A New Transportation Forecasting Model Based on Sinusoidal Neural Network

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Extended Abstract

The linkage of transportation to air quality, energy, land use, and overall quality of life is highly considerable. To this respect, transportation-planning systems have been proposed as an active research field in computer simulation technology.

The main goal in simulating every transportation network is to forecast the behavior of each link in the network in terms of time. Forecasting this behavior will enable engineers to track the effect of different objects (parameters) in the network.

In the urban transportation paradigms, we often deal with a huge network, which is effected by many parameters. Urban transportation modelers need to know the traffic volume of each link in the network in terms of date and time. Conventional approaches attempt to obtain a demand matrix, at first and to assign travels based on the demand matrix, at second. The demand matrix presents the demand and cost of travels between each pair of sources and destinations. This matrix is obtained using statistical method. Travel assignment is a computational procedure in which an equilibrium is produced that satisfies the demand matrix by means of operations research methods. The result of this procedure is the traffic volume of links in the network. This type of simulation is referred to as macro-simulation.

In this paper, we first report the result of such a simulation for Tehran (one of the top five crowded cities in the world). Due to the huge population of this city (over 12 million), irregular texture of the city, and lack of an acceptable culture of motion, this city struggles with serious environmental problems. Heavy traffic is one of the expanding problems of the city. Due to the problem mentioned above, the conventional models (macro-simulators) could not present an acceptable transportation model of the city. In the best case, the accuracy of model for the present time is not more than 75%, so the accuracy is less than the mentioned value for the future.

In this paper, we introduce a new approach to transportation modeling, which is referred to as the micro-simulation. In this approach, instead of producing an equilibrium for travel assignment, an intelligent system is established to simulate the behavior of people in motion based on the environmental parameters. For any given pair of sources and destinations, the proposed intelligent system can predict the path of motion for a defined type of vehicle. To establish this system, an adaptive intelligent system is required, so we have used a neural network for this purpose.

The proposed neural network should be able to predict the priority of each link to be traveled by people, in terms of their view. This system (neural network) uses the environmental parameters of a proposed link as its input and returns a priority level for the link as its output. The input environmental parameters includes geometrical coordinate of the link, length and width of the link, the quality of its asphalt, its parking facility, etc. The output priority level is a number between 1 and 100. In this project, we have used sinusoidal neural networks [1] due to their strong ability in feature extraction.

After determining the priority level of each link in the network, we use shortest path algorithms [2] to determine a path between a given source and destination, where the weight of each link is its priority level. When we apply this method to our proposed demand matrix, the result will be a travel assignment for total transportation network.

In this paper, we report that the accuracy of this simulation method (micro-simulation) is up to 90% for the huge Tehran. In the case of huge network, it seems that its more sophisticated than traditional operations research techniques. In addition to better accuracy, this method can be used to correct the behavior of people only with informing them about the problem of their selected path and without any physical changes in the texture of the city.

References

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