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MULTISCALE KINETIC TRANSPORT MODELS FOR THE SPREAD OF EPIDEMICS WITH UNCERTAIN DATA

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Most epidemiological models are rooted in the pioneering work proposed by Kermack and McKendrick, based on systems of ODEs, which describe the spread of an infectious disease assuming population and territorial homogeneity and considering a deterministic configuration of the problem. Generally, the concept of the average behavior of a population is sufficient to have a reliable description of an epidemic development, but the inclusion of the spatial component becomes crucial when it is necessary to consider spatially heterogeneous interventions, as in the case of the COVID-19 pandemic. In addition, in epidemic models, initial conditions and modeling parameters are always affected by uncertainty, and must be so considered when attempting to solve the problem numerically.

In this work, drawing inspiration from kinetic theory, recent advances on the development of stochastic multiscale kinetic transport models for the spread of epidemics are presented. The propagation of the infectious disease is described by the spatial movement and interactions of a population divided into commuters moving in the territory on a wide scale and non-commuters acting only on urban scales [1, 2]. The resulting models are solved numerically through a suitable stochastic Asymptotic-Preserving IMEX Runge-Kutta Finite Volume Collocation Method, which ensures a consistent treatment of the system of equations, without loss of accuracy, when entering in the stiff diffusive regime [2, 3]. Application studies on the spread of the COVID-19 pandemic in Italy assess the validity of the proposed methodology.

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