

ANFIS based Expert systems prototype development for estimation of Urban mobility

Krešimir Vidović¹, Sadko Mandžuka², Davor Brčić²

¹ Ericsson Nikola Tesla, Krapinska 44, Zagreb

² University of Zagreb Faculty of Transport and Traffic Science, Vukelićeva 4, Zagreb, Croatia,

kresimir.vidovic@ericsson.com

Abstract - For the purpose of estimating urban mobility, an approach that uses urban mobility indicators calculated from the data subsystem from the Charging Data Records database in the public mobile telecommunications network was chosen. Calculated indicators are unified in the urban mobility index as a unique indicator of urban mobility in urban agglomeration. The urban mobility index is calculated using an expert system based on fuzzy logic, that is, the ANFIS (adaptive neuro-fuzzy inference system) method. It functions on the principle of applying conclusion methods which characterize neural networks with the goal of determining parameters of an indirect conclusion system (Fuzzy Inference System – FIS). The prototype of the system was developed by using the appropriate application environment, where the proposed methodology was implemented.

Keywords – Urban mobility estimation, indicators, index, Call Data Records, telecommunications

REFERENCES

- [1] B. Mandžuka, D. Brčić, and P. Škorput, “ITS in the function of sustainable urban mobility,” in 22nd International Symposium on Electronic in Transport - ISEP 2014., 2014.
- [2] S. Mandžuka, M. Žura, B. Horvat, D. Bičanić, and E. Mitsakis, “Directives of the European Union on Intelligent Transport Systems and Their Impact on the Republic of Croatia,” *PROMET - Traffic&Transportation*, vol. 25, no. 3, pp. 273–283, 2013.
- [3] I. Kaparias and M. G. H. Bell, “Key Performance Indicators for traffic management and Intelligent Transport Systems,” London, 2011.
- [4] M. C. González, C. A. Hidalgo, and A.-L. Barabási, “Understanding individual human mobility patterns,” *Nature*, vol. 453, no. June, pp. 779–782, 2008.
- [5] F. Calabrese, M. Diao, G. Di Lorenzo, J. Ferreira, and C. Ratti, “Understanding individual mobility patterns from urban sensing data: A mobile phone trace example,” *Transp. Res. Part C*, vol. 26, p. 301313, 2013.
- [6] T. Litman, “Measuring transportation: Traffic, mobility and accessibility,” *ITE J. (Institute Transp. Eng.)*, vol. 73, no. 10, pp. 28–32, 2003.
- [7] D. Zhang, J. Zhao, F. Zhang, and T. He, “UrbanCPS: a Cyber-Physical System based on Multi-source Big Infrastructure Data for Heterogeneous Model Integration,” in *Proceedings of the ACM/IEEE Sixth International Conference on Cyber-Physical Systems - ICCPS '15*, 2015, pp. 238–247.
- [8] M. Filić, R. Filjar, and K. Vidović, “Graphical presentation of Origin-Destination matrix in R statistical environment,” in 36. skup o prometnim sustavima s međunarodnim sudjelovanjem Korema „Automatizacija u prometu 2016“, 2016.
- [9] R. Filjar, M. Filić, A. Lučić, K. Vidović, and D. Šarić, “Anatomy of Origin-Destination matrix derived from GNSS alternatives,” *Coordinates*, vol. XII, no. 10, pp. 8–10, 2016.
- [10] K. Vidović, S. Mandžuka, D. Brčić, Estimation of Urban Mobility using Public Mobile Network. In: *Proceedings of 59th International Symposium ELMAR-2017*. Zadar: Faculty of Electrical Engineering and Computing, Zagreb., p. 21–4, 2017.
- [11] Hoffman, R.R., The problem of extracting the knowledge of experts from the perspective of experimental psychology. *AI magazine*, 8(2), pp.53-67, 1987.
- [12] Olson, J.R. and Rueter, H.H., Extracting expertise from experts: Methods for knowledge acquisition. *Expert systems*, 4(3), pp.152-168, 1987.
- [13] J. S. R. Jang, “ANFIS: Adaptive-Network-Based Fuzzy Inference System,” *IEEE Trans. Syst. Man Cybern.*, vol. 23, no. 3, pp. 665–685, 1993.
- [14] S. Mandžuka, E. Ivanjko, M. Vujić, P. Škorput, and M. Gregurić, “The Use of Cooperative ITS in Urban Traffic Management,” *Intell. Transp. Syst. Technol. Appl.*, pp. 272–288, 2015.
- [15] P. Škorput, S. Mandžuka, N. Jelušić, Real-time detection of road traffic incidents, *Promet - Traffic & Transportation*, 2010; 22(4), 273-283.
- [16] H. Pilko, S. Mandžuka, D. Barić, D. Urban single-lane roundabouts: A new analytical approach using multi-criteria and simultaneous multi-objective optimization of geometry design, efficiency and safety. *Transportation Research Part C: Emerging Technologies*, 2017; 80 (July): 257-271.