Cardiovascular and Cardiorespiratory Interactions – From Physiological Mechanisms to Clinical Applications

Kick-off Workshop for the Project
"Causality Methods for Cardiovascular Disease Diagnostics and Risk Stratification in V4"
(Project Visegrad Grant No. 22620137)

Jessenius Faculty of Medicine, Comenius University (Martin, Slovakia)

November 2–4, 2026

https://www.pawelpilarczyk.com/causality1

Aims and scope
This workshop is organized within the framework of the project "Causality Methods for Cardiovascular Disease Diagnostics and Risk Stratification in V4", a collaborative research initiative led by Gdańsk University of Technology (Poland) in partnership with the Medical University of Gdańsk (Poland), the HUN-REN Wigner Research Centre for Physics (Hungary), and the Jessenius Faculty of Medicine in Martin, Comenius University Bratislava (Slovakia).

The workshop is devoted to the development and application of advanced mathematical, statistical, and artificial intelligence-based methods for identifying causal and directional relationships within the cardiovascular and cardiorespiratory systems using multivariate physiological time-series data.

Its main aim is to discuss how changes in interactions between physiological signals, including heart rate, blood pressure, and respiration, can contribute to the characterization of cardiovascular dysfunction, and how alterations in directional coupling and physiological dynamics may support earlier diagnosis, risk stratification, and prognosis of cardiovascular diseases.

Organizing and Scientific Committee
Grzegorz Graff, Paweł Pilarczyk, Beata Graff, Michal Javorka, Zoltán Somogyvári

Registration Fee
There is no registration fee.

Presentation Format
Regular scientific presentations: 20 minutes for the talk, followed by 10 minutes for questions and discussion.
Joint extended lecture: 60 minutes, including presentation and discussion.
Open scientific session: Four 20-minute presentations, followed by a 10-minute general discussion.
Brainstorming sessions: Two dedicated 90-minute sessions focusing on research directions, methodological challenges and future collaboration.

Location
Workshop talks and discussions will take place in a Faculty presentation room located in the building at Malá Hora 4C. Public talks on Tuesday 13:00–14:30 will be delivered in a presentation room in the Education Center, Malá Hora 4B, 03601 Martin.

Accommodation
There are at least two hotels within walking distance from the Faculty: Hotel Turiec (distance 750m) and Penzion Martinn (distance 500m). Both can be booked with general hotel booking services such as booking.com.

Day One: Monday, November 2, 2026

— Scientific Presentations and Brainstorming Session I —

13:00–14:00 – Informal Discussions over Lunch: Introduction of Research Groups and Main Topics of Interest (Library of the Department of Physiology, JFM CU, Malá Hora 4C, 2nd floor)

14:00–14:30 – Michal Javorka (Comenius University, Slovakia): *Cardiovascular Network: Physiological Background, Data Sets and Future Perspectives*

14:30–15:30 – Beata Graff (Medical University of Gdańsk, Poland) and Paweł Pilarczyk (Gdańsk University of Technology, Poland): Joint Extended Lecture *Analysis of Respiratory Heart Rate Variability Using Ordinal Patterns with Ties and Tolerance*

15:30–16:00 – Zoltán Somogyvári (HUN-REN Wigner Research Centre for Physics, Hungary): *Data Analysis Methods Based on Dynamical Systems Theory: Unicorns, Dimensions and Higher-Order Hidden Drivers*

16:00–16:30 – coffee break

16:30–17:15 – Visit to the laboratory for autonomic nervous system research

17:15–18:45 – Brainstorming Session I: Research Questions, Methodological Challenges and New Scientific Directions

18:45–19:00 – Summary of the Day

Day Two: Tuesday, November 3, 2026

— Morning Scientific Session —

10:00–10:30 – András Telcs (HUN-REN Wigner Research Centre for Physics, Hungary): *Causal Discovery, Markov Chains, and the Degrees-of-Freedom Method*

10:30–11:00 – Gerard Cybulski (Warsaw University of Technology, Poland): *Applications of Impedance Cardiography (ICG) Signals in Analysis of Cardiovascular System Diagnosis and Description*

11:00–11:30 – coffee break

11:30–12:00 – Marcel Młyńczak (Warsaw University of Technology, Poland): *Bridging Global and Local Causal Discovery in Physiology: From Observational Networks to Dynamic Cardiorespiratory Interactions*

12:00–12:30 – Teodor Buchner (Warsaw University of Technology, Poland): *Respiratory Instability in Heart Failure and Hypertension: A Cross-Species Mathematical Model and Direct Observation of Intermittency in Anaesthetized SHR Rats*

— Open Scientific Session —

13:00–13:20 – Beata Graff (Medical University of Gdańsk, Poland): *Between the Heartbeats: What Heart Rate Variability (HRV) Reveals – From ECG to Smartwatches*

13:20–13:40 – Michal Javorka (Comenius University, Slovakia): *Interactions in a Selected Four-Node Network of Cardiorespiratory Parameters*

13:40–14:00 – Zoltán Somogyvári (HUN-REN Wigner Research Centre for Physics, Hungary): *From Understanding to Control: A Dynamical Systems Approach in Physiology*

14:00–14:20 – Laura Sparacino (Comenius University, Slovakia): *Cerebrovascular Interactions in Relation to Orthostatic Syncope*

14:20–14:30 – General Discussion and Questions from the Audience

— Afternoon Program —

14:30–15:30 – Break, Networking, Transfer to Lunch-Dinner Venue

15:30–18:00 – Informal Discussions over Lunch/Dinner: Methodological Approaches to Causality Analysis, Available Datasets, Data Sharing, Joint Research Projects and Future Collaboration Opportunities

Day Three: Wednesday, November 4, 2026

— Scientific Presentations, Brainstorming Session II and Future Collaboration —

9:30–10:00 – Dorota Wejer (University of Gdańsk, Poland): *Methods for Analyzing Cardiovascular Signal Asymmetry in Healthy Individuals and Patients with OSA*

10:00–10:30 – Laura Sparacino (Comenius University, Slovakia): *Hierarchically-Organized Interactions in Dynamic Physiological Networks*

10:30–11:00 – Marcell Stippinger (HUN-REN Wigner Research Centre for Physics, Hungary): *Dimensional Causality: Revealing Hidden Shared Drivers in Cardiovascular Recordings*

11:00–11:30 – coffee break

11:30–13:00 – Brainstorming Session II: Joint Research Projects, Future Publications and Collaborative Research Directions

13:00–13:40 – Action Plan: Defining Research Priorities, Responsibilities and Next Steps

13:40–14:00 – Final Discussion, Workshop Summary and Closing Remarks

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