

## SOE 8: Semantic Networks, Language and Culture

Time: Tuesday 14:00–15:00

Location: ZEU 260

SOE 8.1 Tue 14:00 ZEU 260

**Evolution of Socio- and Econophysics in the German Physical Society (DPG)** — ●ARMIN POURNAKI<sup>1,2</sup>, SVEN BANISCH<sup>3</sup>, PHILIPP HÖVEL<sup>4</sup>, and ECKEHARD OLBRICH<sup>1</sup> — <sup>1</sup>Max Planck Institute for Mathematics in the Sciences, Germany — <sup>2</sup>Laboratoire Lattice, CNRS & ENS-PSL, France — <sup>3</sup>Karlsruhe Institute for Technology, Germany — <sup>4</sup>Christians-Albrechts-Universität zu Kiel, Germany

We present an interactive visualization (<https://pournaki.com/soe/>) that allows to explore the evolution of the semantic network of all abstracts that were submitted to the division *socio-economic systems (SOE)* of the DPG spring meetings from 2002 until 2022. The online interface allows to search for semantically related work in the *DPG-Verhandlungen* (book of abstracts) by also providing a textual interface that links the abstracts back to the actual website of the *Verhandlungen*. Employing a topic model on the data one can follow the evolution of central topics over time.

Moreover, we use the semantic network to study the role of the network paradigm as an integrative concept and its interaction within and across the different subfields of the SOE division.

SOE 8.2 Tue 14:15 ZEU 260

**Network analysis of the Kyiv Bylyny cycle - East Slavic epic narratives** — PETRO SARKANYCH<sup>1,2</sup>, NAZAR FEDORAK<sup>3,4</sup>, ●YURIJ HOLOVATCH<sup>1,2,5</sup>, PÁDRAIG MACCARRON<sup>6</sup>, JOSEPH YOSE<sup>5,2</sup>, and RALPH KENNA<sup>5,2</sup> — <sup>1</sup>ICMP, NAS of Ukraine, Lviv, Ukraine — <sup>2</sup>L4 Collaboration Leipzig-Lorraine-Lviv-Coventry, Europe — <sup>3</sup>Ivan Franko National University of Lviv, Lviv, Ukraine — <sup>4</sup>Ukrainian Catholic University, Lviv, Ukraine — <sup>5</sup>Coventry University, Coventry, UK — <sup>6</sup>University of Limerick, Limerick, Ireland

In recent times, the advent of network science permitted new quantitative approaches to literary studies [see e.g. *Maths Meets Myths: Complexity-science approaches to folktales, myths, sagas, and histories*. R. Kenna, M. Mac Carron, P. Mac Carron (Editors), Springer, 2016]. Here, we bring the Kyiv bylyny cycle into the field - East Slavic epic narratives originating in modern-day Ukraine. By comparing them to other prominent European epics, we identify universal and distinguishing properties of the social networks in bylyny. We analyze community structures and rank most important characters. The method allows to bolster hypotheses from humanities literature - such as the position of Prince Volodymyr - and to generate new ones. We show how the Kyiv cycle of bylyny fits very well with narrative networks from other nations - especially heroic ones. We anticipate that, besides delivering new narratological insights, this study will aid future scholars and interested public to navigate their way through Ukraine's

epic story and identify its heroes [P. Sarkanych et al., *Adv. Complex Syst.* 25(4) (2022) 2240007].

SOE 8.3 Tue 14:30 ZEU 260

**Dynamics of language features on complex networks: statistical physics analysis, and the introduction of linguistic temperature** — ●CHRISTOPHER KITCHING<sup>1</sup>, JORDAN ABBOTT<sup>1</sup>, TOBIAS GALLA<sup>1,2</sup>, HENRI KAUKANEN<sup>3</sup>, DEEPTI GOPAL<sup>4</sup>, and RICARDO BERMÚDEZ-OTERO<sup>1</sup> — <sup>1</sup>The University of Manchester, UK — <sup>2</sup>Instituto de Física Interdisciplinar y Sistemas Complejos (CSIC-UIB) — <sup>3</sup>University of Konstanz, Germany — <sup>4</sup>University of Cambridge, UK

Statistical physics has made important contributions to the study of language dynamics. Here, we focus on a stochastic individual-based model of the spatio-temporal evolution of language features. Features evolve through a combination of descent across generations, and the influence of geographically neighbouring languages.

The dynamics are a variation of the two-state voter model, with spontaneous changes of state and transmission errors in the imitation process. Previous work is restricted to lattices, here we focus on complex networks. We establish a parabolic relation between the feature frequency and the density of active interfaces, modulated by the network, and 'linguistic temperature' - a measure of a feature's stability.

Results are obtained by combining the voter model, pair approximation and a new approach to networks, based on random walks. While the theoretical work has applications in other areas (e.g. opinion dynamics), our main focus is in linguistics: the frequency and isogloss density of real-world language features can be obtained from WALS and from this we calculate their temperatures.

SOE 8.4 Tue 14:45 ZEU 260

**The Characteristic Time Scale of Cultural Evolution** — ●TOBIAS WAND — Westfälische Wilhelms-Universität Münster, Institut für Theoretische Physik — Center for Nonlinear Sciences Münster

Clidynamics is a field of research that models human societies as dynamical systems, treating the study of history as a scientific discipline. Previous research on the Seshat databank has revealed one dominant principle component as an indicator of social complexity across diverse geographies and time periods. Our research expands on these findings, showing that there is a typical growth phase in social complexity that can be modelled with a universal functional form for all geographic areas included in the databank. Our findings reveal a characteristic time scale of rapid growth and can serve as a baseline to detect outliers.