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EDITORIAL

# Editorial

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The four papers in this special issue are a subset of those that were submitted for publication following an open call for papers considering transportation systems as some kind of day-to-day evolving, dynamical system.[1] Although remarks on the existence of such dynamic adjustment processes can be traced back to the early studies of equilibrium transportation systems (as a justification for the equilibrium hypothesis), a landmark in this field was a small research note, written some 30 years ago, where Horowitz (1984) explored the possibility to consider a simple two-route network through the theoretical frame of a discrete-time, non-linear dynamical system. The significance was in the primacy Horowitz gave to the dynamics; although he was only hypothesising possible behavioural adjustment processes, the underlying focus was on the description of such dynamics as “the model”, with the notion of equilibrium being a state that may or may not be useful for understanding part of such dynamics.

The dynamics of a transport system can be studied within either a deterministic or stochastic framework. This distinction is important. In particular, while a stable equilibrium of a deterministic model is described by a static fixed flow pattern, equilibrium of a stochastic model is represented by a stationary probability distribution, so that day-to-day variation persists even in that setting. An example is provided by the class of Markov day-to-day models introduced in the landmark paper of Cascetta (1989). A random process model of this type will converge in

[1] The editorial decisions for those papers of which one or other guest editor is an author were handled by the editor-in-chief, Michel Bierlaire.

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distribution under rather weak regularity conditions, but the day-to-day dynamics will still be apparent in the Markov transitions.

Following the work of Horowitz (1984) and Cascetta (1989), there has been a slowly growing interest in describing transportation systems through their day-to-day dynamics. This trend seems to have particularly grown in momentum in the last several years. It therefore seems a highly appropriate time for a special issue that is able to reflect the developments and diversity of approach under development.

In the history of this field, there has been a strong connection between, in the first case, the use of numerical experiments to push the boundaries of the model assumptions and, in the second case, the subsequent use of theory to capture at least part of the phenomena observed in the numerical work. The paper “Foxes and Sheep: Effect of Predictive Logic in Day-to-day Dynamics of Route Choice Behaviour” by Alibabai and Mahmassani falls into the former category. The key behavioural hypothesis is that there are two groups of drivers, those that are reactive (“sheep”) and those that are strategic (“foxes”). While reactive drivers forecast only on the basis of how their own decision may change in response to past conditions, strategic drivers anticipate the responses of other drivers when making their dynamic choice decision. In this way, the sheep essentially predict the system behaviour for the forthcoming day to be identical to the experience they have learned up to yesterday, whereas the foxes are ‘second-level thinkers’ who predict the impact of yesterday’s traffic conditions on all travellers. Through numerical tests, the authors show how the ratio of foxes to sheep in the travelling population may affect the overall system performance, the variance in that performance, and the relative benefits to the two groups of travellers. It is also shown how parameters of the model, such as memory length, may influence such phenomena.

In “Day-to-day Travel Time Perception Modeling Using an Adaptive-network-based Fuzzy Inference System” (by Khademi, Rajabi, Mohaymany and Samadzad), the focus of attention is on the way in which drivers dynamically update their perceptions of travel times in response to experienced travel conditions. Having first reviewed the many existing models of ‘traveler perception updating’, the paper goes on to propose a model to capture drivers’ mental representations of uncertain travel time using a combination of an artificial neural network and fuzzy logic. This so-called neuro-fuzzy approach is then tested in a laboratory-like experiment conducted on 100 university students, and is fine-tuned based on the stated data emerging from these experiments. Finally, a deterministic, discrete-event simulation model is proposed to combine the proposed updating approach with a network bottleneck model, with simulation experiments used to gain insights into the properties of the proposed perception updating model.

The motivation of Parry, Hazelton and Watling, in “A New Class of Doubly Stochastic Day-to-Day Dynamic Traffic Assignment Models”, is to develop a richer class of stochastic process traffic assignment model than currently exists, to capture variation in unmeasured factors. Such models are important when attempting to capture the real-life variation in traffic flows, given the non-stationary and complex spatio-temporal correlations that may arise, which are not represented in existing Markov models for transportation systems. The idea for the ‘doubly stochastic’ models proposed emerges from ideas in statistics, whereby some of the fixed parameters in an existing model (in this case, an existing Markov traffic assignment model) are replaced by random variables that are allowed to change over time and/ or space. As an example of this class of models, it is supposed that the (logarithm of the) scale parameter describing the probabilistic choice of travellers follows a Gaussian process over time. A series of simulation experiments are used to illustrate the kinds of link flow behaviour patterns emerging from such a model, and the influence of parameters of the model on these patterns.

In "Modelling Road Traffic Assignment as a Day-to-Day Dynamic, Deterministic Process: A Unified Approach to Discrete and Continuous-Time Models", Cantarella and Watling consider models in which the day-to-day dynamics are described by a non-linear, deterministic, dynamical system. The main contribution is to present a unified treatment of discrete-time and continuous-time approaches, these having developed in parallel streams of research with little overlap. Bringing such approaches together is not so conceptually trivial, since it is not simply that the discrete-time approaches can be regarded as a fine-scale approximation to the continuous-time ones. The paper reviews existing models, discusses these conceptual difficulties, and suggests resolutions (e.g. to maintain the Markov assumption). An exemplar dynamical is used to illustrate a consistent way in which discrete- and continuous-time analyses may be brought together, and future research perspectives are identified and discussed.

## References

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