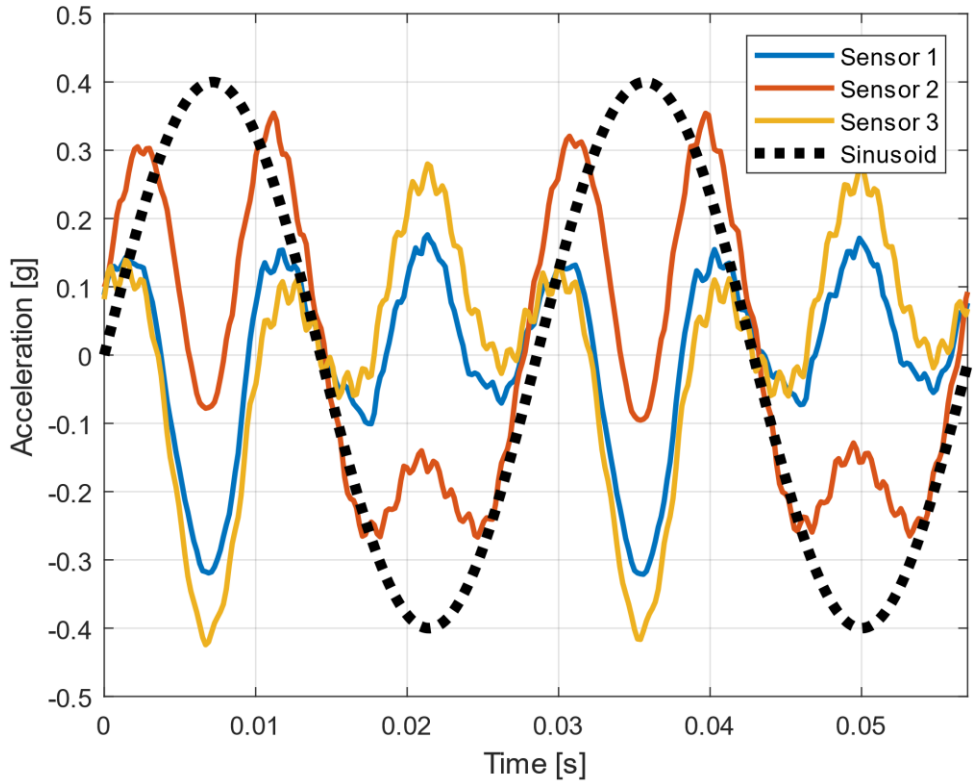
Brno University of Technology



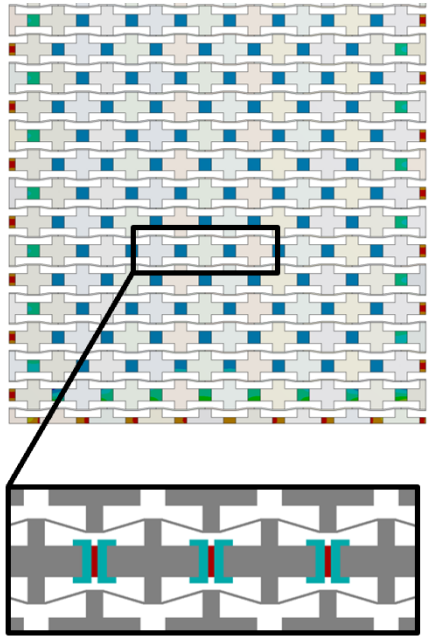


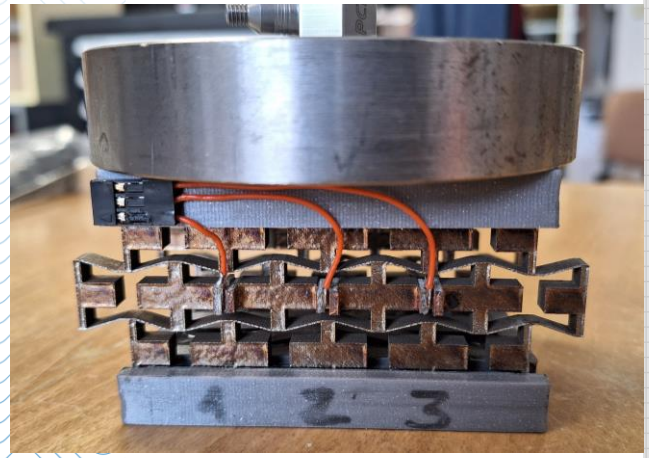
Shaker test – nonlinear systems !!!

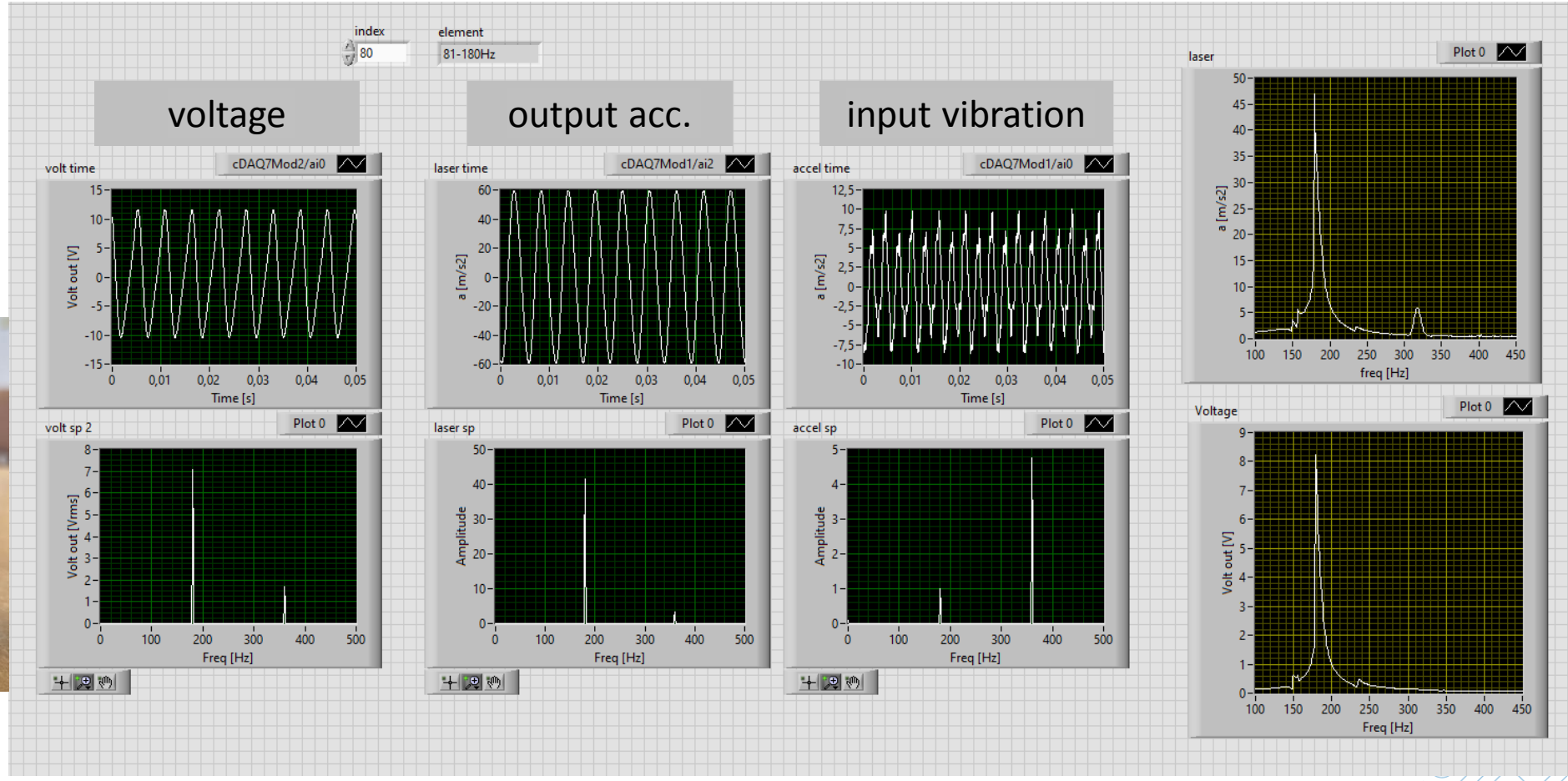




Shaker TEST of metamaterial







WG3 Power management and energy harvesting

D3.1 Publication of state of art so future developments in energy harvesting/power management can be measured and assessed (M12) ✓

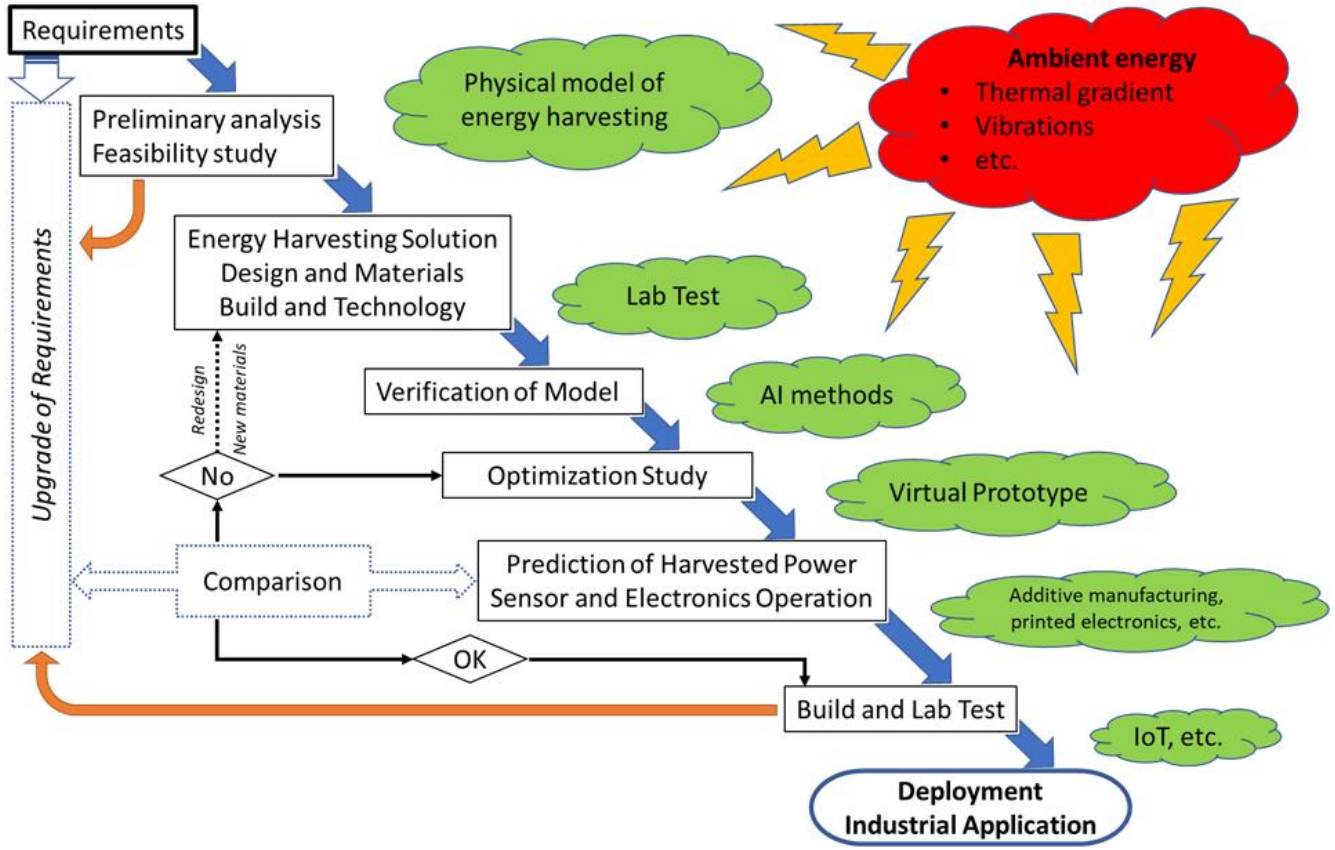
D3.2 Publication of positions linked to vibration and temperature gradients (M24) ✓

D3.3 Development and publication of standardized approaches for the comparison of new and existing devices (M39)

- Figure of merit - thermoelectrics
- Vibration test with automatized efficiency measurement ✓

D3.4 Final review of power availability on aerospace structures (M48)

D3.4 Final review of power availability on aerospace structures (M48)



ELSEVIER

Mechanical Systems and Signal Processing

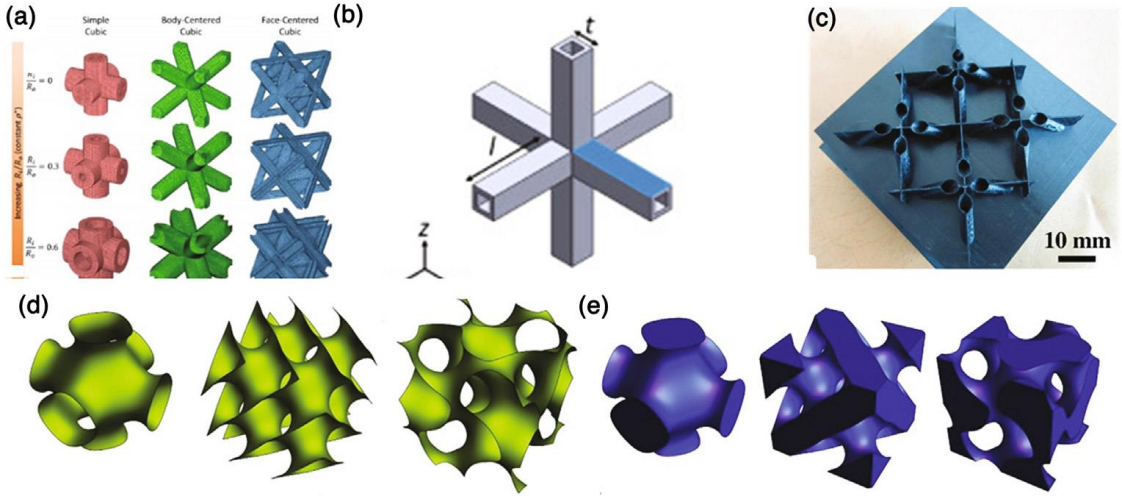
Volume 110, 15 September 2018, Pages 152-164

Virtual prototypes of energy harvesting systems for industrial applications ☆

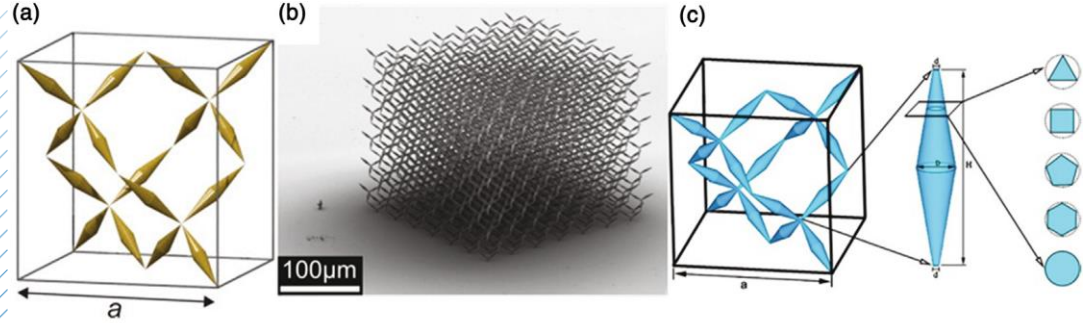
Zdenek Hadas, Ludek Janak, Jan Smilek

MEBioSys
Metamaterial

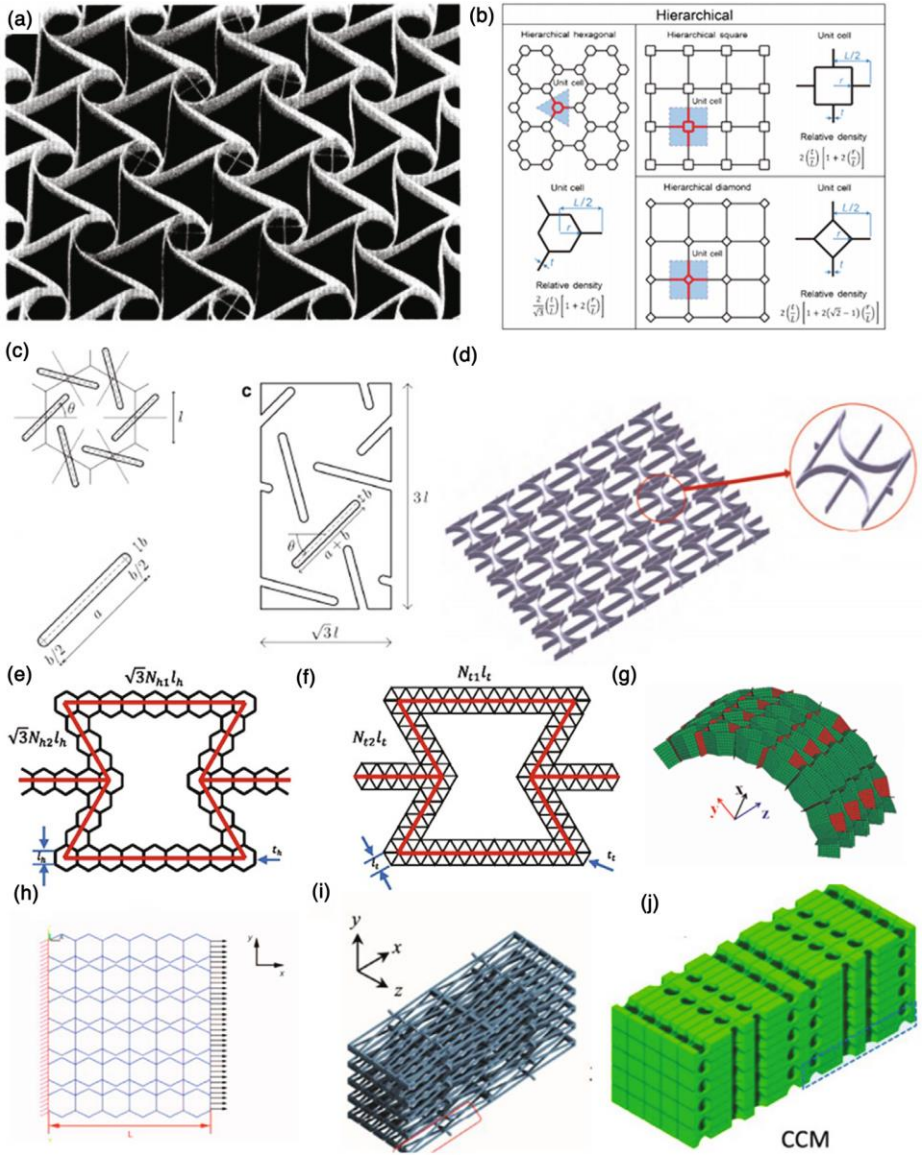
Lightweight and energy absorption MM



Pentamode MM

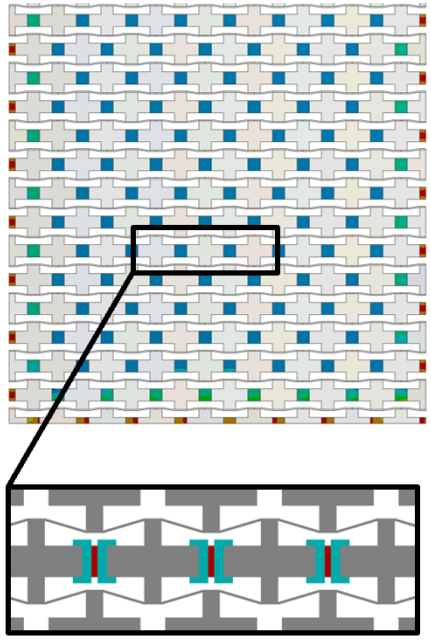


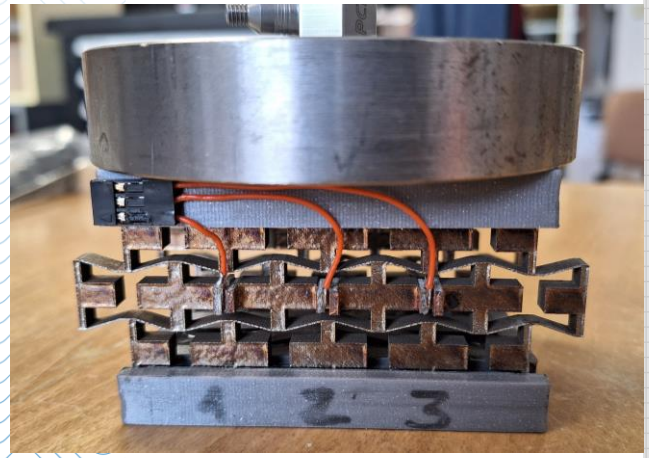
Zero or negative Poisson's ratio MM

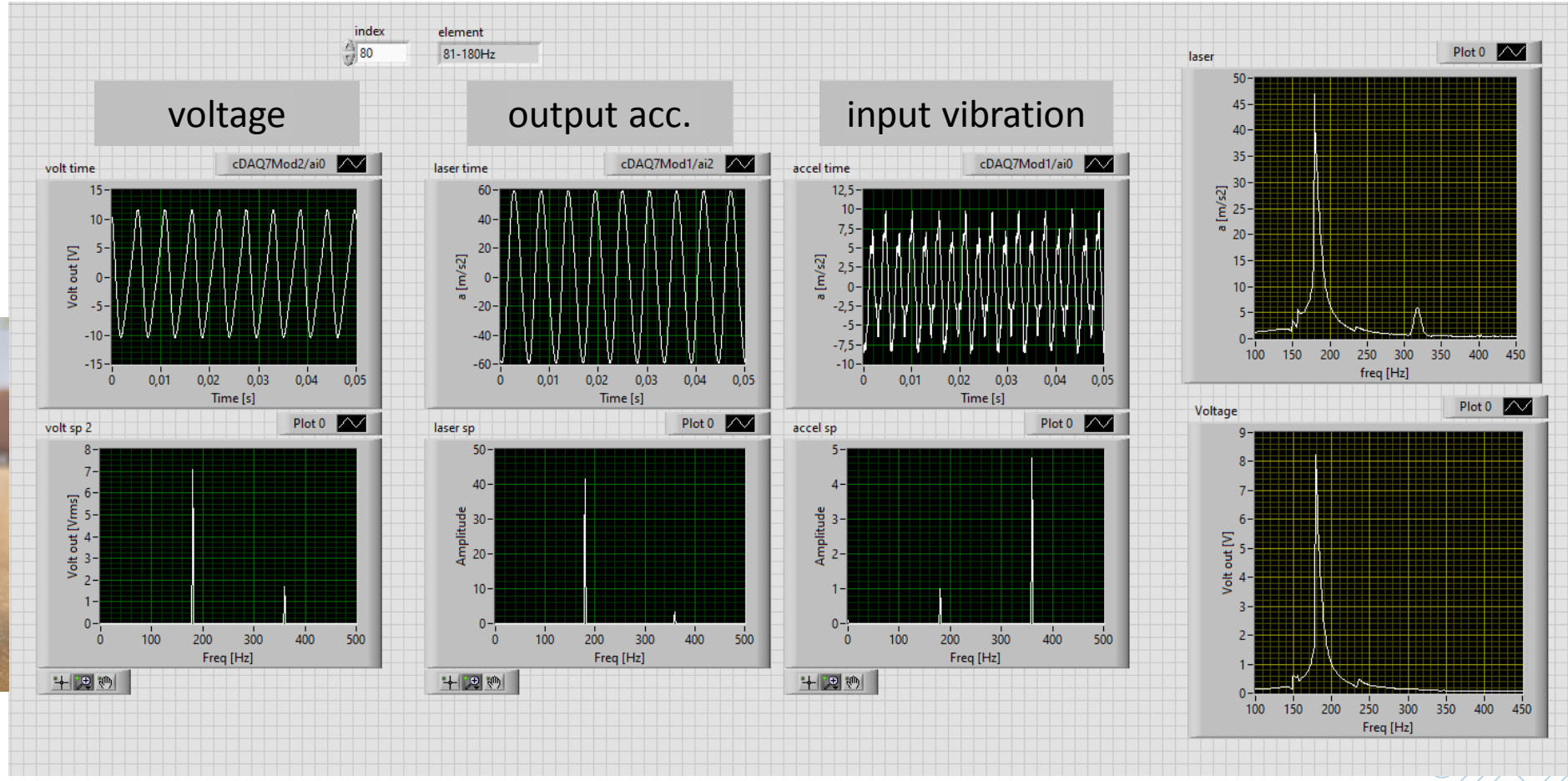


1. J. Fan, L. Zhang, S. Wei, Z. Zhang, S. -kyum Choi, B. Song, and Y. Shi, "A review of additive manufacturing of metamaterials and developing trends", *Materials today (Kidlington, England)*, vol. 50, pp. 303-328, 2021.

Shaker TEST of metamaterial

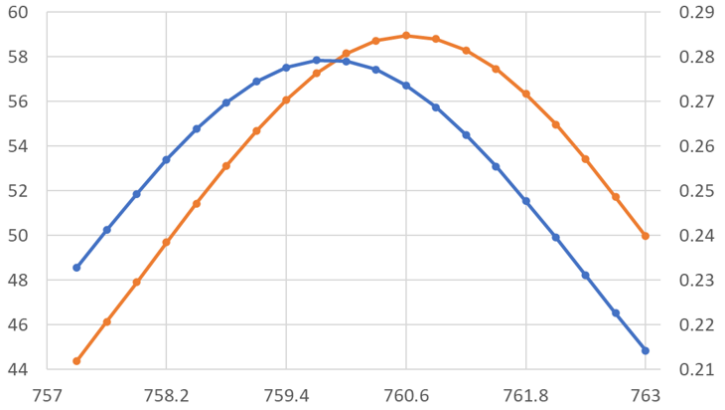


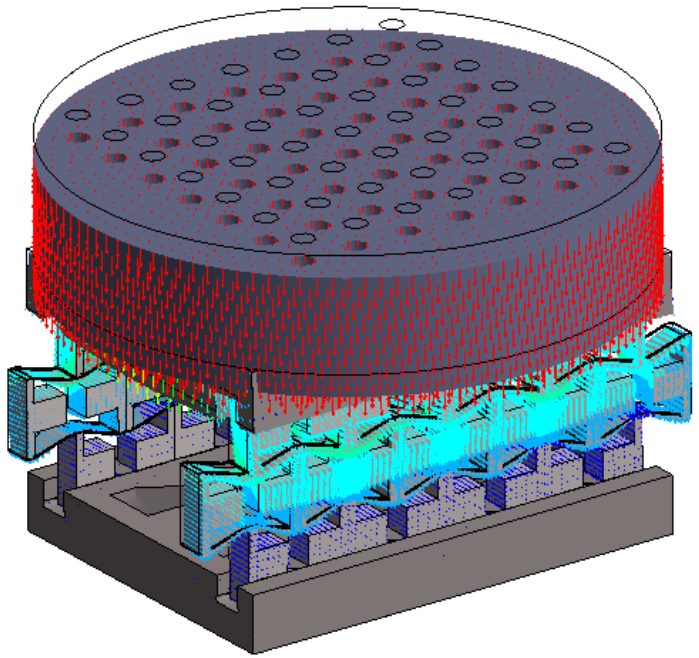


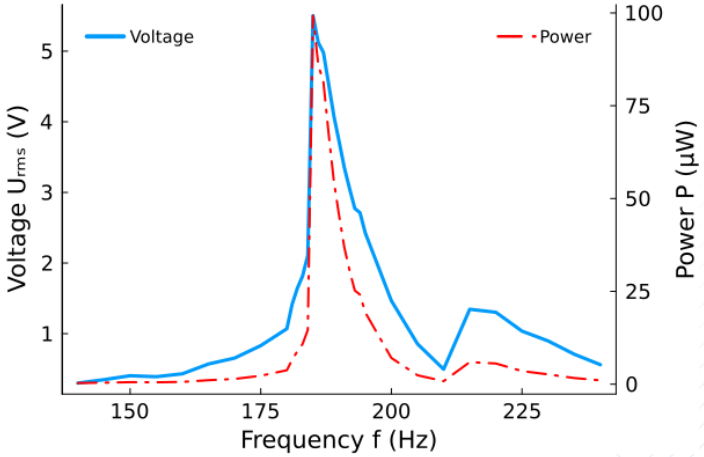


Multidisciplinary ANSYS Modelling

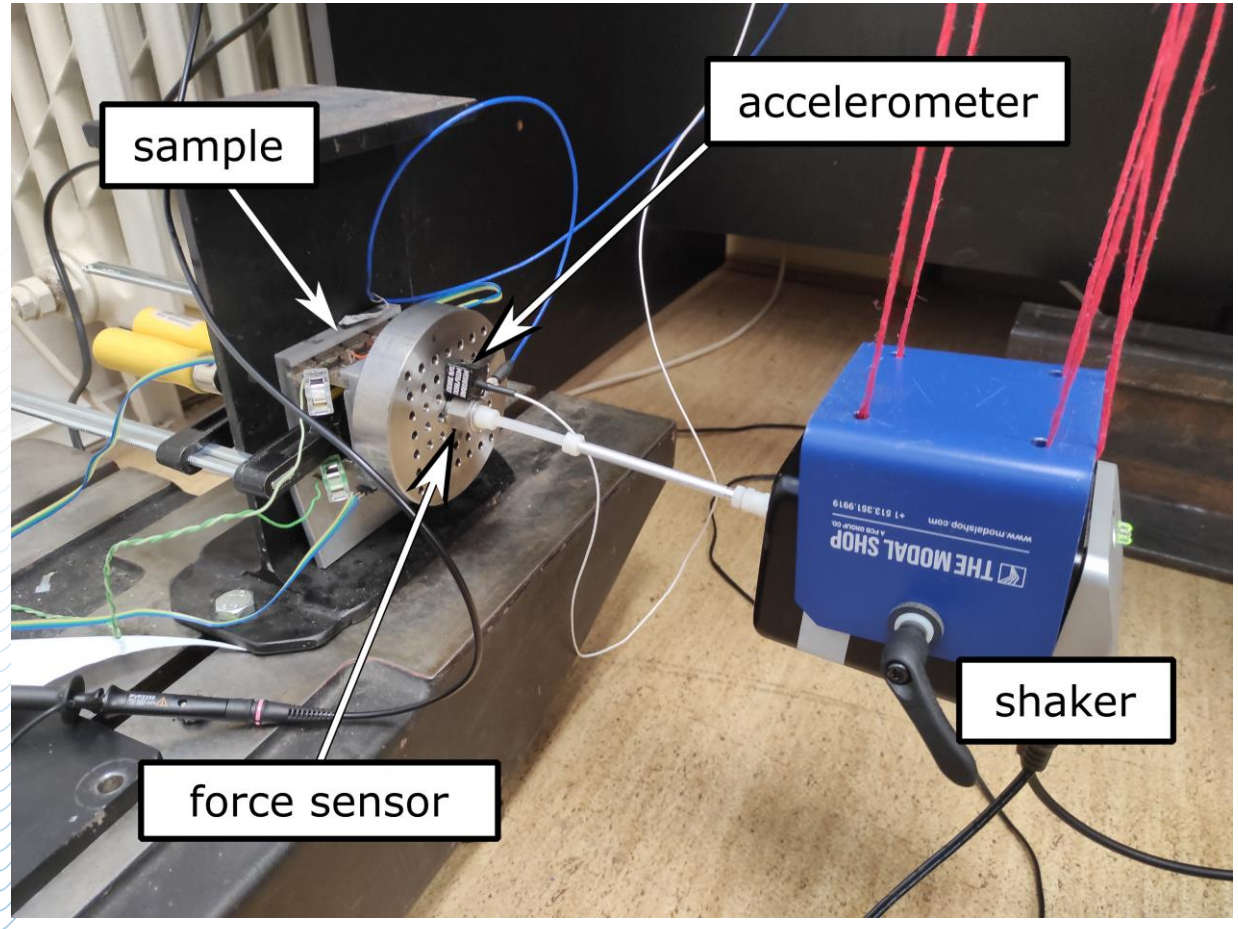
- Electromechanical FE model
- Natural frequency
  - Experiments: 191 Hz
  - FEM: 198 Hz
- Open vs. Short Circuit

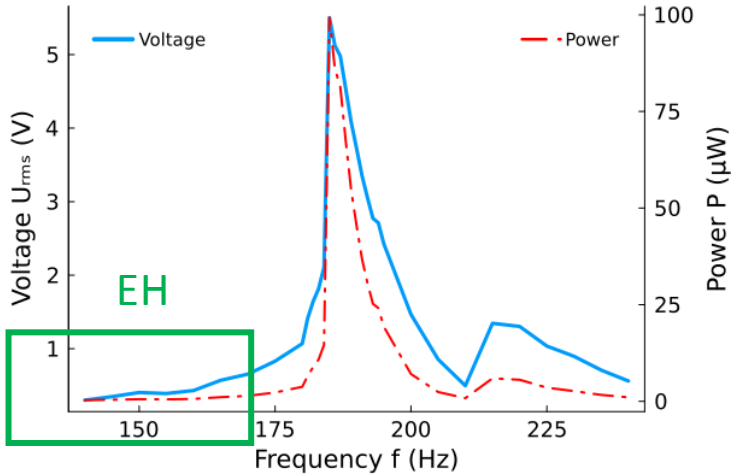


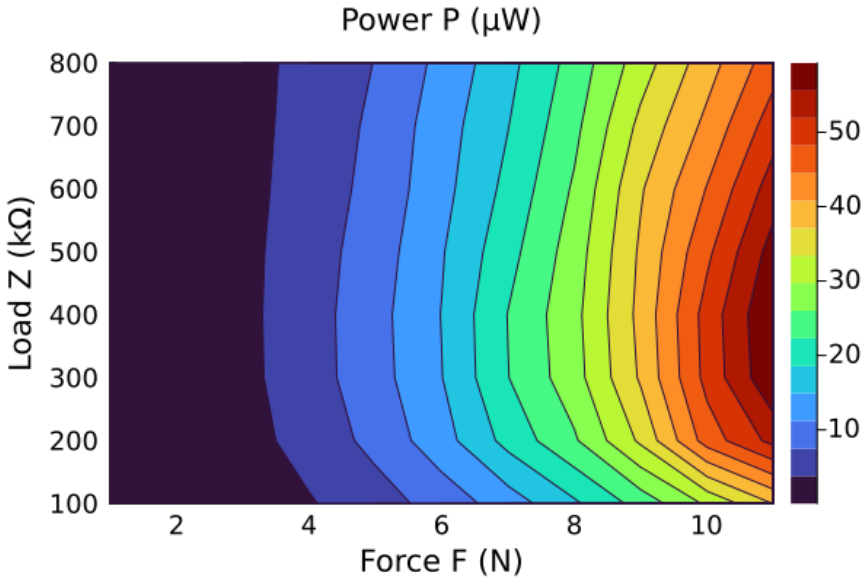




Mode	Freq
1	80.269
2	104.09
3	116.59
4	124.62
5	**198.38**
6	214

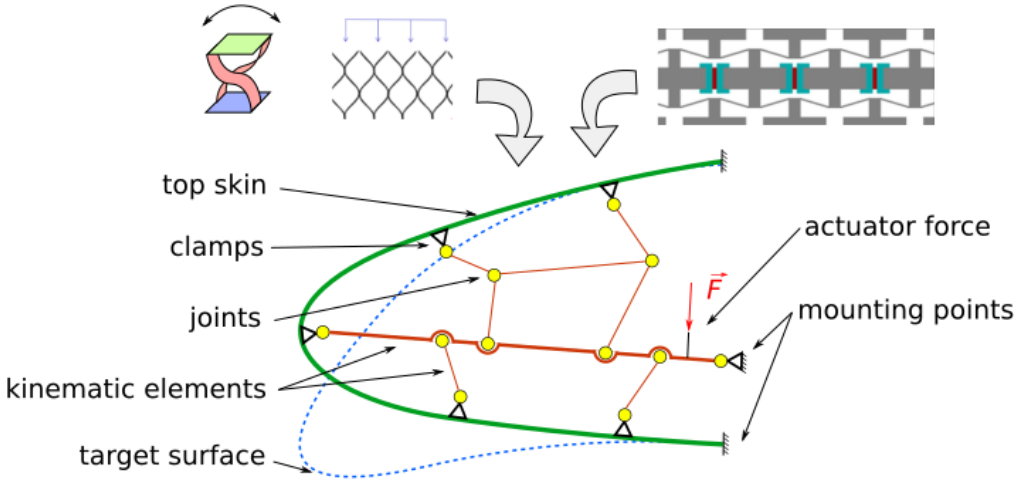

sample
accelerometer
shaker
force sensor

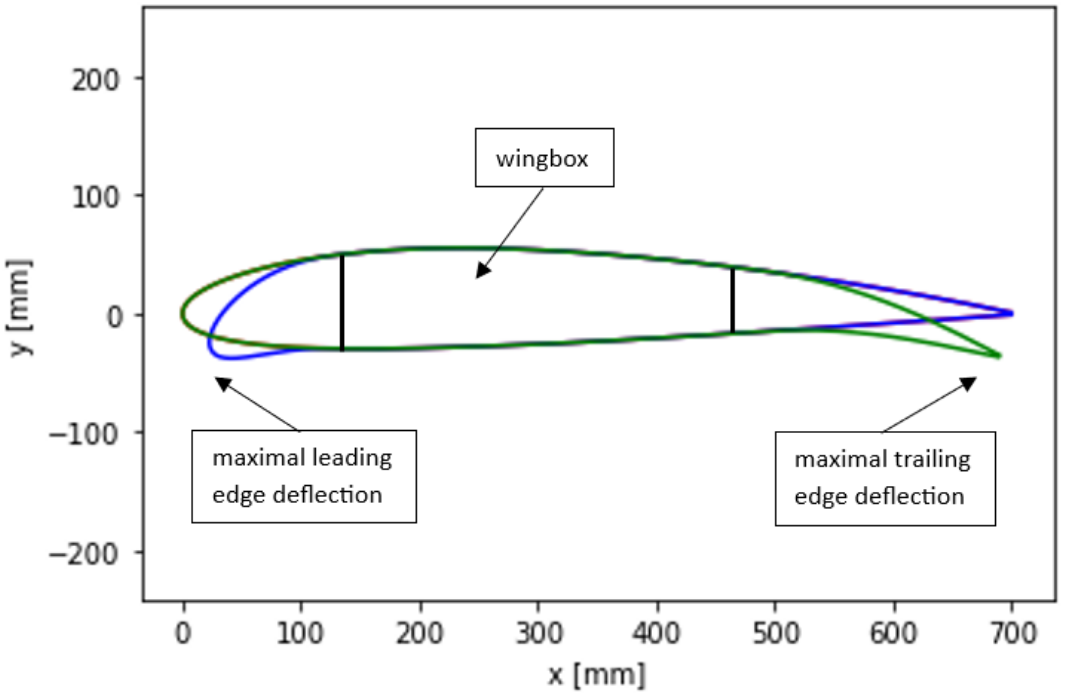

Voltage
Power
Voltage U_{rms} (V)
Power P (µW)
EH
Frequency f (Hz)
150
175
200
225
1
2
3
4
5
0
25
50
75
100


Power P (µW)
Load Z (kΩ)
Force F (N)
100
200
300
400
500
600
700
800
2
4
6
8
10
10
20
30
40
50

Concept of SMART Morphing Structure

- Integration of Sensing / morphing operation (Miroslav ICL)

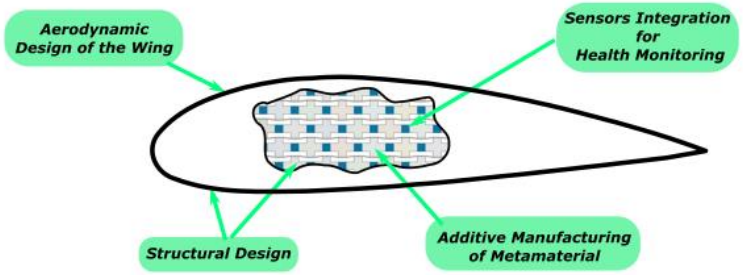


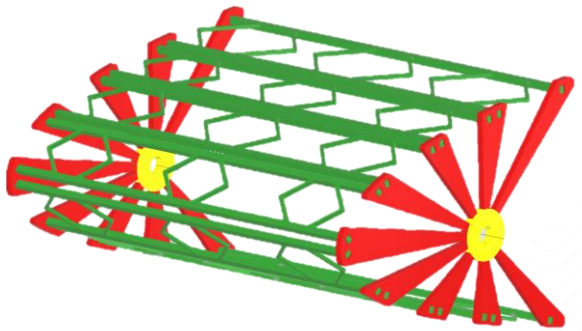


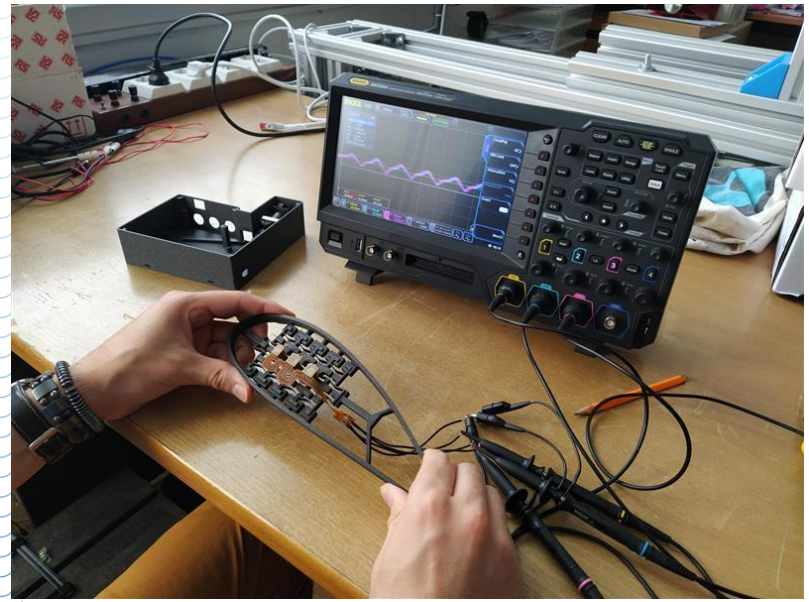
BAANG

WG1 - Zahra Sharif Khodaei - Imperial College London, UK

Model-based design of metamaterial lattice for morphing wing operation - T3.5







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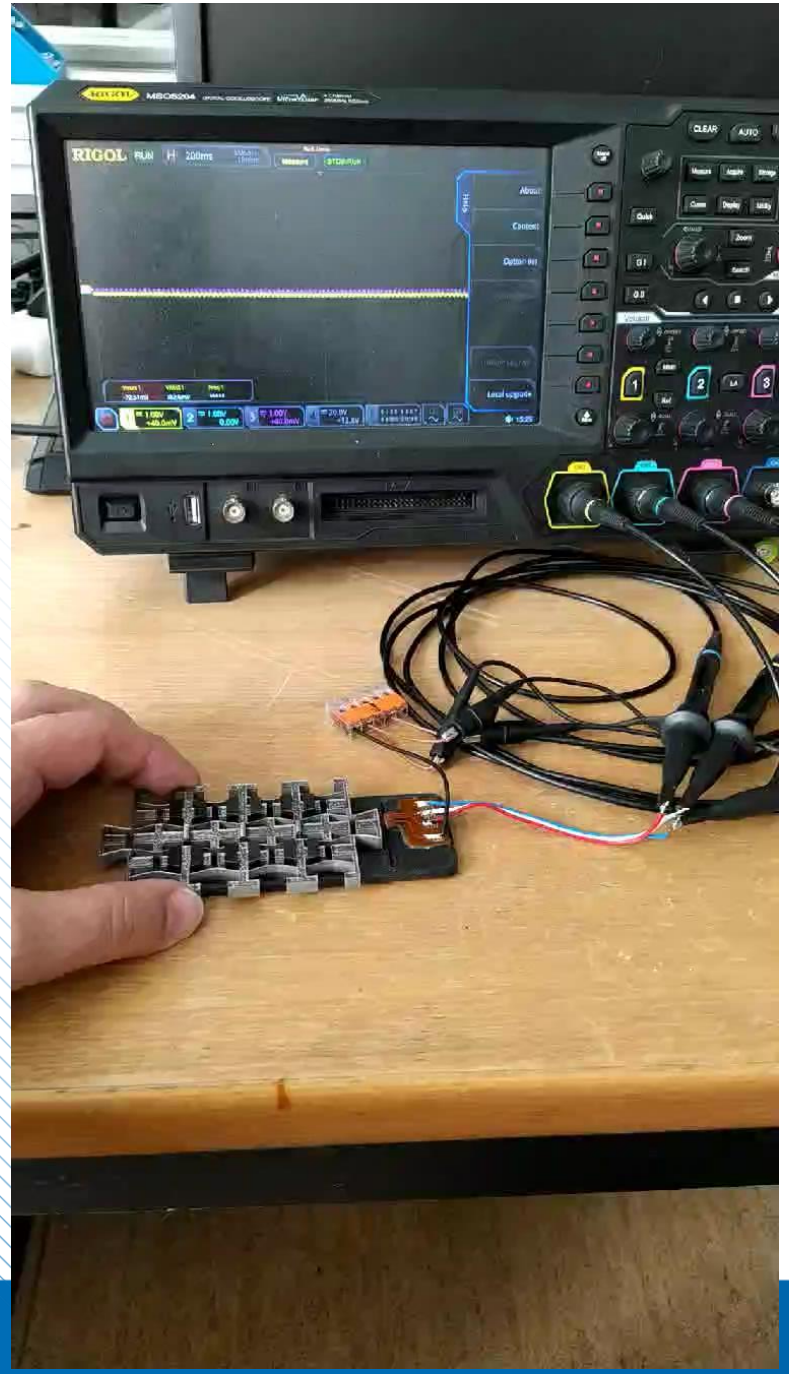

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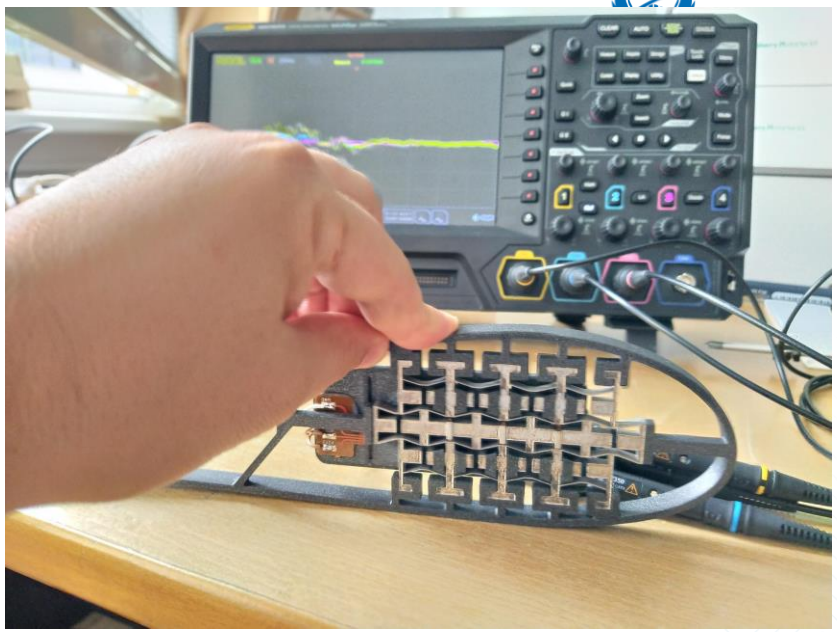
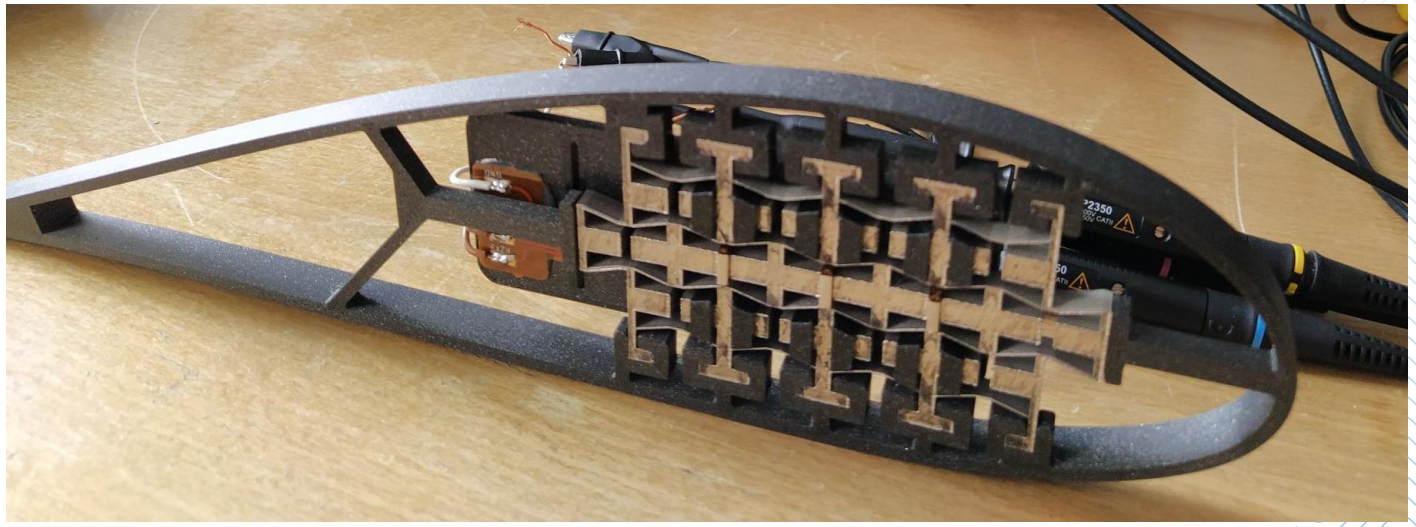


Ti6A/4V



WG3 Power management and energy harvesting

Opportunities – ultra low power systems – model base design

Energy harvesting (+ sensing element .. low consumption)

Power management + communication electronics on one board

Working Group Four

Name: Romana Śliwa

Organization: Rzeszów University of Technology, Poland

Email: rsliwa@prz.edu.pl

Management Committee Meeting (MC6)

Outline

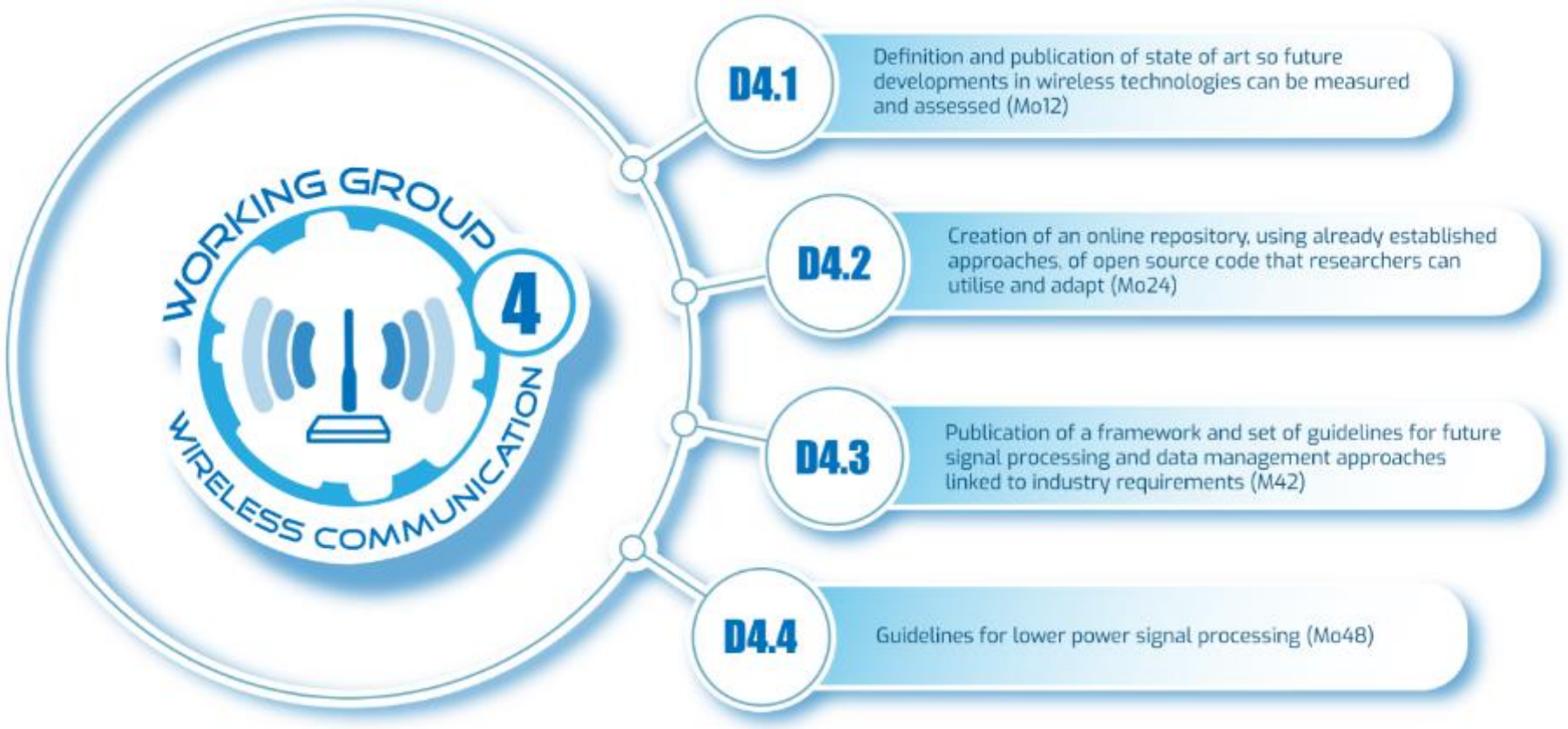
- WG4 Status. Active partners
- WG4 meetings online and during CAT AERONET Aviation Valley Conferences (Poland)
- Scope of research work
- Joint Publications
- Energy Harvesting Training School in Rzeszow, Poland (WG3 + WG4)
- Cooperation between WG 4 + WG3 + WG2 +WG5

  (to build concept of CIG project (after ODIN)
- Next Steps

WG4 Active Institutional Partners

- **Cardiff University School of Engineering**, U.K.
- **School of Engineering and Natural Sciences, University of Iceland**, Iceland
- **Faculty of Mechanical Engineering and Aeronautics, Rzeszow University of Technology**, Poland
- **Faculty of Electrical and Computer Engineering, Rzeszow University of Technology**, Poland
- **Faculty of Civil and Environmental Engineering and Architecture, Rzeszow University of Technology**, Poland
- **Institute of Fluid-Flow Machinery Polish Academy of Sciences**, Gdansk, Poland;
- **Faculty of Mechanical Engineering and Ship Technology, Gdansk University of Technology**, Poland
- **WG4 still invites other teams from other countries (acc. to previous declaration) to take part in WG4 activity to finalize core programme dealing with aviation**

Deliverables



- **WG4 ODIN Wireless communication is of great importance to unlocking the potential of SHM systems in aerospace, bridge structures and wind turbines. However, the greatest challenge lies in aerospace where there is a restriction in allowable wireless protocols and the complex geometry that signals have to propagate through and around. The working group will focus on aerospace protocols and strategies that will reduce power requirements at a sensor node. In addition, the working group will review the safety and security of existing protocols.**

- **<u>Deliverables</u>**
- **D4.1: Definition and publication of state of art so future developments in wireless technologies can be measured and assessed (Mo12)**
- **- D4.2: Creation of an online repository, using already established approaches, of open source code that researchers can utilise and adapt (Mo24);**
- **D4.3: Publication of a framework and set of guidelines for future signal processing and data management approaches linked to industry requirements (M42)*(focused fon aviation application)***
- **D4.4 Guidelines for lower power signal processing (Mo48 + 6) (*under preparation and realization)***

Now WG4 teams are active in realizing tasks / developing research in the fields:

Direction 1: In the context of wireless communication in sensor networks including IoT/IoE, we can distinguish three main problems: performance, energy efficiency and security. Moreover, existing research presents some limitation when using public key mechanisms such as digital signature algorithms. Therefore, further work may be to explore new reliable, efficient and energy-efficient integrity schemes for data collection in WSNs to significantly mitigate and reduce these problems by using secure and lightweight signature algorithm.

Direction 2: Internet of Things (IoT) security and privacy with minimal performance requirements is an open research challenge. Blockchain technology, as a distributed and decentralized technology can be a potential solution to deal with the limitations of current peer-to-peer IoT networks. This can be achieved by developing an integrated IoT system implementing permissioned blockchain to secure edge devices by using a local authentication process and identifying data generated by IoT devices. The challenge is the scalability of IoT systems, computational power, and problems with IoT edge devices storing data in the blockchain network.

Direction 3: Wireless sensor networks require a high degree of synchronization to produce data streams, and timing discrepancies manifest as unwanted incidents, data misrepresentations. Network Time Protocol (NTP) can provide accurate results, although it has a high variance depending on the environment and channel load. Therefore, an important issue to be developed in future work will be the investigation of accurate techniques for software clock synchronization in a network of interconnected devices to ensure stable microsecond accuracy regardless of the number of sensors and network conditions.

Direction 4 **Wireless communication for implementation in aviation (tasks for D4.4)**

Short Term Scientific Missions (STSM) - Odin CA18203 - 03.06.2023 – 18.06.2023
cooperation between WG4 and WG3

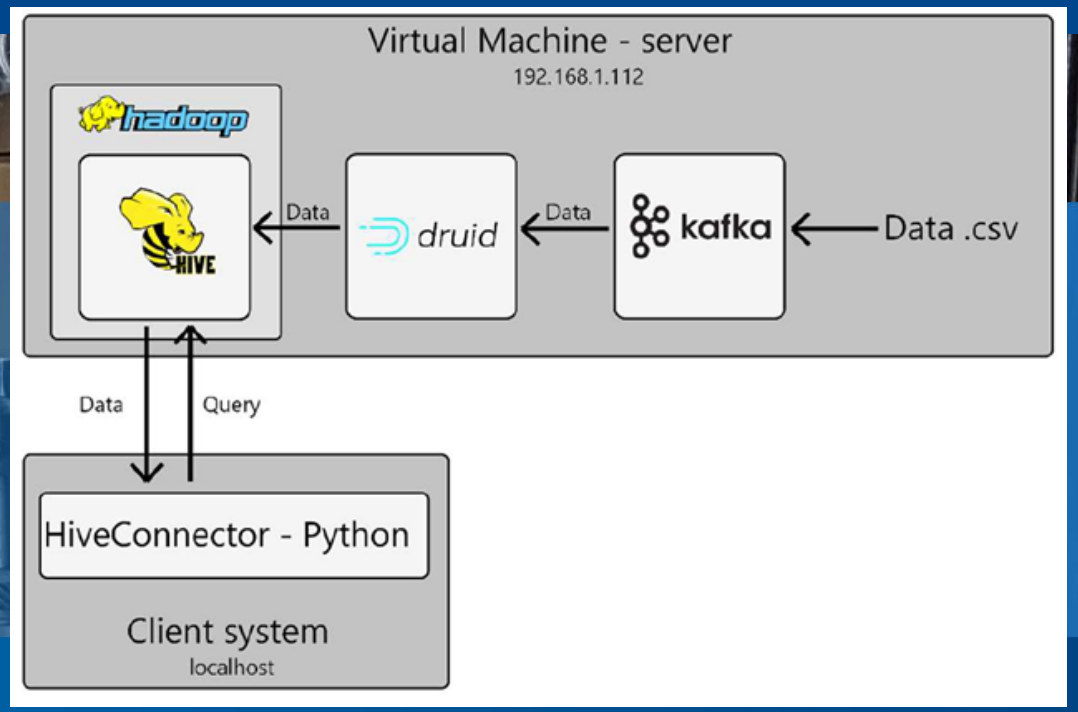
Publications

- Dymora, P., Mazurek, M., Jucha, M. (2023). Regression Models Evaluation of Short-Term Traffic Flow Prediction. In: Zamojski, W., Mazurkiewicz, J., Sugier, J., Walkowiak, T., Kacprzyk, J. (eds) Dependable Computer Systems and Networks. DepCoS-RELCOMEX 2023. Lecture Notes in Networks and Systems, vol 737. Springer, Cham. https://doi.org/10.1007/978-3-031-37720-4_5 (SCOPUS).

- Dymora, P., Lichacz, G., Mazurek, M. (2023). Performance Analysis of a Real-Time Data Warehouse System Implementation Based on Open-Source Technologies. In: Zamojski, W., Mazurkiewicz, J., Sugier, J., Walkowiak, T., Kacprzyk, J. (eds) Dependable Computer Systems and Networks. DepCoS-RELCOMEX 2023. Lecture Notes in Networks and Systems, vol 737. Springer, Cham. https://doi.org/10.1007/978-3-031-37720-4_6 (SCOPUS).

- R.E. Śliwa; P. Dymora; M. Mazurek; B. Kowal; M. Jurek; D. Kordos; T. Rogalski; P. Flaszynski; P. Doerffer; K. Doerffer; S. Grigg (2022); The Latest Advances in Wireless Communication in Aviation, Wind Turbines and Bridges. Inventions 2022, 7, 18. https://doi.org/10.3390/inventions701001 (SCOPUS)

Future plans

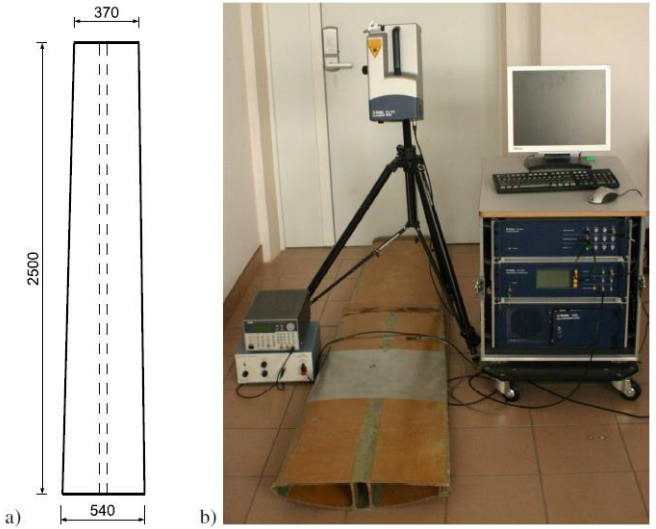


Dymora, P., Lichacz, G., Mazurek, M. (2023). Performance Analysis of a Real-Time Data Warehouse System Implementation Based on Open-Source Technologies. In: Zamojski, W., Mazurkiewicz, J., Sugier, J., Walkowiak, T., Kacprzyk, J. (eds) Dependable Computer Systems and Networks. DepCoS-RELCOMEX 2023. Lecture Notes in Networks and Systems, vol 737. Springer.

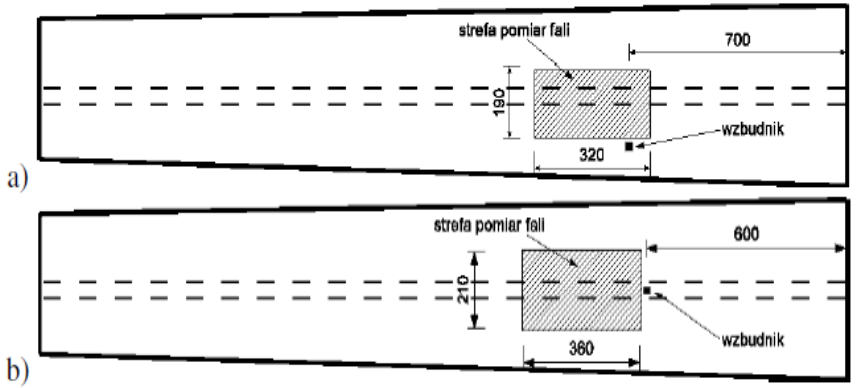
Integration and test of piezocomposite sensors for structure health monitoring in aerospace, Filip Ksica,Zdenek Hadas, Jiri Hlinka, Measurement 147 (2019) 106861

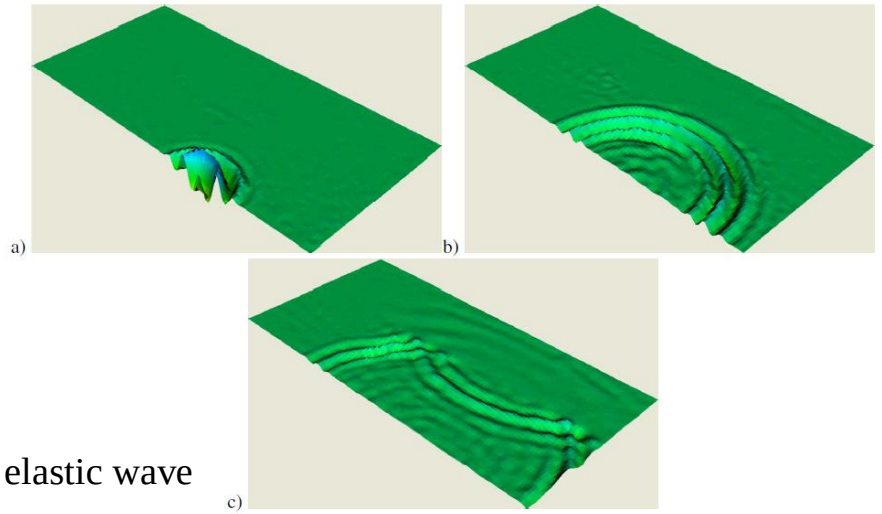
WG4+WG2 Structural health monitoring SHM of aviation structures

Elastic wave propagation method

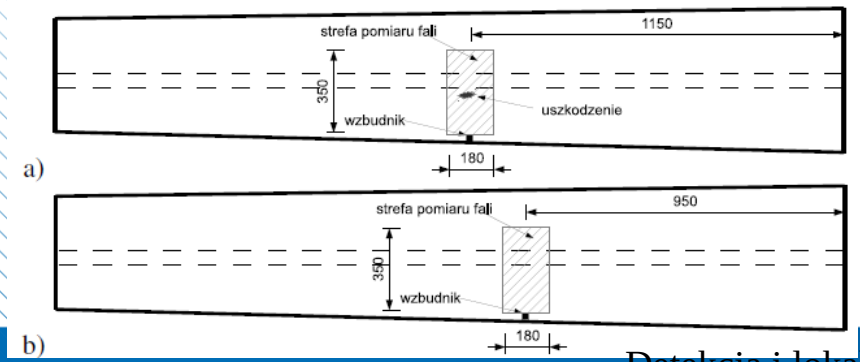


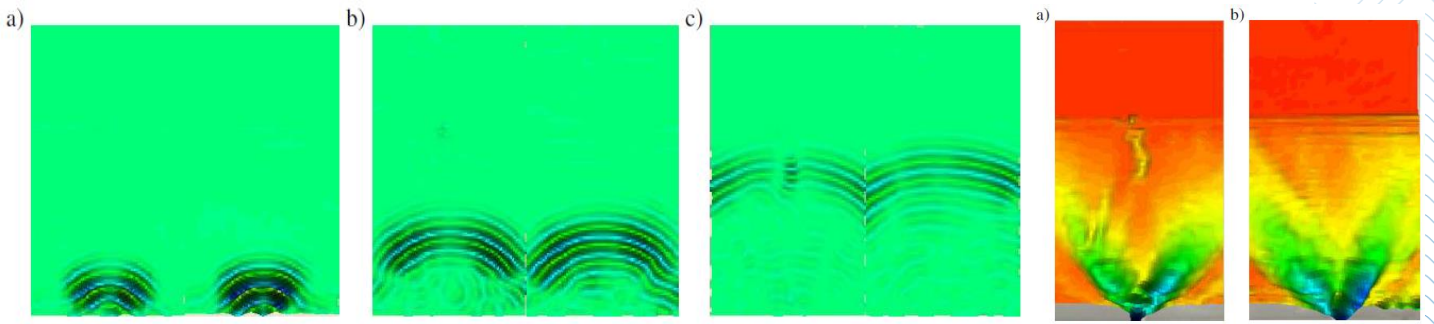
Measuring station - measurement of elastic wave propagation on a composite wing





Analysis of the internal structure – maps of elastic wave propagation in selected moments of time

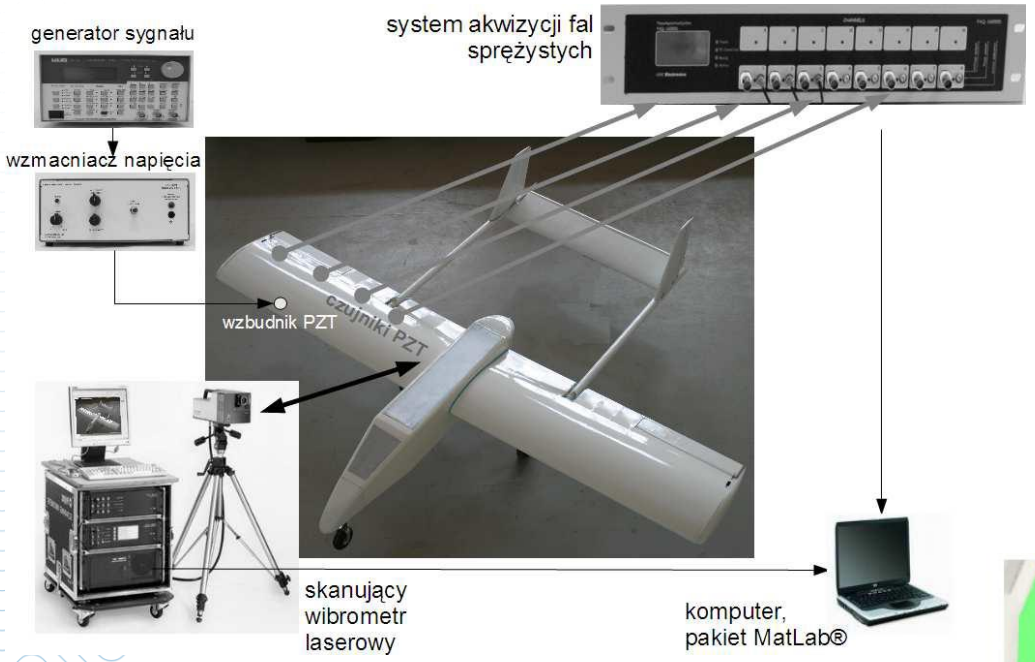




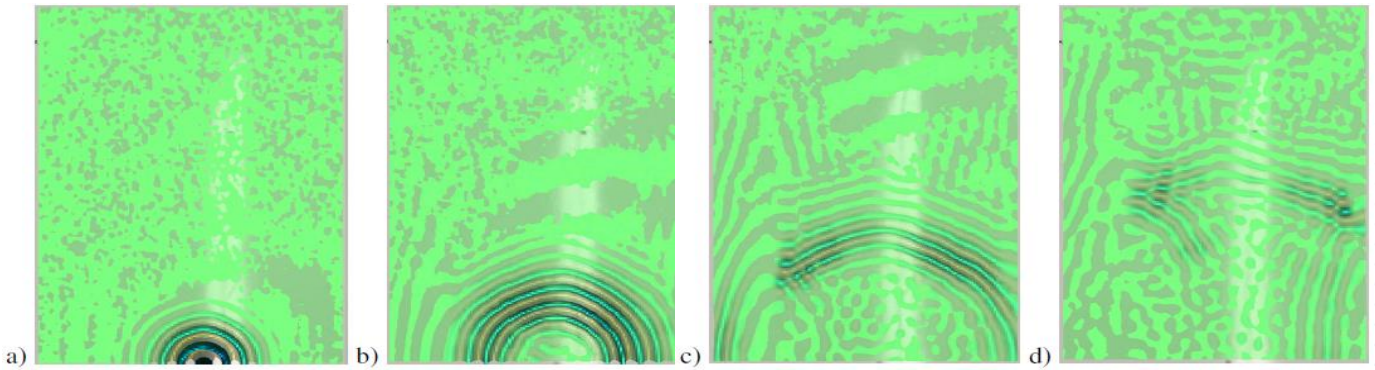
Detekcja i lokalizacja uszkodzenia – mapy propagacji fali sprężystej w wybranych chwilach czasu, mapy RMS - dla stanu bez uszkodzenia i z uszkodzeniem,

WG4 + WG2 Structural health monitoring SHM of aviation structures

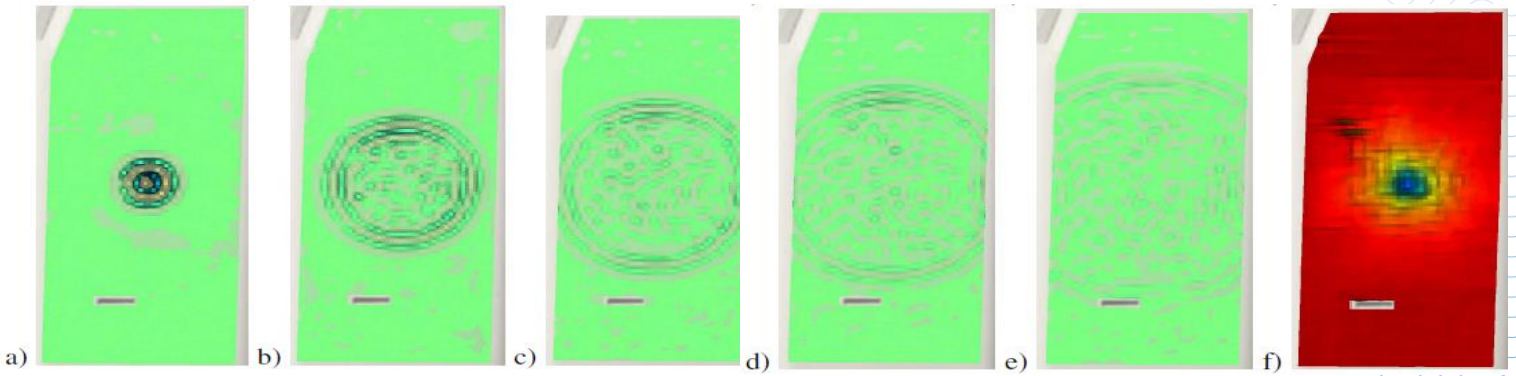
Elastic wave propagation method



Measuring station - measurement of elastic wave propagatio in structural elements of an unmanned aerial vehicle (UAV)



Internal structure analysis – maps of elastic wave propagation in the UAV wing at selected moments of time

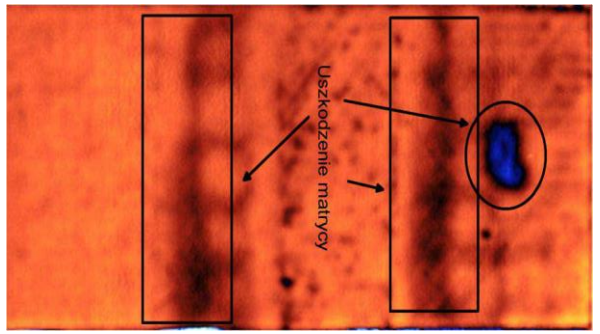


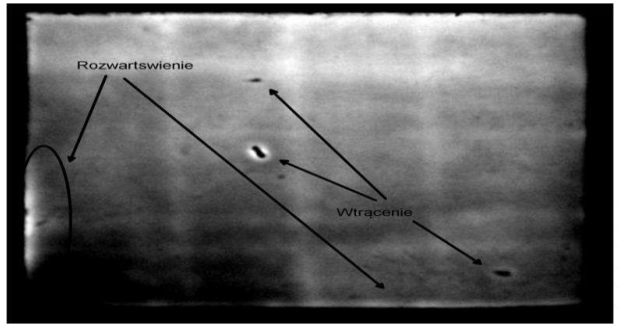
Analiza struktury wewnętrznej – mapy propagacji fali sprężystej w kadłubie UAV w wybranych chwilach czasu

WG4 +WG2 Structural health monitoring SHM of aviation structures

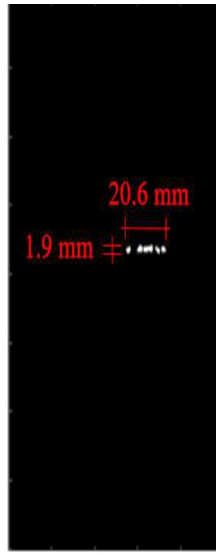
Active thermography method

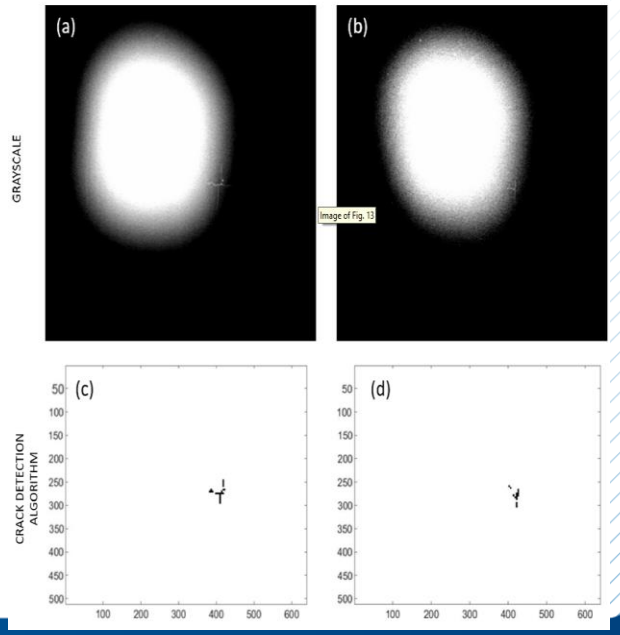
Measuring station for non-destructive thermal imaging tests





Examples of **damage and discontinuity detection in composite materials** based on the analysis of the material response to thermal forcing





Przykłady wykrywania uszkodzeń udarowych na podstawie analizy sekwencji termogramów

WG2+WG4

- The invitation from prof. Elena Jesiuniene **STSM** internship from **10/09/2023 to 23/09/2023. the Kaunas University of Technology** for **dr Michał Jurek and dr Dominika Ziaja** within two weeks, they worked in prof. Elena's laboratory acc. to work-plan.
- Now there are prepared plans to implement and realize common research work together with prof. Elena and her team in Kaunas and Rzeszów University of Technology

D4.4 Guidelines for lower power signal processing (Mo48 + 6) (*under preparation and realization)*

- **Currently, measurement systems equipped with AHRS, two independent accelerometers, and wireless transmission module are being developed. This allows data transmission at a distance of 50 meters with a frequency of up to 1000 Hz for each measured parameter, independently for each module.**
- **It is essential that two identical samples of the tested laminate will be placed and monitored on the aircraft. Such an approach will enable real-time comparison of the impact of damage to one of the samples compared to the reference sample located on the other side of the aircraft. This is particularly important because each flight is different and unique therefore, interpreting the results, although carried out on a real object, would be difficult due to the lack of a reference point.**
- **Planned tests include in-flight studies, initially focusing on validating the measurement systems. Flights will be conducted with identical, undamaged laminate samples placed on both sides. During the studies, the plates with the measurement systems will be swapped. Such an action will enable the verification of the correct functioning of the measurement system and will show whether the effects on the tested materials are identical.**
- **Subsequent studies will involve flights with introduced damage to one of the tested samples. These flights will be repeated, and with each new flight, the damage to the tested laminate will be increased under controlled conditions. This will allow an independent assessment of the state of damage using online research methods, which will be a reference point for data interpretation.**
- **After conducting the studies, the collected data will be analyzed for the purpose of interpreting the gathered measurements in terms of the impact of damage on the material's behavior during flight.**
- **Ultimately, a system will be developed to enable real-time assessment of the structure's condition.**

WG4

Wireless measurement systems installed on the tested laminate, placed in the tail section of the aircraft, outside its outline.

The data recording and analysis module installed in the cabin enables remote communication with measurement systems located in the tail section.

Publications

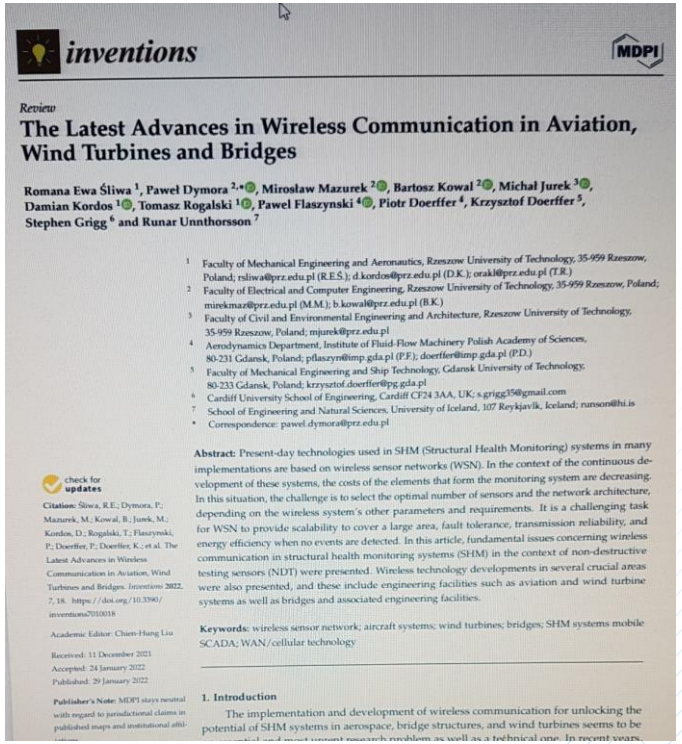
Inventions 2022, 7, 18. https://doi.org/10.3390/inventions7010018

Review

The Latest Advances in Wireless Communication in Aviation, Wind Turbines and Bridges

Romana Ewa Sliwa ´ [1] , Paweł Dymora [2],* , Mirosław Mazurek [2] , Bartosz Kowal [2] , Michał Jurek [3] , Damian Kordos [1] , Tomasz Rogalski [1] , Pawel Flaszynski [4] , Piotr Doerffer [4] , Krzysztof Doerffer [5] , Stephen Grigg [6] and Runar Unnthorsson [7]

1 **Faculty of Mechanical Engineering and Aeronautics, Rzeszow University of Technology**, 35-959 Rzeszow, Poland; rsliwa@prz.edu.pl (R.E.S.); d.kordos@prz.edu.pl (D.K.); orakl@prz.edu.pl (T.R.) ´ 2 **Faculty of Electrical and Computer Engineering, Rzeszow University of Technology**, 35-959 Rzeszow, Poland; mirekmaz@prz.edu.pl (M.M.); b.kowal@prz.edu.pl (B.K.) 3 **Faculty of Civil and Environmental Engineering and Architecture, Rzeszow University of Technology**, 35-959 Rzeszow, Poland; mjurek@prz.edu.pl 4 Aerodynamics Department, **Institute of Fluid-Flow Machinery Polish Academy of Sciences**, 80-231 Gdansk, Poland; pflaszyn@imp.gda.pl (P.F.); doerffer@imp.gda.pl (P.D.) 5 **Faculty of Mechanical Engineering and Ship Technology, Gdansk University of Technology**, 80-233 Gdansk, Poland; krzysztof.doerffer@pg.gda.pl 6 **Cardiff University School of Engineering**, Cardiff CF24 3AA, UK; s.grigg35@gmail.com 7 **School of Engineering and Natural Sciences, University of Iceland**, 107 Reykjavlk, Iceland; runson@hi.is * Correspondence: pawel.dymora@prz.edu.pl



inventions

MDPI

Review

The Latest Advances in Wireless Communication in Aviation, Wind Turbines and Bridges

Romana Ewa Śliwa [1], Paweł Dymora [2,*], Mirosław Mazurek [2], Bartosz Kowal [2], Michał Jurek [3], Damian Kordos [1], Tomasz Rogalski [1], Pawel Flaszynski [4], Piotr Doerffer [4], Krzysztof Doerffer [5], Stephen Grigg [6] and Runar Unnthorsson [7]

Abstract: Present-day technologies used in SHM (Structural Health Monitoring) systems in many implementations are based on wireless sensor networks (WSN). In the context of the continuous development of these systems, the costs of the elements that form the monitoring system are decreasing. In this situation, the challenge is to select the optimal number of sensors and the network architecture, depending on the wireless system's other parameters and requirements. It is a challenging task for WSN to provide scalability to cover a large area, fault tolerance, transmission reliability, and energy efficiency when no events are detected. In this article, fundamental issues concerning wireless communication in structural health monitoring systems (SHM) in the context of non-destructive testing sensors (NDT) were presented. Wireless technology developments in several crucial areas were also presented, and these include engineering facilities such as aviation and wind turbine systems as well as bridges and associated engineering facilities.

Keywords: wireless sensor network; aircraft systems; wind turbines; bridges; SHM systems mobile SCADA; WAN/cellular technology

1. Introduction

Materials, 2021, 14, 7268. https://doi.org/10.3390/ma14237268

Experimental and Numerical Analysis of Multiple Low-Velocity Impact Damages in a Glass Fibered Composite Structure.

Balasubramaniam, K.; Ziaja, D.; Jurek, M.; Fiborek, P.; Malinowski, P.

From June 29 to July 1, 2022, Rzeszów University of Technology was the host of the **ENERGY HARVESTING TRAINING SCHOOL**, which was the result of cooperation of scientists from Europe as part of Cost Action CA18203 - **Optimizing Design for Inspection (ODIN)**

The event is the result of **cooperation between two ODIN working groups: WG3** (Leader, Prof. Zdenek Hadas), **and WG4** (Leader, Prof. Romana Ewa Śliwa).

This action aims to maximize the full benefits of continuous monitoring of critical aviation structures through the integration and use of non-destructive ultrasonic wave (NDE) methods, energy harvesting and wireless sensor technology in the design concept phase.

Activities relate to optimization (sensors and structures), computational modeling, advanced signal processing and advanced design approaches to create novel frameworks, design tools and guidelines for the first generation of sensed aircraft capable of delivering accurate structural predictions. Ultrasound-based NDE techniques, energy harvesting and wireless sensor networks are increasingly shown to be effective in monitoring the failure of aircraft components under laboratory conditions. These components include critical components such as airframe structures, engines, landing gear and control surfaces. However, there is an urgent need to integrate these approaches and techniques at the aircraft design conception phase.

The event was attended by 39 representatives of research groups from **17 European countries**: **Italy, Cyprus, Ireland, the Czech Republic, Turkey, Estonia, Serbia, Iceland, Bosnia and Herzegovina, Great Britain, Finland, Sweden, Slovakia, Macedonia, Slovenia, Croatia and Poland.**

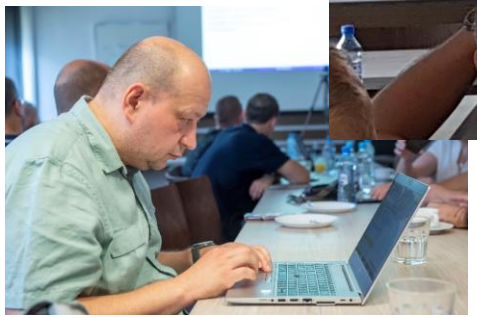
Funded by the Horizon 2020 Framework Programme of the European Union

RZESZÓW UNIVERSITY OF TECHNOLOGY

cost EUROPEAN COOPERATION IN SCIENCE & TECHNOLOGY

Rzeszów University of Technology
Faculty of Mechanical Engineering and Aeronautics
Poland, 29 June – 1 July 2022

Study visit of **EHTS** participants to the Aviation Training Center in Jasionka



The possibility of taking advantage of such wide contacts, specialist lectures, participation in the implementation of the program of computer workshops and the exchange of experiences of researchers from many different European teams will certainly result in the desired cooperation and its good results in the future.

Next Steps

1. **Complete and submit the joint publications**
2. **Preparing research dealing with wireless comunication in aviation (flight tests), engineering structures, etc….**
3. **Coordinating with WG3 the work related to energy harvesting basing on exerience during Energy Harvesting Training School in Rzeszow , Poland**
4. **Results of WG 4 activity presented during conferences**

Open Access Review

Energy Harvesting Technologies for Structural Health Monitoring of Airplane Components—A Review

by Saša Zelenika [1,2,*], Zdenek Hadas [3,*], Sebastian Bader [4], Thomas Becker [5], Petar Gljušćić [1,2], Jiri Hlinka [3], Ludek Janak [3], Ervin Kamenar [1,2], Filip Ksica [3], Theodora Kyratsi [6], Loucas Louca [6], Miroslav Mrlik [7], Adnan Osmanović [8], Vikram Pakrashi [9], Ondrej Rubes [3], Oldřich Ševeček [3], José P.B. Silva [10], Pavel Tofel [11], Bojan Trkulja [12], Runar Unnthorsson [13], Jasmin Velagić [8] and Željko Vrcan [1]

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2 University of Rijeka, Centre for Micro- and Nanosciences and Technologies, Radmile Matejčić 2, 51000 Rijeka, Croatia
3 Faculty of Mechanical Engineering, Brno University of Technology, Technická 2896/2, 61669 Brno, Czech Republic
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8 Faculty of Electrical Engineering, University of Sarajevo, Zmaja od Bosne bb, 71000 Sarajevo, Bosnia and Herzegovina
9 Dynamical Systems and Risk Laboratory, School of Mechanical and Materials Engineering, Engineering Building Belfield, University College Dublin, Dublin 4, Ireland
10 Centre of Physics of University of Minho and Porto (CF-UM-UP), Campus de Gualtar, 4710-057 Braga, Portugal
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13 Faculty of Industrial Engineering, Mechanical Engineering and Computer Science, School of Engineering and Natural Sciences, University of Iceland, Saemundargotu 2, 102 Reykjavik, Iceland
* Authors to whom correspondence should be addressed.

Sensors **2020**, *20*(22), 6685; https://doi.org/10.3390/s20226685

Received: 18 October 2020 / Revised: 12 November 2020 / Accepted: 19 November 2020 / Published: 22 November 2020

(This article belongs to the Special Issue Damage Detection Systems for Aerospace Applications)

View Full-Text | Download PDF | Browse Figures | Citation Export

NEXT STEPS

1 A. AVIATION

The MP-02A aircraft operated by Rzeszow University of Technology is fitted with a **set of devices which are to be used in research aimed on wireless communication.** An on-board flight and taxi control system together with several measurement devices are capable to control the aircraft and monitor and record flight parameters. Pylons, inner and outer bays are capable to host different kinds of communication devices including transmitters, receivers, antennas etc.

Recently Rzeszow University of Technology has been granted with a patent according to which it is possible to transmit taxi commands and information to the on-board taxi control system to conduct automatic taxi from parking position to runway's holding points. A patented RFID based technology has already been tested in laboratory conditions, now it is the time to start outdoor tests including airfield real taxi tests.

The ongoing research planed by Rzeszow University of Technology in related to ODIN project goals is to develop end test patented technology

(Patent P.434156 The system transferring information and controlling aircraft taxing through airfield - 2022)

MP-02A aircraft

NEXT STEPS

1. AVIATION

Analysis of current and new routing algorithms in WSN with potential use in industry and aviation (study of protocols, concepts and possibilities of implementing a new algorithm)

Tasks:

1. It will be examined which routing algorithms are currently used in wireless sensor networks

2. WSN algorithms will be tested in the network simulator for energy efficiency, latency, coverage and performance.

3. Optimization, the possibility of modifying algorithms / protocols.

NEXT STEPS

2. Defining the requirements for the parameters of devices and software needed for the wireless operation of the system for monitoring the condition of steel and composite structural elements and nodes of engineering structures.

The analysis requires separate consideration of:

- module for the management of remote elastic wave excitation

- module for the recording and wireless transmission of the structure response signals

and / or

- the recorded and wireless data processing module.

3. There is an idea to develop WiFi bridge instead of GCM, to reduce maintenance costs.

The goal is to substitute GSM communication by WiFi long distance connection. This will reduce maintenance costs paid to GSM provider.

The important issue is to transmit data and vision from 4 cameras. Thanks to GSM we can transmit the data over large distances.

In case of WiFi connection we are interested to transmit the data to the nearest WiFi access point in which fixed IP is available. This longer distance points need aerials which should be visible to each other.

In the above way data transmission may become independent from the GSM system and provider.

The implementation of the system will need some investment on the level of 10 kEuro.

WG4 data / suggestions

- **Increased Membership** (*Academics and Industry*), we are looking for ideas to develop industry contacts particularly, any ideas what we can do, any budget needs allocating? For information our budget next year is 130,000 euros.
- **Invitation of representatives of companies dealing with given technology profile to attend ODIN meetings**
- **STSM and ITC grant plans,** lets get a good coherent plan on **conferences and visits**. Can people identify opportunities now?
- **Members of WG4 are interested in STSM and ITC grants ,if possible.**
- **Dissemination**
- **WG4 may organize dedicated seminar /special event during CAT AERONET AV Conference on 5 December 2023 in Rzeszow (with e.g. possible attendance of students teams from Europe)**

Latest **Publication on**

DIC application for damage detection in FRP composite specimens based on an example of a shearing test (under publicattion procedurę)

Updates from Group, relevant grants, papers, teaching materials, outreach etc.

WG4 together with WG2, WG3 and WG5 will prepare updated version of COST CIG project by the end of ODIN.

{31.03.2024) .

Working Group Five

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Management Committee Meeting (MC6)

WG 5 Tasks

- T5.1 - Review of signal processing techniques applicable to damage detection that can identify/classify damage characteristics and parameters (location, severity etc.)
- T5.2 - Review of data reduction and processing power requirements for identified DSP techniques;
- T5.3 – Development of strategies for transforming raw SHM data into usable asset management quantities (reliability, expected residual life etc.)
- T5.4 – Guidelines and standards for approaches to data management and visualisation




10. Scientific Planning

Management Committee Meeting (MC6)

Remaining Tasks

- All remaining activities must meet one of the following tasks (TS/MC/VMG)
  - T1.1 - Development of optimisation strategies and guidelines for systems and structures and design of demonstrator wing section.
  - T2.2 - Identify signal processing, power requirements (WG3) data management (with WG5) requirements needed for identified damage detection techniques;
  - T2.3 - Sharing of best practices and data sets through a common EU framework/online data bases and websites
  - T5.3 - Development of strategies for transforming raw SHM data into usable asset management quantities (reliability, expected residual life etc.)
  - T5.4 - Guidelines and standards for approaches to data management and visualisation
  - Final Report Submission

Training School Proposals

1. Dublin University – Energy Harvesting
    1. No details (but I didn't ask)
2. Cardiff University – Measurement Techniques
    1. Late November/Early December 2023 (three days) – coincide with Cardiff Christmas Markets
    2. Acoustic Emission (MISTRAS), Vibrometry (Polytec), Acoustic Camera (ACSoft), Ultrasonic Scanning (Olympus)
    3. Companies would be allowed to invite industry (no cost to Action)
    4. Each trainee would complete a 2.5-hour session in the above categories
    5. Final day would be the large component test with company input

MC Meeting

- Final MC meeting
  - February/March 2024
  - Life beyond COST – Alan
  - Final Report Preparation – Rhys
  - Key output celebration - All
- Porto, (or possibly Azores/Madeira) Portugal
- Brno, Czech Republic

Proposed Budget – Estimated

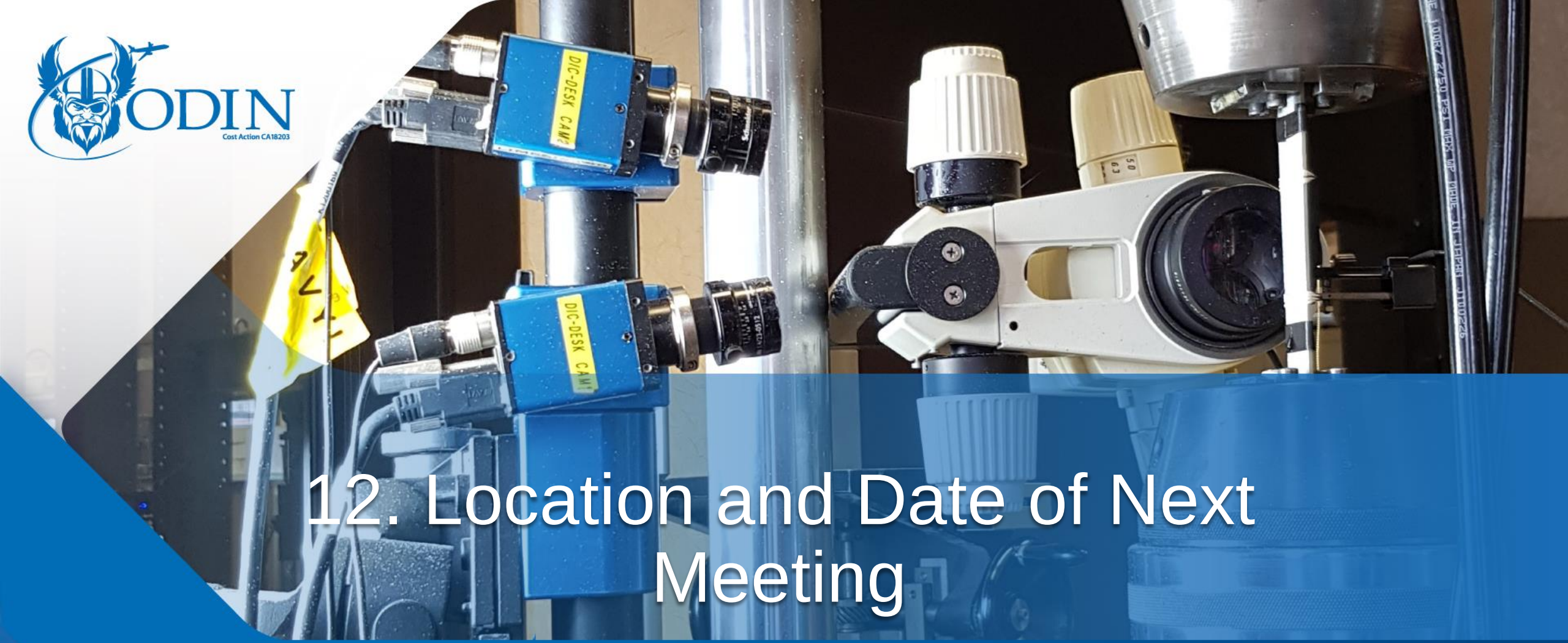
	Grant budget
Meetings	31.000,0
Training Schools	32.000,0
Short Term Scientific Mission Grant (STSMG)	0,0
Virtual Mobility Grants (VMG)	4.500,0
Total Inclusiveness Target Countries Conference Grant (ITC CG)	0,0
Dissemination Conference Grant (DCG)	0,0
Dissemination and Communication Products	760,0
Other Expenses Related to Scientific Activities (OERSA)	0,0
Virtual Networking Support Grant	0,0
Networking expenditure	**68.260,0**
FSAC 15% of Eligible Networking expenditure	10.239,0
Eligible Costs	**78.499,0**

Dissemination planning (Publications and outreach)

- Website and LinkedIn page established
  - Need more content
  - Videos/images/data

11. Any Other Business

Management Committee Meeting (MC6)



12. Location and Date of Next Meeting

Porto – Portugal – DATE TBC

Management Committee Meeting (MC6)

13. Summary of Decisions

Management Committee Meeting (MC6)

Decisions

- That we had Quorum (including online participants)
- The MC agreed that we could raise our STSM total to 4,000 Euros for the current grant period
- The MC agreed that we would redistribute funds as follows:
  - We would add 6000 Euros to Virtual Mobility Grants, We would add 10,000 to STSM and 8,000 to dissemination. These funds would come from the underspend int Training School and MC meeting.
- The MC Agreed that all further STSM, ITC and VMG must target one of the Actions remaining tasks as highlighted in the Scientific Planning slides.
- The final MC will be hosted in Porto in February/March

14. Meeting Close

Management Committee Meeting (MC6)