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An asymptotic-preserving scheme for a kinetic equation describing propagation phenomena

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The run-and-tumble motion of bacteria such as E. coli can be represented by a nonlinear kinetic equation. It will be considered under an hyperbolic scaling, and rewritten using the Hopf-Cole transform of the distribution function. It has been shown that the asymptotic model is either a Hamilton-Jacobi equation in which the Hamiltonian is implicitely defined, or a non-local Hamilton-Jacobi-like equation.

Since the kinetic equation becomes a stiff problem when reaching the asymptotic, its numerical computation must be performed with care to avoid instabilities when reaching it. Asymptotic Preserving (AP) schemes have been introduced to avoid these difficulties, since they enjoy the property of being stable along the transition towards the asymptotic regime.

I will present an AP scheme for this nonlinear kinetic equation, which is based on a formal asymptotic analysis of the problem. The discretization of the limit Hamilon-Jacobi equation will also be discussed.

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