Academic CV and Previous Research Projects

Ľuboš Buzna

Department of Mathematical Methods and Operations Research, Faculty of Management Science and Informatics, University of Žilina

May 15, 2015

Academic CV: Education



Master degree (1995-2000): University of Žilina, Faculty of Management Science and Informatics, MSc in the study program *"Information and Control Systems"* (**diploma with distinction**)



PhD degree (2000-2003): University of Žilina, Faculty of Management Science and Informatics, PhD in the study program *"Transportation and Communication Technology""*,

PhD Thesis:

The distribution system design problem using integer programming and continuous approximation approach

Key outputs:

J. Janáček, J., Ľ. Buzna: A comparison of Continuous Approximation with Mathematical Programming Approach to Location Problems, **Central European Journal of Operation Research**, Springer, Vol. 12, Issue 3, p. 295-305, 2004

J. Janáček, Ľ. Buzna, (2008) An acceleration of Erlenkotter-Koerkel's algorithms for the uncapacitated facility location problem, **Annals of Operations Research**, Springer, Vol. 164, Num. 1, p. 97-109.

Academic CV: Scientific positions

Scientific positions:



Assistent Professor (09/2003-01/2011): University of Žilina, Faculty of Management Science and Informatics, Department of Transportation Networks



Postdoctoral Researcher (02/2005-09/2007): Dresden University of Technology, Faculty of Transportation and Traffic Sciences "Friedrich List", Chair of Traffic Modelling and Econometrics, Germany (Prof. Dirk Helbing)

Postdoctoral Researcher (10/2007-07/2009): ETH Zurich, Department of Humanities, Social and Political Sciences, Chair of Sociology in particular of Modelling and Simulation, Switzerland (Prof. Dirk Helbing)



Postdoctoral Researcher (06/2014-01/2015): University of Barcelona, Faculty of Physics, Department of Fundamental Physics, Spain (Prof. Albert Diaz Guilera, Prof. Marian Boguna, Prof. Mariangeles Serrano)



Associate Professor of Applied Informatics (01/2011-present): University of Žilina, Faculty of Management Science and Informatics, Department of Mathematical Methods and Operations Research

Previous Research Projects

Self-organized pedestrian crowd dynamics

How do interactions between pedestrians lead to self-organized phenomena?

Empirical study of pedestrian flows (lanes formation, counterflows, bottlenecks)

Flow intersections





Evacuation scenarios



Validation of improved design by computer simulations (social force model)





D. Helbing, Ľ. Buzna, A. Johansson, T. Werner, Self-organized pedestrian crowd dynamics: experiments, 5 simulations, and design solutions (2005) : In: **Transportation Science** - Vol. 39, No 1, Febr. (2005), pp. 1-24

Natural disasters and large-scale evacuations

Project: DFG He 2789/6-1



Modelling the recovery of networks



L. Buzna, K. Peters, H. Ammoser, C. Kuehnert and D. Helbing, Efficient response to cascading disaster spreading, **Physical Review E**, vol. 75, 5, 056107.



http://www.ptvag.com Large scale evacuations



Overall travel time has been reduced by optimization algorithm to 40 % and the total length of evacuation routes to 6 12 %.

Stochastic model of interconnected infrastructures

Goal:

To quantify the effects of interdependencies on the reliability of interconnected systems **Rome scenario**



Data provided by project partners: (ENEA, Telecom Italia, Acea, Siemens)

In colaboration with:



R. Bloomfield, Ľ. Buzna, P. Popov, K. Salako and D. Wright, Stochastic Modelling of the Effects of Interdependencies between Critical Infrastructures, **Lecture Notes in Computer Science**, Springer, Vol. 6027/2010, p. 201-212, 2010



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Project:

Recent Research Projects

Application of fair optimization and convex optimization to study the gas supply security of Europe



R. Carvalho, Ľ. Buzna, F. Bono, M. Masera, D.K. Arrowsmith, and D. Helbing, Resilience of Natural Gas Networks during Conflicts, Crises and Disruption, **PLOS ONE** 9(3), 2014

Response in the media



Algorithm A-LEX- faster and more efficient fair algorithm

for network location problems

Goal:

To find efficient and equitable allocation of facilities on the transportation network

Solution A: $\begin{array}{c|c}
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& 1$ **Projects:** APVV-0760-11, VEGA 1/0339/13



Sorted distances: 10,9,9,0

Sorted distances: 10,8,7,0

L. Buzna, M. Koháni, J. Janáček: An Approximation Algorithm for the Facility Location Problem with Lexicographic Minimax Objective, Special issue: Fair Optimization and Networks: Models, Algorithms, and Applications, Editors: W. Ogryczak, H. Luss, D. 11 Nace, and M. Pióro., **Journal of Applied Mathematics**, (562373), 2014

Congestion control in charging of electric vehicles

Goal:

To compare congestion control protocols for charging electric vehicles

Projects:

APVV-0760-11, VEGA 1/0339/13 EPSRC EP/I016023/1

Application of **convex optimization** and **fair optimization** to

energy and transportation.



Initial modelling assumptions:

- Radial network topology,
- Loads (price-inelastic, price elastic)
- Capacity limitation (voltage drop),
- Centralized control scheme.

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Outlooks

Possible future research directions:

- analytical analysis of model properties;
- more realistic model of congestion control in charging EV (relaxing some modelling assumption);
- mechanism design (pricing mechanisms and collective behavior);
- decentralized optimization (ADMM, duality);
- new applications of convex optimization (sparse modeling algorithms: compressed sensing, design of sparse materials);

Thank you for your attention

Increased robustness of multilayered networks

explained by selfsimilarity

Goal:

To analyse how is related robustness of scale-free multilayered networks and selfsimilarity

Mutilayered networks:



Connectivity of multilayered networks and selfsimilarity



In collaboration with:

B Universitat de Barcelona

M. A. Serrano, Ľ. Buzna and M. Boguna, Escaping the avalanche collapse in self-similar multiplexes, **New Journal of Physics**, accepted, 2015 15

Solving extremely large location problems in geographical areas



Communications in Computer and Information Science, Springer, 2015