# Lubomir Kostal

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Current position	Research Group Leader	LinkedIn	www.linkedin.com/in/lubomir-kostal

# **Summary**

- I have been trained as a physicist and I have two decades of experience in mathematical modeling, data analysis and using Linux systems.
- In my academic research I use probability theory, stochastic point process theory, information and estimation theory to study neural systems, bio-inspired algorithms and NeuroAI.
- I regularly publish in top scientific journals, receive grant support and present my research results at universities abroad and at international conferences (see my full academic CV).

### Skills

- My expertise in the mathematical foundations of neural networks, information theory and statistical estimation allows me to efficiently approach and insightfully implement classic and modern machine learning methods.
- Programming, data analysis and visualisation: R (dplyr, ggplot2, optimx, lpSolve, pracma), Wolfram Mathematica, C++, Python (Scikit-learn, Keras, TensorFlow), scripting in Linux, Fortran.
- Languages: Czech (native), English (full professional proficiency), German (limited working proficiency).

### Experience

2014—	Research group leader: Lab. of Computational Neuroscience, Institute of Physiology, CAS
	- I lead and supervise an international research team (~6 people incl. students and postdocs).
	- I propose externally-funded grant projects and arrange international collaborations.
	– I am responsible for managing the budget and the team composition.
2011–2013	Associated scientist, Institute of Physiology
2005–2010	Doctoral and Postdoc stay: Laboratory of prof. Jean-Pierre Rospars, INRA, Versailles, France
	- I mathematically analyzed information coding in the neuronal sensory system of insects.
	- I was supported by the Marie-Curie fellowship and the ECO-NET 12644PF project.
2004–2007	PhD student (supervisor: prof. Petr Lansky, Institute of Physiology, CAS)
	- Thesis: "Principles of information processing in neuronal models".
2000–2005	Freelance: Programmer; Linux System Administrator; English Translator

# Education

2007	PhD (biophysics), Charles University Prague and Institute of Physiology.
2003	MSc (physics), Faculty of Mathematics and Physics, Charles University Prague

#### Awards

- Prize for the best paper of the year (Institute of Physiology, CAS): awarded in 2017 (Rajdl K, Lansky P, Kostal L (2017) *Neural Netw.*, 95, 57–65) and in 2011 (Kostal L, Lansky P Pokora O (2011) *PLoS ONE*, 6, e21998).
- 2012: *Otto Wichterle Award*: Prestigious award given by the Czech Academy of Sciences to young researchers for achieving exceptional results in the given area of science.
- 2010: Best poster presentation award (Kostal L: "Information capacity in the weak-signal approximation"), *Neural Coding 2010*, Limassol, Cyprus.
- 1997: *Students' Professional Activities (SPA)*: Winner of the nation-wide high-school student competition in Physics with the thesis: "Numerical solution of the geodesic equation in general relativity for the extreme Schwarzschild-de Sitter metric" (supervisor: Prof. J. Podolsky, Faculty of Mathematics and Physics, Charles University Prague).

# Research project management (5 most important grants, principal investigator)

- 2020–2022: *Optimality of neuronal communication: an information-theoretic perspective*, The Czech Science Foundation (GACR), ( $\approx 261.000 \text{ EUR}$ )
- 2017–2019: *Neural coding precision and its adaptation to the stimulus statistics*, The Czech Science Foundation (GACR) (≈ 217.000 EUR)
- 2015–2017: *Efficiency of information transfer and the role of energetic constraints in neuronal systems*, The Czech Science Foundation (GACR) ( $\approx 259.000 \text{ EUR}$ )
- 2012–2014: *Information-theoretic analysis of stimulus coding in sensory neurons*, The Czech Science Foundation (GACR) (≈ 56.000 EUR)
- 2011–2013: *Neural Coding and Information beyond Shannon*, European Office of Aerospace Research and Development, Office of Naval Research Global (support for the respective workshops in 2012 and 2013, ≈ 20.000 EUR)

# Selected scientific publications (corresponding or main author)

- Barta, T. & Kostal, L. (2024) Shared input and recurrency in neural networks for metabolically efficient information transmission. *PLoS Comput. Biol.*, **20**, e1011896.
- Rajdl, K. & Kostal, L. (2023) Estimation of the instantaneous spike train variability. *Chaos Solit. Fractals*, **177**, 114280.
- Kostal, L.& Kobayashi, R. (2019) Critical size of neural population for reliable information transmission. *Phys. Rev. E (Rapid Commun.)*, **100**, 050401(R).
- Rajdl, K., Lansky, P. & Kostal, L. (2017) Entropy factor for randomness quantification in neuronal data. *Neural Netw.*, **95**, 57–65.
- Kostal, L. (2016) Stimulus reference frame and neural coding precision. J. Math. Psychol., 71, 22–27.
- Kostal, L., Lansky, P. & Pilarski, S. (2015) Performance breakdown in optimal stimulus decoding. *J. Neural Eng.*, **12**, 036012.
- Kostal, L., Lansky, P. & Pokora, O. (2013) Measures of statistical dispersion based on Shannon and Fisher information concepts. *Inform. Sciences*, 235, 214–223.
- Kostal, L. (2010) Information capacity in the weak-signal approximation. Phys. Rev. E, 82, 026115.

Total: 43 papers in IF journals, 3 in peer-reviewed proceedings, 2 editorials Google Scholar: 721 citations, *h*-index: 16

# Outreach

### Professional service

- Organizer of international conferences in Prague: Neural Coding (2012, ~100 participants), Information beyond Shannon (2013, ~20p), Inform. Theory in Computational Neurosciences (2015, ~100p)
- Technical and program committee member: ESSAN (European Symposium on Artificial Neural Networks) and ICMNS (International Conference on Mathematical NeuroScience)
- Editorial board of scientific journals: *Neural Proc. Lett.* since 2016; guest editor (2016, 2018) for *BioSystems* and *Math. Biosci. Eng.*
- Reviewer for 20+ scientific journals (including . Neural Netw., Phys Rev E, Plos Comput. Biol.)
- 10+ invited scientific talks in last 10 years (expenses covered by the inviting party).

### Popularization of science

- Interviews for several Czech Radio stations and newspapers in 2008, 2012
- Czech TV interview (Otto Wichterle prize reception); Neural Coding 2012 conference coverage
- Lectures for general public: Brain Awareness Week (2018); Public library in Nymburk (2022).

### Educational collaboration

• Initiated (jointly with Dr. R. Kobayashi) the *Memorandum of Understanding* between the *Institute of Physiology of the Czech Academy of Sciences, Czech Republic*, and the *National Institute of Informatics, Japan*, in the area of research and education in the fields of artificial intelligence and computational neuroscience (signed by the directors in 2016)