MATHEMATICAL DESCRIPTION OF BACTERIAL MOTION BY CHEMOTAXIS : AGGREGATION AND WAVES OF CONCENTRATION

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Abstract

Chemotaxis is the phenomenom in which a population of cells rearranges its structure according to the behaviour of some chemical present in the environment. In this work, we consider a kinetic description of the collective motion of bacteria, incorporating the ability of cells to response to spatial and temporal variation of the gradient of the chemical. In the presence of nutriants, it has been experimentally observed the formation of concentration waves of bacteria [4]. A parabolic scaling of the kinetic model allows to recover this dynamics. Then a particular attention has been given to the interactions between different species. In a hyperbolic scaling, a macroscopic model of aggregation type is derived. Blow up of regular solutions for this system is well-known and a carefull analysis of measure solutions, in the sense of duality, has been obtained in one dimension [2]. Numerical simulations are challenging since it implies the treatment of singular solutions including possible Dirac deltas in order to recover the dynamics of aggregates [3]. This study has been recently extended in dimension greater than one [1] thanks to the notion of the Filippov flow for transport equations with singular velocity field.

References

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