Electrical & Computer Engineering

S E M I N A R

Louisiana State University

Reproduction Numbers for Modeling, Analysis, and Control of Epidemics

Baike She

Georgia Institute of Technology

Abstract—In this talk, we present a control-oriented framework for modeling, analyzing, and mitigating infectious disease spread using reproduction numbers. In a connected society, disease transmission is shaped by mobility, heterogeneous mixing across spaces, population behavior, and policy interventions, making epidemic spread a complex dynamical system. To support decision making, we use the effective reproduction number as a compact indicator of transmission and a potential feedback signal. A key challenge is that the quantitative relationship between specific interventions and changes in the effective reproduction number is often unclear. We address this gap by characterizing how control inputs map to reproduction-number dynamics. We then use this connection to design a closed-loop strategy that adjusts intervention strength based on real-time reproduction-number estimates. We then introduce two extensions that capture richer behaviors. We define an opinion-dependent reproduction number that reflects behavior change driven by risk perception. We also define distributed reproduction numbers that quantify heterogeneity across regions or subpopulations.

Bio—Dr. Baike She is a Postdoctoral Fellow in the School of Electrical and Computer Engineering at the Georgia Institute of Technology. He received his Ph.D. in Mechanical Engineering from the University of Iowa. His research lies at the intersection of control theory, dynamical systems, and network science, with applications to multi-agent systems, collective decision making, opinion dynamics over social networks, and infectious disease spread.

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