OBITUARY

Doc. RNDr. Martin Janžura, DrSc.

1955 – 2016

Martin Janžura completed his studies at the Faculty of Mathematics and Physics, Charles University in Prague, in 1979 and, after military service, started his doctoral studies with the Institute of Information Theory and Automation, then of the Czechoslovak Academy of sciences, now the Czech Academy of Sciences. He stayed with the Institute for all his professional life. In 1987 he participated in creating the tradition of annual Winter Schools for Young Scientists, which lasted for about ten years and helped young colleagues in the beginning of their professional careers; and he was Chairman or Vice-Chairman of five Organizing Committees of Prague Conferences on Information Theory, Statistical Decision Functions, and Random Processes jointly with Prague Stochastics, including the prestigious joint session with the European Meeting of Statisticians in 2002. He supervised half a dozen doctoral students and taught Markov Processes at the Faculty of Nuclear Engineering of the Czech Technical University for many years.

One central part of the original scientific contributions by Martin Janžura was devoted to issues related to information theory. It is essential to recognize the precise framework of these contributions. He never wrote a single research paper in the theory of digital communication or channel coding. He proved source coding theorems for general stationary random fields (including Gibbs' fields) and their reduced or simplified versions. Such results of his efforts in the 1980s are concisely summarized in the conference paper [16]. But mainly he adhered to one of the research traditions at ÚTIA, whereby information theory is rendered instrumental for dealing with and/or found inherently linked to statistical modeling and inference as well as to signal processing and image analysis. In this regard he was deeply influenced, and never made a secret of this, by his supervisor, Albert Perez, by his Professor at Charles University, Karel Winkelbauer, and by his co-author and colleague Igor Vajda, to mention but only a few names. The papers in information theory and statistics by Imre Csiszar from Budapest were also without doubt indicative for the intellectual outlook of Martin Janžura. Actually, statistical mechanics played perhaps an even more important role for Martin Janžura than information theory, but his statistical research was stimulated by both these disciplines.

Martin Janžura followed in his scientific career the path to the future that was mapped out already by his dissertation. Quite naturally, the focus shifted over the years. Those of us who had the pleasure to know Martin as a doctoral student heard from him about generalizations of the Shannon-McMillan theorem, which later seemed to vanish from his key set of interests. The techniques of statistical information theory, like, say, Shannon-McMillan theorem, were not clearly a main stream topic amongst statisticians at the time of Martin's doctoral studies; nevertheless, they have since been developed to be

one of the tenets of statistical theory and practice.

A document on Martin Janžura's priorities in information theory is the syllabus of Statistická teorie informace – NSTP150, which he lectured at Charles University. Martin's version of this syllabus in English is characteristically succinct, reflecting his aversion to certain kinds of verbose nonsense and embellishment: entropy in statistics, limit theorems. But the corresponding Czech version reveals more detail. The learning outcomes are recapitulated as: entropy, relative entropy, differential entropy, maximum entropy distributions, entropy in statistical problems of parameter estimation and hypothesis testing, limit theorems based on the method of types – a strong law of large numbers and a theorem on large deviations, limit theorems for error type II - theorems of Stein and Chernoff, convergence theorems for conditional distributions. Evidently Martin could count on interacting and did, in fact, interact with highly motivated and talented university students. Although the syllabus recapitulated above presents his selection of topics for the academic teaching, it essentially captures the toolbox of his research, too, as evidenced by the key words and titles in his research papers. Of course, we should not forget to mention his expertise and skill in convex analysis, which is required for work with the information distances of statistics like the I-divergences.

One frequently applied device in Martin Janžura's research is the minimum I-divergence principle (due to I. Csiszar), e.g., minimizing the relative entropy between an empirical distribution and theoretical distributions in a statistical family of distributions. This notion was also extended by him in order to find maximum pseudolikelihood estimators for, e.g., Gibbs random fields using a minimization of a mean conditional relative entropy. There are several important real-life applications of such maximum pseudolikelihood estimators. He was also interested in analyzing variants of the minimum I-divergence principle with reduced computational complexity, one expression of this being the paper on learning the structures of Bayesian networks. This paper [3], co-authored with Jan Nielsen, would seem to deserve a good deal of attention. Martin Janžura also published on the so-called minimum entropy of error estimators [14, 18]. These estimators were originally argued in terms of concepts of control engineering and gave, e.g., another interpretation for the linear Gaussian Kalman filter. Martin Janžura contributed to discovering the natural structure of these estimators in terms of a certain likelihood ratio.

In the paper "Marginal problem, statistical estimation, and Möbius formula" [2] the reader finds Martin Janžura's various ideas and techniques of information theory and statistical mechanics converging to what for all practical purposes amounts to a single compendium of the highlights in the work by Martin Janžura. In addition, the reader experiences here, as elsewhere, his penchant for meaningful and concise expression as well as for careful writing. The marginal problem does, in fact, lie inside an earlier highly interesting and innovative paper "A method for knowledge integration" [10], jointly authored with Pavel Boček. The idea in this paper is to design a Markov chain Monte Carlo sampler from complex multi-dimensional distributions, which cannot be exactly calculated, as the authors abandon the standard assumptions of the marginal problem. In fact, the exact analysis of the loss incurred by simplified representations of large and complex models was a topic that followed him in various forms from his earliest research in source coding. By this Martin Janžura made early contributions to the analysis of very complex and massive data sets, nowadays of huge interest and, to some degree, surrounded by verbose nonsense and embellishment.

An important area of Martin's research concerned the use of Gibbs random fields as probability models for spatial data and image processing. Their importance for the statistical analysis stems from the fact that they represent a natural generalization of basic concepts of probability theory and mathematical statistics, such as exponential distribution or Markov chains. However, particular features of Gibbs fields – the existence of phase transitions and symmetry breakdown – were preventing a direct use of methods developed for independent or almost independent fields and a new approach had to be developed. Martin investigated various aspects of these problems in several papers. In the most influential one, written jointly with Francis Comets [9], they prove consistency and asymptotic normality of the maximum pseudo-likelihood estimator for a general class of Markov random field models. Their result opened a door to diverse applications. For example, very recently[1] it was appreciated in a newly emerging field of exponential random graph models.

In addition to his research work, Martin Janžura was a great manager. For more than ten years he headed the Council of the large "Data – Algorithms – Decision Making" Research Center, within which 11 research institutions and commercial companies cooperated. In the 1990s he became Head of the Department of Stochastic Informatics, and later Vice-Director for Research of the Institute. His activities in the latter role were both distinctive and successful; he largely contributed to the Institute becoming one of the most renowned within the Academy of Sciences.

Martin Janžura worked as editor of the Kybernetika journal since 1999. He covered an area of statistics, random processes and the theory of information. In 2011 Martin became Editor-in-Chief. He understood the Kybernetika, on the one hand, as a good opportunity for Czech and Slovak researchers to publish their work in a renowned international journal and, on the other hand, as a "shop window" of the Institute. His idea was that the scope of the journal should include the topics living at the Institute. He cared about modernization of the editorial system of the journal as well as about maintaining the Editorial Board's viability.

In the 2000s he withdrew from his more public roles in the Institute, retaining only his position of Editor-in-Chief of the Kybernetika Journal. This decision may have been caused by his beginning illness; or perhaps the illness fully came into force after that, who knows?

We who knew him are only too well aware of the fact that the last years of his life were full of pain and suffering. All of us have the indispensable right not to let doctors spoil our way of life, but Martin seemed to have brought this kind of freedom to the most harmful extreme by his untimely death on August 2, 2016. Well, let his steps tread lightly, wherever it may be.

Antonín Otáhal, Timo Koski,
Roman Kotecký and Lucie Fajfrová

[1] S. Chatterjee and P. Diaconis: Estimating and understanding exponential random graph models. The Annals of Statistics *41* (2013), 2428–2461.

SELECTION OF BIBLIOGRAPHY

[1] M. Janžura: An efficient estimator for Gibbs random fields. Kybernetika *50* (2014), 6, 883–895.

[2] M. Janžura: Marginal problem, statistical estimation, and Möbius formula. Kybernetika *43* (2007), 5, 619–631.

[3] M. Janžura and J. Nielsen: A simulated annealing-based method for learning Bayesian networks from statistical data. International Journal of Intelligent Systems *21* (2006), 3, 335–348.

[4] M. Janžura: On the exponential representation problem. Soft Computing *7* (2003), 5, 321–327.

[5] M. Janžura and P. Boček: Relative asymptotic efficiency of the maximum pseudolikelihood estimate for Gauss-Markov random fields. Statistical Inference for Stochastic Processes *5* (2002), 2, 179–197.

[6] P. Boček, T. Feglar, M. Janžura, and I. Vajda: Prognosis and optimization of homogeneous Markov message handling networks. Kybernetika *37* (2001), 6, 625–646.

[7] M. Janžura: On the concept of the asymptotic Rényi distances for random fields. Kybernetika *35* (1999), 3, 353–366.

[8] M. Janžura: Asymptotic Rényi distances for random fields: Properties and applications. Kybernetika *35* (1999), 4, 507–525.

[9] F. Comets and M. Janžura: A central limit theorem for conditionally centered random fields with an application to Markov fields. Journal of Applied Probability *35* (1998), 3, 608–621.

[10] M. Janžura and P. Boček: A method for knowledge integration. Kybernetika *34* (1998), 1, 41–55.

[11] I. Vajda and M. Janžura: On asymptotically optimal estimates for general observations. Stochastic Processes and their Applications *72* (1997), 1, 27–45.

[12] M. Janžura: Asymptotic results in parameter estimation for Gibbs random fields. Kybernetika *33* (1997), 2, 133–159.

[13] M. Janžura, T. Koski, and A. Otáhal: Minimum entropy of error estimation for discrete random variables. IEEE Transactions on Information Theory *42* (1996), 4, 1193–1201.

[14] M. Janžura and P. Lachout: A central limit theorem for stationary random fields. Mathematical Methods of Statistics *4* (1995), 4, 463–472.

[15] M. Janžura: Statistical analysis of Gibbs-Markov binary random sequences. Statistics & Decisions *12* (1994), 12, 367–384.

[16] M. Janžura: Source coding theorem for random fields. Proceedings of the 1994 IEEE International Symposium on Information theory, p. 185, (1994).

[17] M. Janžura, T. Koski, and A. Otáhal: Minimum entropy of error principle in estimation. Information Sciences *79*, 123–144.

[18] M. Janžura: The central limit theorem for random fields. Kybernetika *30* (1994), 1, 77–86.

[19] M. Janžura: An Approximation of the Pressure for the Two-Dimensional Ising Model. Kybernetika *28* (1992), 3, 234–238.

[20] M. Janžura: Test for Submodel in Gibbs-Markov Binary Random Sequences. Kybernetika *25* (1989), 3, 200–208.

[21] M. Janžura: Divergences of Gauss-Markov Random Fields with Application to Statistical Inference. Kybernetika *24* (1988), 6, 401–412.