Cost Action CA18203 - Optimizing Design for Inspection (ODIN)

PRACTICAL INFORMATION GUIDE

TECHNICAL PROGRAMME

Energy Harvesting Training School

Rzeszów University of Technology
Ave. Powstancow Warszawy 12
35-959 Rzeszów
Poland
Date: 29 June - 1 July 2022

Contents

Funded by the Horizon 2020
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EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

About COST

The European Cooperation in Science and Technology (COST) is a funding organisation for the creation of research networks, called COST Actions. These networks offer an open space for collaboration among scientists across Europe (and beyond) and thereby give impetus to research advancements and innovation.

COST is bottom up, this means that researchers can create a network - based on their own research interests and ideas - by submitting a proposal to the COST Open Call. The proposal can be in any science field. COST Actions are highly interdisciplinary and open. It is possible to join ongoing Actions, which therefore keep expanding over the funding period of four years. They are multi-stakeholder, often involving the private sector, policymakers as well as civil society.

Since 1971, COST receives EU funding under the various research and innovation framework programmes, such as Horizon 2020.

COST funding intends to complement national research funds, as they are exclusively dedicated to cover collaboration activities, such as workshops, conferences, working group meetings, training schools, short-term scientific missions, and dissemination and communication activities. For more information, please go to the Funding section of the COST website (https://www.cost.eu/).

The COST Association places emphasis on actively involving researchers from less research-intensive COST Countries (Inclusiveness Target Countries, ITC[1]). Researchers from Near Neighbour Countries and International Partner Countries can also take part in COST Actions, based on mutual benefit. For more information, please visit the global networking page (https://www.cost.eu/).

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[1] Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Macedonia, Hungary, Latvia, Lithuania, Luxembourg, Malta, Montenegro, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Turkey

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Cost Action CA18203 - Optimizing Design for Inspection (ODIN)

This Action will maximize the full benefit of in service, continuous monitoring of critical aerospace structures by integrating ultrasonic wave based non-destructive evaluation (NDE), energy harvesting and wireless sensor technologies at the design conception phase.

Optimization (of sensors and structures), computational modelling, advanced signal processing and advanced design approaches will be integrated to produce a novel framework, design tools and guidelines for the delivery of the first generation of self-sensing aircraft capable of delivering accurate structural prognosis.

Ultrasound based NDE techniques, energy harvesting and wireless sensor networks are being increasingly demonstrated to be effective in monitoring damage in aerospace components at a laboratory setting.

These components include critical elements such as airframe, engines, landing gear and control surfaces. However, there is an urgent need to integrate these approaches and techniques at the inception of an aircraft. This COST Action will bring together the top European experts across these areas to support the development of an integrated framework for optimized self-sensing structures capable of diagnosis and prognosis, together with demonstrators and educational activities, including training programs, which will ultimately lead to cleaner and safer skies.

General information

Start of Action: 02/10/2019
End of Action: 01/10/2023

Main Contacts

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Action website: https://odin-cost.com/
Domain website: https://www.cost.eu/actions/CA18203/

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Action's Working Groups

Working group 1	**Design, Optimisation and Integration** This group will encompass industrial aerospace design engineers and experts, mathematicians, computer scientists and optimizers 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.
Working group 2	**Damage detection** This group will focus on the analysis of existing strategies including sensor technologies. They will quantify the capability of systems to identify damage in new structures, power level requirements and compare state of the art signal processing approaches to damage location and characterisation. Finally, the group will deliver a strategy for sharing data and signal processing algorithms.
Working group 3	**Power management and energy harvesting** Power requirements are a crucial element of this Network. Currently there is a power gap between low power systems and the available energy through current harvesting approaches. Furthermore, there are large disparities between published data and that which is achievable based on methods of testing and analysis. Therefore, this group will seek to develop a detailed understanding of current vibration levels and temperature differences and the location or position they would be found on an aircraft and standard testing procedures to allow a comparison across European research groups. There will be cross work group activities associated with this group.
Working group 4	**Wireless Communications** 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.
Working group 5	**Data management and signal processing** This working group will focus on human interface, data interpretation, data presentation, data mining, data efficiency/reduction and hardware integration. There are three tasks associated with this working group. The group will be heavily linked to WG1 and WG2. In addition, there will be strong activities focused on low power processing to reduce power consumption of systems.

Agenda

Day 1, WEDNESDAY 29TH OF JUNE		
Welcome, aim meeting & general project overview		
09:00	The Introduction of Energy Harvesting Technologies and Motivations (room L 125)	- Sebastian Bader "Energy harvesting - a high-level introduction" - Carol Featherston "Motivation for SHM and energy harvesting applications"
	Coffee/Tea Break / Refreshments	
	State of the Art in Piezoelectric Materials, Principles and Designs (room L 125)	- David Blazevic - *An introduction on materials for energy harvesters (on line)* - Aasifa Rounak - *Alternative energy harvesting materials for SHM* - Saša Zelenika - *Piezoelectric energy harvesters (on line)*
Lunch		
13:00	Bus transport from Rzeszow to Jasionka	Study visit in Aviation Centre of Rzeszow University of Technology, Jasionka
	Coffee/Tea Break / Refreshments	
	Addressing important issues, Petar DIMITROV, Science Communication Coordinator	
	Evening Round Table: Problems of Energy Harvesting Technologies in Aircraft Applications	Zdeněk Hadaš – moderator

Day 2 THURSDAY 30TH OF JUNE		
09:00	Energy Harvesting Workshop: Vibration & Resonators (computer lab room L 29B -147)	▪ Zdeněk Hadaš & Ondřej Rubeš - *Principles of electromechanical resonators*
	Coffee/Tea Break / Refreshments	
	Energy Harvesting Workshop: Modelling and Simulation (computer lab room L 29B -147)	▪ Ondřej Rubeš - *Design and modelling of energy harvesters and prediction of harvested power*
	Lunch	
15:00 - 18:00	Afternoon Visit in Łańcut Castle	
19:00	Training School Evening Meal - DINNER in Vis a Vis Restaurant in Łańcut	

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Day 3 FRIDAY 1ST OF JULY		
09:00	Vibration Energy Harvesting – linear vs. nonlinear Resonators (room L 125)	*Zdeněk Hadaš – Approaches for development of effective energy harvesters* - Grzegorz Litak - *Nonlinear effects in vibration energy harvesting: an overview and a state of the art*
	Coffee/Tea Break / Refreshments	
	Thermoelectric Energy Harvesting (room L 125)	- Theodora Kyratsi - *"Review on Thermoelectric Materials"* - Loucas Louca - *"Concepts on TEG design"*
	Lunch	
13:30	Round Table: Energy Harvesting Technologies in Aircraft Applications (Room L 125) - Carol Featherston – Experience of SHM applications - Thomas Becker (Online)	
	Coffee/Tea Break / Refreshments	
15:00	Closing of Training School	

About Rzeszów

Rzeszów is the largest city in southeastern Poland. It is located on both sides of the Wisłok River. Rzeszów is capital of the Subcarpathian Voivodeship. The history of Rzeszów dates back to the Middle Ages. It received city rights and privileges from King Casimir III the Great in 1354. Local trade routes connecting Europe with the Middle East and the Ottoman Empire resulted in the city's early prosperity and development. In the 16th century, Rzeszów has found its place in the group of the most elite cities in Poland, with growing number of investments, rapid progress and a very high standard of living. In 2011 Forbes awarded Rzeszów with the second place in the ranking of the most attractive semi-large cities for business. Moreover, the city is home to a number of universities and other schools and foreign consulates. Rzeszów is also developing as a regional tourist destination; its Old Town, Main Market Square, churches and synagogues are among the best preserved in the country.

**Rzeszow, Jasionka Airport**

Łańcut

Rzeszów University of Technology

Rzeszów University of Technology is the largest polytechnic in the region and continues to grow. Over its history it has educated 57 952 graduates, including 593 pilots. A great number of alumni hold important positions both in the region and country. As a matter of course, the University's development has been accompanied by a continual increase in the number of academic staff and independent scientists.

In the current term the University has an enrolment of 17 000 students at 6 faculties and 24 courses of study. Three faculties: the Faculty of Civil and Environmental Engineering, the Faculty of Mechanical Engineering and Aeronautics and the Faculty of Electrical and Computer Engineering have the right to confer a university degree of PhD in Technology, and the Faculty of Chemistry PhD in Chemistry. The Faculty of Mechanical Engineering and Aeronautics, the Faculty of Electrical and Computer Engineering and the Faculty of Civil and Environmental Engineering have the right to confer a university degree of DSc. The Faculty of Mechanical Engineering and Aeronautics, as the only one in Poland, has been training civil aviation pilots since 1976. Pilots receive an MSc in Aeronautical Engineering and a 2nd Class (CPL) pilot's licence. Their training meets European requirements for receiving an airline pilot licence (ATPL), and is conducted at Jasionka (aviation) and Bezmiechowa (gliders).

The University participates in the Erasmus programme and maintains bilateral exchanges both university-wide and for particular faculties. Apart from research, the University takes part in regional affairs and development schemes. Forecasting the demands of the nation's economy, the University provides a rich syllabus adapted to the realities and demands of the marketplace.

All of the aforementioned activities serve to reinforce the importance of the University's instruction and research. The University strives to preserve the best of its traditions while promoting innovation in order to better equip tomorrow's graduates with the means to rise to the new millennium's social, economic and cultural challenges.
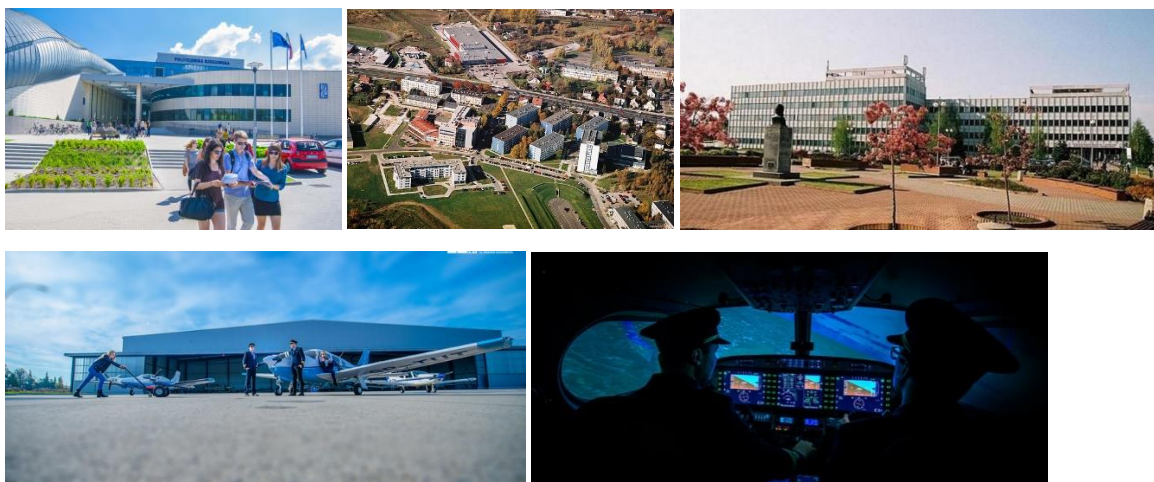
Lańcut (close to Rzeszów)

Łańcut is a town in south-eastern Poland, situated in the Subcarpathian Voivodeship It is the capital of Łańcut County. Archeological investigations carried out in the region of Łańcut confirm the existence of human settlements from about 4000 years B.C.

The first owner of the town was Otton (z Pilczy) Pilecki, who was given the Łańcut estate by the Polish king, Casimir III the Great, in 1349, as a reward for his service. At the same time, the king also granted Łańcut its city rights according to Magdeburg law

The city was then owned consecutively by aristocratic Polish families of Stadnicki, Lubomirski, and Potocki. Łańcut was purchased by Stanisław Lubomirski in 1629, at which time he secured the services of architect Matteo (Polish: 'Maciej') Trapola and the stuccoist Giovanni Battista Falconi, in order to build a fortified residence in the town, Łańcut Castle, completed in 1641 and reconstructed many times since. Jerzy Sebastian Lubomirski, fearing attack from the Swedes, further strengthened the fortifications. To perform these works he employed Tylman van Gameren, a Dutchman and one of the most prominent foreign architects to ever work in Poland.[3]

The castle is situated in the centre of the town and constructed in the style of a grand aristocratic palace-residence. It was last owned until 1944 by the Potocki family, and made infamous in late 16th century during the times of Stanisław Stadnicki,[4] who was known as 'the Devil of Łańcut' (Polish: diabeł łańcucki) for his violent behaviour. After 1775 the palace was owned by Izabella Lubomirska, who extended it and had the interiors remodelled. The palace is currently a museum particularly well known for its large collection of historic carriages.. The Music Festival in Łańcut has been an annual event since 1961. The Festival is a series of modern and classical music concerts performed by distinguished European soloists, ensembles and choirs.

https://odin-cost.com/

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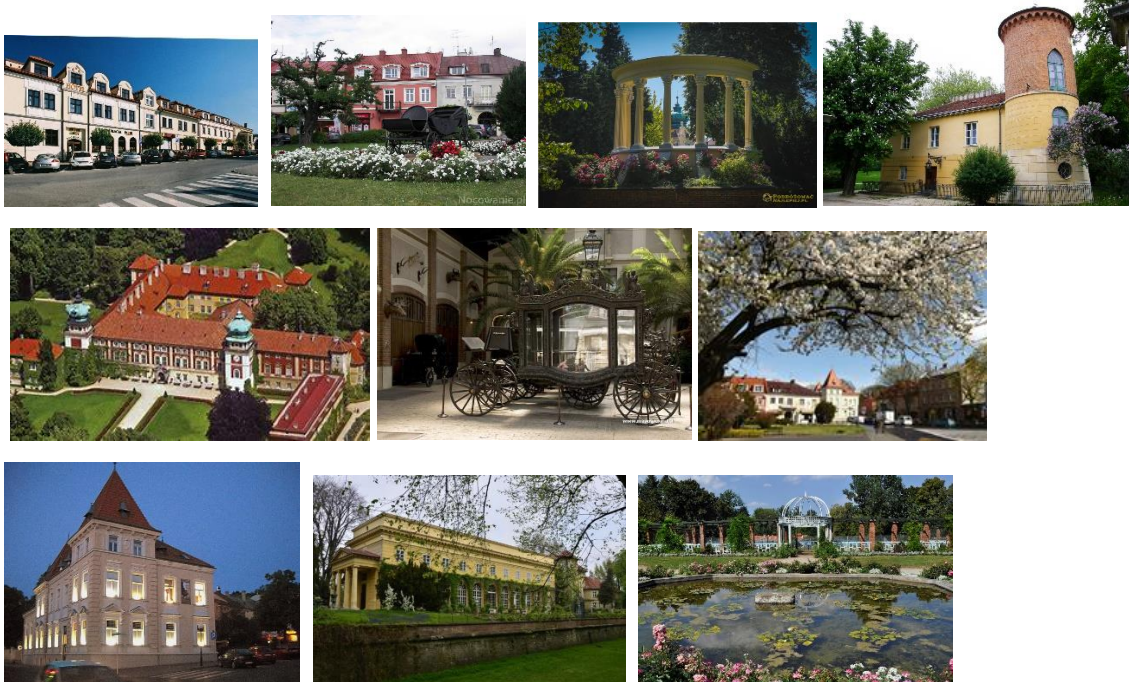
How to reach the city & Venue

Airplane - airport "JASIONKA" (RZE) /Rzeszow

Transfer options from the airport Jasionka to Rzeszow:

- **Using public Buses:**

Public Transport Authority In Rzeszow (ZTM), lines:

- No **51** from the Airport to the City Center (Bardowskiego Street)
- No **53** from the Airport to the City Center 9 (Local Bus Station, Jana Kasprowicza Street)

51 — Bardowskiego 02 (City Center)

DNI POWSZEDNIE / MONDAY – FRIDAY

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53 — Dworzec Lokalny (City Center)

DNI POWSZEDNIE / MONDAY – FRIDAY

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SOBOTY / SATURDAYS

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NIEDZIELE I ŚWIĘTA /SUNDAYS AND HOLIDAYS

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Tickets can be purchased from the authorized ticket machine in Passenger Terminal (payment in cash, only in PLN or with credit card or debit card in the machine), the bus driver (payment in cash, only in PLN), the authorized ticket machine found on 51, 53 - line busses (payment in cash, only in PLN or with credit card or debit card in the machine).

- ZG PKS Yellow Line 224 and 225 (MKS), lines:

224 from the Airport to the City Center (Main Bus Station, Artura Grottgera 1 Street)
225 from the Airport to the City Center (Main Bus Station, Artura Grottgera 1 Street)

Tickets can be purchased from the bus driver (payment in cash, only in PLN)

- **Private buses and minibuses:**

- Eurobus - Rzeszow Airport -> Rzeszow City Center (Plac Wolnosci), Reservation required by phone: +48 531 631 080
- Galicja Express - Rzeszow Airport -> Rzeszow City Center (Sokola Street) , Reservation required by phone: +48 603 212 617

- **Using a car rental**

You can rent a car at one of the customer service points located at the O and 2 Level of the AirPort Jasionka Passenger Terminal.

- AVIS Budget
https://www.avis.pl/oferta-avis/biura-wynajmu-samochodow/europa/polska/rzeszow/rzeszow-lotnisko
Tel: +48 221 139 171
- RentCars pl
https://rentcars.pl/en/
Tel: +48 222 111 885
- Panek
https://www.ipanek.pl/en/
Tel: +48 665 800 000

- **Using a taxi**

- Radio TAXI tel. +48 603 919 919, 19 191 https://www.taxi19191rzeszow.pl/en
- iTaxi tel. +48 737 737 737, https://itaxi.pl/english/

Transfer options from the main bus station to Rzeszow University of Technology:

Public Transport Authority In Rzeszow (ZTM), lines:

0A, 0B, 36 – from Piłsudskiego U. Marszałkowski 05 bus stop
5, 6, 12, 13 – pl. Wolnosci 01 bus stop
Timetable for buses available here: http://einfo.erzeszow.pl/?tab=2

by CAR

by TRAIN

Transfer options from the airport Jasionka to Łańcut:

Private buses and minibuses:

- Bus Dej Express - Reservation required by phone: ++48 695 144 391
- Eurobus - Rzeszow Airport - Reservation required by phone: +48 531 631 080

Venue

Rzeszów University of Technology
Ave. Powstancow Warszawy 12
35-959 Rzeszów
Poland
Building L, Room L 125 (Lecture Theatre) and L29 B –147
(computer Lab)

Meals & Refreshements

Meals & Refreshements will be served during the meeting according to the programme schedule/as agreed.

Lunch will be provided by the local organizer.

Recommended hotels

- **Hotel Łańcut** (reservation of 30 rooms from 28 June till 1 July 2022)

Address : Armii Krajowej 55a, 37-100 Łańcut, Poland, https://www.hotel-lancut.pl/

Hotel Łańcut is a modern and comfortable hotel equipped with rooms, suites, conference rooms, ballrooms and restaurant. We offer accommodations in comfortable single, double, triple rooms and suites. The tastefully decorated interiors, comfortable and functional furniture provide comfort and excellent working conditions.Our facilities allows us to organize events for up to 500 people.

single room - 195 PLN /day
double room - 255 PLN / day
apartment for 1 or 2 persons - 350 PLN/day

- **Hotel Vis a Vis**

Address: plac Sobieskiego 14, 37-100, Lancut, Poland, https://visavis-lancut.pl/

Vis a Vis Łańcut is a boutique property, located opposite the palace in Łańcut. Free broadband internet access is available in all rooms. All rooms include an individually designed, private bathroom and offer views of the palace or the Market Square. There is cherry-coloured furniture and a flat-screen TV. The Vis a Vis' restaurant serves traditional Polish dishes. There is also a seasonal café operating during summer, which offers Polish and Italian snacks, beverages and desserts.

single room - 190 PLN / day
double room - 250 PLN / day
apartment for 1 or 2 persons - 350 PLN/day

Notice: If booking, please have in mind to mention "booking by Rzeszow University of Technology".

How to reach the Venue from the hotels: see *special bus*[2] (it is really easiest method to reach the event's venue).

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[2] Look for a specially marked bus only for participants of the COST ODIN event!