On a nonlinear follow-the-leader microscopic model of traffic flow

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We propose a general model for car-following traffic on a single lane. As an important model for a number of reasons, the acceleration is assumed to be a sigmoidal function of the distance between the cars and of the speed difference. We assume that the car following the leader is in an equilibrium state when there is no speed differential with the leading car, and when it follows it at the safe minimum distance. Taking into account the driver's reaction time, the resulting model is a functional differential equation. We study the stability of the equilibrium state by investigating the location of the roots of the quasi-characteristic equation. We carry out both numerical and graphical simulations, and use a continuation method to get the variation of these roots as the parameters change whithin some ranges of values. This gives us regions of values of the parameters for which the equilibrium solution changes its stability giving rise, eventually, to some kind of periodic solutions.

References

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