Seminario de Análisis Numérico y Modelamiento Matemático SANMoMa - Estudiantes

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CI²MA
Centro de Investigación en Ingeniería Matemática

Numerical analysis for a nonlocal traffic flow model

Miércoles 8 de julio, 12:30 -13:30 horas

Auditorio 'Hermann Alder Weller'

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Abstract

Conservation laws with nonlocal terms arise in a variety of physical and engineering applications such as traffic flow, sedimentation, crowd dynamics, granular flows, production networks, navigation processes, conveyor belts, weakly coupled oscillators, laser cutting processes or biological applications like structured populations dynamics. In this talk we analyze the well-posedness of a new class of macroscopic vehicular traffic model, which is described by a scalar nonlocal conservation law that simultaneously incorporates both upstream and downstream effects in the flow dynamics. Unlike nonlocal models previously described in the literature, which only account for downstream density averages (look-ahead behavior), the proposed model introduces an additional term depending on an upstream average (look-behind), allowing for a more realistic representation of anticipatory driver behavior under high-density conditions.
The considered flux takes the form ρ g(ρ) W (ˆRδ) V (Rη), where the nonlocal terms ˆRδ and Rη represent backward- and forward-looking spatial averages of the density, respectively, and the functions W and V encode the drivers' responses to these observations. The main novelty of this work lies in establishing the existence and uniqueness theory for entropy weak solutions, together with a rigorous proof of Lipschitz continuous dependence of solutions not only on the initial data, but also on the kernel functions, under reasonable structural assumptions on the flux components. The proofs are achieved through the design of a conservative numerical scheme that preserves key structural properties of the continuous model, such as maximum principle, mass conservation, BV estimates, and L1-stability.
Finally, we present numerical experiments that illustrate the behavior of solutions and the qualitative impact of nonlocal terms on traffic dynamics.