Optimizing of nonlinear logistic problems concerning uncertainty, time dependency and prospect theory

Péter Földesi PhD

Széchenyi István University, Győr, Hungary

The logistic (transportation) system is a set of complex human, social, economic, and political interactions, and traditionally probability theory has been used for handling the obvious uncertainty. On the basis of recent research possibility theory offers a more useful way of handling the uncertain situations that often arise in logistic (transportation) analysis [1,2,3]. The two classes of uncertainty in transportation are vagueness, which is associated with the lack of clarity of the definition, such as the loss caused by a delivery delay, and ambiguity, which is associated with the lack of clarity in information, e.g., the predicted cost elements are often ambiguous. Considering real road transport, logistic networks, especially in city logistics, the actual circumstances and condition of the transit process are subject to not only the topography of the given network but to timing as well. Referring to the phenomenon of cyclic peak-hours and also to the weekly (monthly, yearly) periodicity of traffic on road, it can be stated that the unit cost of traveling is also a variable, and it can be described as a time series rather than a constant [4]. Obviously the physical distances can be considered as constant values in a given relation, but transit times are subject to external factors [5]. Furthermore the actual costs are rarely constant and predictable, so fuzzy cost coefficient can be applied in order to represent the uncertainty. In modern logistics systems uncertainty and inaccuracy are not tolerated due to the widespread just-in-time approach, service time windows are considered [6]. Multiobjective models have been presented [7,8] concerning a set of alternative solutions.

Time become an important factor of logistics service level. The satisfaction of customers has – in general terms - nonlinear characteristics, moreover, when time is included in the optimization, subjective elements have a significant affect on evaluation, so prospect theory must be involved in the analysis.

Considering the special features of the logistic processes dedicated optimizing principles, strategies, techniques and tools must be set in order to explore methods that can be provide appropriate means for practical use. The main focus of the research is to identify the principal difference between the general optimization theory and logistic optimization, such as the nature and uncertainty of input data, the nonlinear behaviour of the objective functions, and also the side-effects of the decision-makers' subjective assessment, the problems that have to be solved when NP-hard problems describes the real life tasks.

References

1. Dubois, D., Prade, H., *Possibility Theory: An Approach to Computerized Processing of Uncertainty*, Plenum Press, New York, 1988

2. Kikuchi, S., Chakroborty, P., *Place of possibility theory in transportation analysis*, Transportation Research Part B 40, pages 595-615, 2006.

3. Zadeh, L.A., *The concept of linguistic variable and its application to approximate reasoning*, Inform. Sci. Part 1, 8, pages 199-249, Part 2, pages 301-357, Part 3, 9 pages 43-80, 1975.

4. Földesi, Péter and Botzheim, János, *Modeling of loss aversion in solving fuzzy road transport traveling salesman problem using eugenic bacterial memetic algorithm*, Memetic Computing, volume 2, number 4, pages 259-271, ISSN 1865-9284, 2010.

5. Földesi, Péter, Botzheim, János and Kóczy, László T., *Eugenic Bacterial Memetic Algorithm for Fuzzy Road Transport Traveling Salesman Problem*, International Journal of Innovative Computing, Information and Control, volume vol.7, number no.5, pages 2775-2798, ISSN 1349-4198, 2011.

6. Favaretto D., Moretti E., Pellegrini P., *An ant colony system approach for variants of traveling salesman problem with time windows*, Journal of Information & Optimization Sciences, Vol. 27, pages 35-54, 2006.

7. Ammar, E. E., Youness, E. A., *Study on multiobjective transportation problem with fuzzy numbers*, Applied Mathematics and Computation 166, pages 241-253, 2005

8. Gholamian M.R., Fatemi Ghomi S.M.T., Ghazanfari M., *A hybrid system for multiobjective problems – A case study in NP-hard problems*, Knowledge-Based Systems 20 pages 426-436, 2007.