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CSSI Element: Cyberinfrastructure for Pedestrian Dynamics-Based Analysis of Infection Propagation Through Air Travel

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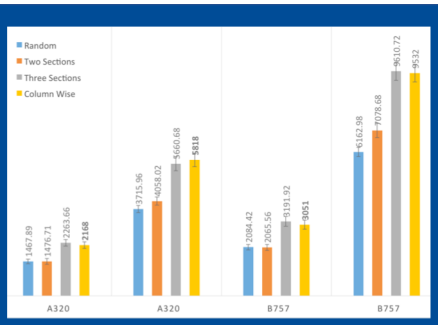
Award #: 1931511

Ebola risk could have been reduced by 87% in 2015 without travel restrictions

- Use better procedures, such as for boarding
- Use smaller planes



Contacts between passengers while boarding

Motivation

- Air travel is an important factor in infection spread
- Air travel restrictions have severe economic and human impacts
  - We can reduce infection without limiting air travel by manipulating fine-scale human interaction patterns
  - Pedestrian dynamics can simulate such interactions

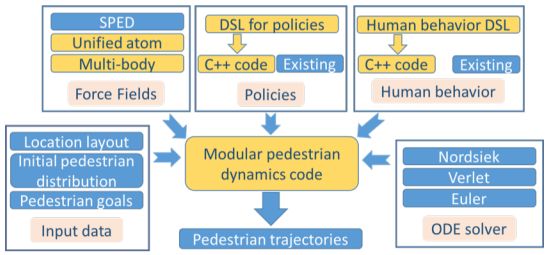
Project Goals

- Develop a community software for pedestrian dynamics
  - Simulate movement of individuals in a crowd
  - Applications to infection spread, evacuation, etc
- Provide a workflow to integrate models for pedestrian dynamics, infection spread, and phylogeography
  - Analyze impact of boarding procedures, airport layout, etc., and global impact of local policies

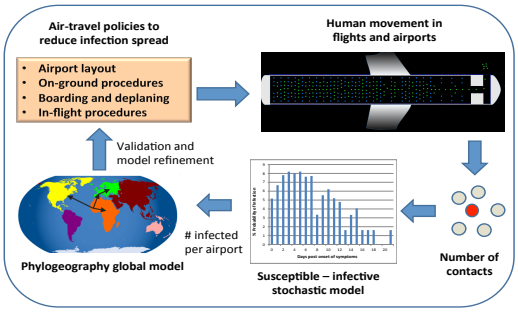
Models Implemented

- Pedestrian dynamics
  - Social dynamics – people treated as particles
    - A force propels them toward their destination, which is counteracted by a repulsive force due to fixed objects and other people blocking them
  - Applications to infection spread, evacuation, etc
- Infection transmission
  - Susceptible-infective stochastic model to determine infection transmission from contacts
- Phylogeography
  - Use genetic sequence and geographic data to model long-range transmission for viruses

Pedestrian Dynamics Software



Workflow for Epidemic Analysis



Innovations in Approach

- Models for scientific understanding are hard to use for policy analysis
  - Insufficient or poor quality data
  - Uncertainties in human behavior
  - Often at an aggregate level
- Our approach
  - Use a fine-scale model for individual movement
  - Parameterize sources of uncertainty
    - A parameter sweep yields a set of possible scenarios
  - Compare vulnerabilities of different policies, rather than prediction

The Economist — Come flu with me
The way airlines board planes affects how easily bugs are spread among passengers

The way we board planes could actually be spreading diseases — FOX NEWS

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