

Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

SIR Fronts in Complex Networks with Metapopulation Structure

JASON HINDES, Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York, SARABJEET SINGH, Theoretical and Applied Mechanics, Sibley School of Mechanical and Aerospace Engineering, Cornell University, Ithaca, New York, CHRIS MYERS, Laboratory of Atomic and Solid State Physics, Cornell University, Ithaca, New York, DAVE SCHNEIDER, Department of Plant Pathology and Plant ? Microbe Biology, Cornell University, Ithaca, New York, ANALYTICAL FRAMEWORKS FOR INFECTIOUS DISEASE DYNAMICS COLLABORATION — SIR dynamics has been studied extensively on complex networks, yielding insight into the effects of heterogeneity in contact patterns on the spread of infectious diseases. Separately, metapopulations have provided a paradigm for modeling systems with extended and “patchy” organization. In this paper we demonstrate how multi-type networks can be used to combine these paradigms such that simple disease dynamics models can include heterogeneity in connectivity and multi-scale structure. We first present a multi-type generalization of the Volz-Miller mean-field approximation for SIR dynamics on multi-type random graphs. We then use this technique to study the propagation of epidemic fronts in a simple metapopulation model with population centers composed of configuration model networks coupled on a one-dimensional lattice. Using the formalism of front propagation into unstable states, we derive the effective transport coefficients of the linear spreading: asymptotic speed, characteristic perturbation size, and diffusion coefficient for the pulled fronts, and explore their dependence on the underlying graph structure. We also derive the average steady-state incidence, the equilibrium spectrum, and the threshold for invasion.

Jason Hinds
Cornell University

Date submitted: 20 Dec 2012

Electronic form version 1.4