SOE 10: Networks, From Topology to Dynamics II (joint session SOE/DY)

Time: Wednesday 15:00–15:45 Location: GÖR/0226

SOE 10.1 Wed 15:00 GÖR/0226

Combining machine-learning and dynamic network models for sepsis prediction — •Juri Backes[1,3], Artyom Tsanda[1,2], Tobias Knopp[1,2], Wolfgang Renz[3], and Eckehard Schöll[4] — [1]TU Hamburg — [2]UKE Hamburg — [3]HAW Hamburg — [4]TU Berlin

We enhance short-term sepsis predictions by integrating machine learning techniques like Auto-Encoders and Gated-Recurrent-Units with a dynamical 2-layer network model of adaptive phase oscillators [1] representing the interaction between parenchymal cells (functional organ cells) and the immune system via cytokines. The model trajectories determined by machine learning are used for detection and prediction of critical infection states and mortality. The model-based predictions are compared with those of purely data-based approaches in terms of predictive power and interpretability. To this end we project real high-dimensional medical patient data into the low-dimensional parameter space of the model.

[1] R. Berner, J. Sawicki, M. Thiele, T. Löser, and E. Schöll: Critical parameters in dynamic network modeling of sepsis. Front. Netw. Physiol. 2, 904480 (2022).

SOE 10.2 Wed 15:15 GÖR/0226

Forecasting emergency department visits in the reference hospital of the Balearic Islands: the role of tourist and weather data — •Paride Crisafulli, Tobias Galla, Raul Toral, and Claudio Mirasso — IFISC (UIB-CSIC), Palma de Mallorca, Spain

Accurate forecasting of patient arrivals at emergency departments (EDs) is vital for efficient resource allocation and high-quality patient care. Despite its significance and extensive prior research, certain conditions can significantly impact the accuracy of these estimates. This study investigates the relevance of tourism and weather data alongside traditional calendar and demographic variables in forecasting ED visits in the reference hospital in Palma de Mallorca, a city with significant seasonal population fluctuations due to tourism. Utilizing a machine learning approach, we develop a model that predicts ED visits based solely on exogenous variables. We test three different machine learning algorithms (random forests, support vector machines, and feed-forward neural networks) with four different input combinations, comparing their mean average percentage errors (MAPEs) and prediction horizons.

SOE 10.3 Wed 15:30 GÖR/0226

Beyond Averages: How Disease Severity and Social Structure Interact to Shape Pandemic Dynamics — •Fabio Sartori, Sophia Horn, Sven Banisch, and Michael Maes — Chair of Sociology and Computational Social Science, Karlsruhe Institute of Technology, Karlsruhe

Epidemiological models typically rely on population averages, overlooking behavioral polarization and social structure. We developed a compartmental framework examining how polarization and homophily shape outcomes across mask-wearing, testing, and vaccination interventions. Results reveal intervention-specific effects: polarization benefits masks but harms testing and vaccination. Homophily worsens outcomes for low-infectivity diseases by removing protective barriers, but improves outcomes for highly infectious diseases through protective bubbles. Calibrating with German survey data (n=1,612), homogeneous models showed large errors. Intervention effectiveness depends critically on social structure and pathogen characteristics, not just average compliance.