Workshop on Nonlinear and Topological Methods in Biomedical Signal Analysis

Gdańsk University of Technology, November 26–27, 2025

https://www.pawelpilarczyk.com/workshop2025/

Aims and scope
The workshop focuses on advanced mathematical approaches for the analysis of biomedical time series, combining theoretical and algorithmic tools that span from entropy measures to computational topology. Such methods make it possible to identify and quantify complex dynamic behaviors inherent in physiological systems.

Its primary goal is to foster exchange between researchers involved in the mathematical examination of biomedical recordings, including ECG, blood pressure, EEG, and respiratory signals. Special emphasis will be placed on nonlinear dynamics techniques, such as attractor reconstruction, dimensionality estimation, and ordinal pattern analysis, which together provide powerful means for characterizing the underlying structure and complexity of biological processes.

Invited speakers from Gdańsk University of Technology, the Medical University of Gdańsk, University of Gdańsk, the Wigner Research Centre for Physics (Hungary) will present their recent findings and discuss ongoing as well as prospective opportunities for collaborative research and interdisciplinary cooperation.

Organizing Committee
Grzegorz Graff, Paweł Pilarczyk

Registration Fee
There is no registration fee. However, the meals, including coffee breaks and dinners, must be arranged and covered by each participant individually.

Location
Wednesday 9:00–12:00: Gdańsk University of Technology, Faculty Council room no. 2/07 in the Nanotechnology Center: building no. 4 on the Campus Map.
Wednesday 14:15–16:00: Medical University of Gdańsk
Thursday 9:30–16:00: Gdańsk University of Technology, room no. 501 (5th floor) in Gmach B: building no. 10 on the Campus Map.

Day One: Wednesday, November 26, 2025
9:00–9:30 – Zoltán Somogyvári (HUN-REN Wigner Research Centre for Physics & Axoncord LLC, Budapest): *Inferring Higher-Order Hidden Drivers from fMRI Data*
9:30–10:00 – Marcell Stippinger (HUN-REN Wigner Research Centre for Physics, Budapest): *Dimensional Causality and Hidden Drivers in Cardiovascular and Respiratory Time Series*
10:00–10:20 – Beata Graff and Oliwia Król (Medical University of Gdańsk): *Integrative Exploration of Cardiorespiratory Interactions: An Interdisciplinary Study*
10:20–10:40 – coffee break
10:40–11:10 – Justyna Signerska-Rynkowska (Gdańsk Tech): *Detecting Topological Conjugacy of Dynamical Systems via TDA*
11:10–11:40 – Piotr Weber (Gdańsk Tech): *Recurrence Method in the Analysis of Electroencephalographic Signals in Healthy Adults under Light-Dark Conditions*
12:00–14:00 – lunch break
14:15–16:00 – informal meetings and discussions at the Medical University of Gdańsk

Day Two: Thursday, November 27, 2025
9:30–10:00 – Beata Jackowska-Zduniak (Gdańsk Tech): *From Tissue Damage to Lost Beats: Modeling Infarction in the SAN*
10:00–10:20 – Marta Marszewska (Gdańsk Tech & Dioscuri Center in Topological Data Analysis): *A Conceptual Outlook on Gene Migration Analysis Using an Euler-Based Method*
10:20–10:40 – Nikodem Mierski (Gdańsk Tech): *Analysis of the Chaotic Itinerancy Phenomenon using Entropy and Clustering*
10:40–11:00 – coffee break
11:00–11:20 – Wojciech Jaworek (Gdańsk Tech): *Classification of ECG Signals through Persistent Homology*
11:20–11:40 – Mikołaj Rosman (Gdańsk Tech): *Topological-Numerical Analysis of the Discrete-Time Two-Gene Andrecut-Kauffman Model*
12:00–14:00 – lunch break
14:00–16:00 – informal meetings and discussions