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A spectral scheme for nonlinear integro-differential equations with discontinuity propagation; application to epidemic models

In this talk, we consider the age-structured SIR and MSEIR epidemic models. These models contain two independent variables (an age variable a and a time variable t) and are governed by a set of coupled nonlinear integro-differential equations. The numerical analysis of these equations is challenging and, in order to make a numerical study feasible, most studies in the past have discretized the age variable by considering a finite number of age groups. In practice, the number of age groups has been quite limited.

Our goal is to study the SIR and MSEIR equations in a continuous fashion, i.e., with a continuous age variable. We will do this by employing a spectral method to resolve the problem with respect to the variable a up to machine precision. As far as we know, it is the first time that has been done for the two aforementioned disease models. The piece of software developed for our investigation uses Chebfun and will be made available online.

This is joint work with Zain Patel, Youssef Guirguis, Eric Koritko and Dr. Jamie Foster.