

## Summary of activities (2022)

The research was carried out according to the objectives and tasks specified in the implementation plan. The objectives and activities planned in the project for the year 2022, Stage 2 (Models and Analytical Methods in the statistical study of complex phenomena) were the following:

(O1) Analysis of socio-economic and biological data with tasks T1.4 and T1.5, activities 2.1 and 2.2.

(O2) A "bottom-up" approach starting from microscopic evolution equations and reaching a thermodynamic description corresponding to equilibrium statistics. Specifically, tasks T2.2 and T2.3, which aim at the correct definition of entropy in the studied socio-economic systems, and task T2.4, which aims at the same objective in biological systems by means of the same methodology. The activities for these studies in the implementation plan are planned in items 2.3 and 2.4.

(O3) A "top-down" approach regarding the generalization of thermodynamic methods for socio-economic systems. Tasks T3.3 and T3.4 aim at applications on socio-economic and biological problems, through activities: 2.5 and 2.6.

The objectives for the year 2022 were achieved through the study of 6 specific problems, 5 of them planned in the project. These are presented in detail in the activity report, here we only enumerate them: (1) a new methodology inspired by mean-field theories for determining the Gini coefficient when using coarse-grained data; (2)  $f$ -Gintropy – generalization of Gintropy; (3) the generalization of thermodynamic methods to describe the hadronization phenomenon; (4) the statistical approach of some limits and scaling of the Hirsch index with the total number of citations; (5) the study of the cerebral neural network by a simple statistical model; (6) collective behavior in oscillating fluid columns.

For applications in biological systems, the neural systems were studied through the methodologies provided in the project. For the abundance studies in biological systems, only data processing and visualization were performed. Respecting the applied changes to the implementation plan (additional act signed to in order to reduce the budget for 2022), these were rescheduled for 2023.

Deliverables included ISI publications, presentations and participation in conferences. The following disseminations were carried out:

### WOS indexed publications (2022) with acknowledgement to the project:

1. T.S. Biró, A. Telcs, M. Józsa and Z. Néda, *f-Gintropy: An Entropic Distance Ranking Based on the Gini Index*, **Entropy**, vol. 24, 407 (2022) (IF: 2.524)  
<https://doi.org/10.3390/e24030407>
2. T.S. Biró and Z. Néda, *Thermodynamical aspects of the LGGR approach for Hadron Energy Spectra*, **Symmetry**, vol. 14, 1807 (2022) (IF: 2.94)  
<https://doi.org/10.3390/sym14091807>
3. A. Gergely and Z. Néda, *Computational Fluid Dynamics Approach for Oscillating and Interacting Convective Flows*, **Fluids**, vol. 7, 339 (2022) (IS: 1.93)  
<https://doi.org/10.3390/fluids7110339>

4. A. Gergely, Cs. Paizs, R. Tötös and Z. Néda, *Oscillations and collective behavior in convective flows*, **Physics of Fluids**, vol. 33, 124104 (2021) (IF: 3.26, acceptat spre publicare si raportat in 2021). <https://doi.org/10.1063/5.0073347>

#### Submitted:

1. A. Kuki, F. Járjai-Szabó, A. Gergely, I. Gere, Z. Néda, S. Lipcsei, P. Dusan-Ispanovity, Z. Dankházi and I. Groma; *Statistical analogies between earthquakes, micro-quakes and avalanches in the 1D Burridge-Knopoff model*, submitted to **Geofizika**, 2022

#### International conference presentations in 2022 on the thematic of the project:

1. Z. Néda, **MECO47** (Middle European Cooperation in Statistical Physics, 12-14 June 2022, Erice, Italy) *A unified approach to wealth and income inequalities in modern societies*. <https://meco47.sciencesconf.org/resource/page/id/9>
2. S. Kelemen, I. Gere, T. Biro and Z. Néda, **MECO 47** (Middle European Cooperation in Statistical Physics, 12-14 June 2022, Erice, Italy) *Wealth inequalities in different socio-economic situations, Exhaustive data and a general modelling framework*. <https://meco47.sciencesconf.org/resource/page/id/10>
3. Mate Jozsa, Maria Ercsey-Ravasz, Zsolt I. Lazar, *Investigating brain wiring by simple statistical models*, **MECO 47**, Erice, Sicily, June 12-16 2022 <https://meco47.sciencesconf.org/resource/page/id/10>
4. Z. Néda, **BIODYNAMICS**, A transdisciplinary approach -invited talk (Academia Romana si Institutul de Biodinamica, Bucuresti, 19-21 May, 2022) *The growth and reset dynamics in Complex Systems*. <https://sites.google.com/view/biodynamics2022/home>
5. I. Gere, Sz. Kelemen, T.S. Biro and Z. Néda; **Econophysics Colloquium 2022** (August 24-26, 2022, Thessaloniki, online) *Wealth inequality patterns based on exhaustive sampling. Data mining and modelling*. <https://ec2022.auth.gr/>
6. Sz. Kelemen, M. Jozsa and Z. Néda; **Econophysics Colloquium 2022** (August 24-26, 2022, Thessaloniki, online) *Estimation of the Gini coefficient from incomplete datasets*. <https://ec2022.auth.gr/>

#### Presentations accesibile on the WEB:

Social inequalities in the perspective of a physicist (in Hungarian)  
<https://www.youtube.com/watch?v=BzoTP8pSyzg>  
<https://www.youtube.com/watch?v=nHLxJxSryy0>