Berlin Mathematics Research Center

MATH+

MATH+ Spotlight Talk

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Hybrid Models for Large Scale Infection Spread Simulations

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Abstract:

Since the SARS-CoV-19 outbreak, various strategies for modeling infection spread and counter-measures have been proposed. Agent-based models (ABMs) are widely used due to their ability to incorporate counter-measures, vaccines, and virus mutations. However, they are computationally expensive, especially for large-scale regions like Germany.

To address this challenge, we develop a hybrid model that combines ABMs with Partial Differential Equations (PDEs) and Ordinary Differential Equations (ODEs) to balance computational efficiency and accuracy. In this talk, I will present our hybrid modeling approach applied to Berlin-Brandenburg: Brandenburg is modeled using an ABM with event-based interactions and mobility data from cellular networks, while Berlin is represented as a PDE model. A coupling mechanism ensures seamless information exchange, capturing cross-region infection dynamics.

This framework, implemented in the C++ software Kaskade, demonstrates significant computational savings while preserving model fidelity. Designed for scalability, it lays the groundwork for future extensions to national-scale modeling, integrating ABM, PDE, and ODE approaches as needed.