

On the variational theory of traffic flow: well-posedness, duality and applications

Networks and Heterogeneous Media, Vol. 1, No. 4, pp. 601-619, 2006

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Abstract

This paper describes some simplifications allowed by the variational theory of traffic flow (VT). It presents general conditions guaranteeing that the solution of a VT problem with bottlenecks exists, is unique and makes physical sense; i.e., that the problem is well-posed. The requirements for well-posedness are mild and met by practical applications. They are consistent with narrower results available for kinematic wave or Hamilton-Jacobi theories. The paper also describes some duality ideas relevant to these theories. Duality and VT are used to establish the equivalence of eight traffic models. Finally, the paper discusses how its ideas can be used to model networks of multi-lane traffic streams.