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A theoretical method for assessing disruptive computer viruses

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Abstract

To assess the prevalence of disruptive computer viruses in the situation that every node in a network has its own virus-related attributes, a heterogeneous epidemic model is proposed. A criterion for the global stability of the virus-free equilibrium and a criterion for the existence of a unique viral equilibrium are given, respectively. Furthermore, extensive simulation experiments are conducted, and some interesting phenomena are found from the experimental results. On this basis, some policies of suppressing disruptive viruses are recommended.

Keywords: disruptive computer virus, heterogeneous epidemic model, equilibrium, global stability, virus-spreading network, spectral radius

1. Introduction

The convenience and popularization of the Internet have brought huge benefits to human society. Meanwhile, it offers a shortcut to spread computer viruses, inflicting large economic losses [1]. Consequently, the problem of how to effectively suppress digital viruses has long been a hot spot in the field of network security research. The epidemic modeling of computer infections is recognized as a feasible approach to the assessment of prevalence of electronic viruses as well as that of effectiveness of different virus-containing strategies [2]. Since the seminal work by Kephart and White [3, 4], multifarious computer virus spreading models, ranging from the coarsest population-level models [5–12] and the intermediate network-level models [13–17] to the finest node-level epidemic models, have been proposed [18–23].

Disruptive computer virusese are defined as those whose life period consists of two consecutive phases: the latent phase and the disruptive phase. In the latent phase, a disruptive virus staying in a host does not perform any disruptive operations. Rather, the virus tries to infect as many hosts as possible by sending its copies to them. In the disruptive phase, a disruptive virus staying in a host performs a variety of operations that disrupt the host, such as distorting data,

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