Toll road operators and other toll facility stakeholders require analysis tools to estimate the ridership and projected income for an increasing variety of tolling schemes. Some tolling schemes commonly considered include distance-based tolls as well as derived schemes such as charging a maximum toll (or cap) for the use of the facility or minimum toll, if the distance-based toll is less than this value. In addition, different entry ramp tolls are considered, which may be added to a distance-based toll and additionally subjected to the toll cap value. In order to meet these requirements a new model formulation and algorithm for distance-based toll modelling is developed. It uses the toll cost per link, which may be distance-dependent, together with minimum and a maximum value of the tolls paid. The model is based on the addition of a set of temporary links to the network, which inherit the tolls and the delays of the original links. The method presented in this paper is general and self-contained. A proof is provided for the equivalence of the modified and original network formulations.

This new method is illustrated with a small example and a case of capped distance-based toll modelling on a network originating from practice. In order to solve the resulting multi-class network equilibrium model, a multi-threaded bi-conjugate variant of the linear approximation method has been adapted for the particular toll structure considered.

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