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Qualitative and bifurcation analysis using a computer virus model with a saturated recovery function. (English) [Zbl 1304.34099]

Summary: In this paper, we introduce a saturated treatment function into the computer virus propagation model, where the treatment function is limited for increasing number of infected computers. By carrying out global qualitative and bifurcation analysis, it is shown that the system exhibits some new and complicated behaviors: if the basic reproduction number is larger than unity, the number of infected computers will show persistent behavior, either converging to some positive constant or oscillating; and if the basic reproduction number is below unity, the model may exhibit complicated behaviors including: (i) backward bifurcation; (ii) almost sure virus eradication where the number of infective computers tends to zero for all initial positions except the interior equilibria; (iii) oscillating backward bifurcation where either the number of infective computers oscillates persistently, if the initial position lies in a region covering the stable virus equilibrium, or virus eradication, if the initial position lies outside this region; (iv) virus eradication for all initial positions if the basic reproduction number is less than a turning point value.

MSC:

34D23 Global stability of solutions to ordinary differential equations
34C23 Bifurcation theory for ordinary differential equations
68M99 Computer system organization

Keywords:
global stability; virus infection; ratio-dependent; basic reproduction number