

An SIS model for the epidemic dynamics with two phases of the human day-to-day activity

日次活動2相を組み込んだ SIS モデルによる感染症伝染ダイナミクス

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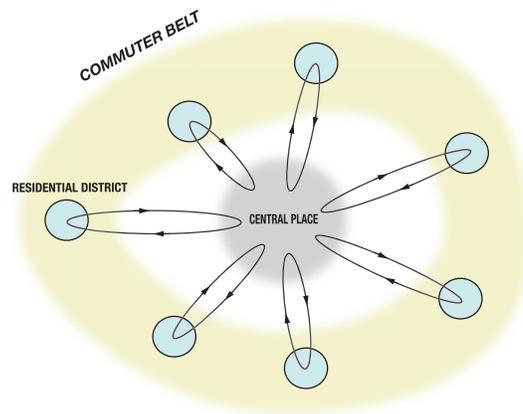
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There have been many investigations concerning the effect of transportation (or population dispersal) on the spread of a transmissible disease, and especially conducted been many *theoretical/mathematical* studies taken account of such a possibility for some individuals to become infective during transportation in order to such a significant contribution of transport-related infection. Not only the particular transportation with a long travel, but also the human quotidian mobility as a common phase of the human activity can be considered as one of relevant factors that could cause the spread of a transmissible disease such as influenza and SARS (WHO, 2018).

In this paper, we propose a specific model of so-called SIS type in a simplified geographical structure of a city with a *central place* (downtown) and some *residential districts* (outskirts) in the commuter belt, between which the quotidian commuting occurs. At the central place, the commuters make their social activities. We focus on the human day-to-day activity introduced by commuting to a central place for the social activity. We assume that the community is classified into two subpopulations: commuter and non-commuter, of which the commuter has two phases of the day-to-day activity: private and social. Moreover we take account of the combination of contact patterns in two phases, making use of mass-action and ratio-dependent types for the infection force.



We investigate the dependence of the basic reproduction number on the commuter ratio and the daily expected duration at the social phase as essential factors characterizing the community structure, and show that the dependence is significantly affected by the combination of contact patterns, and further that the difference in the commuter ratio or the representative duration at the social phase could make the likelihood of the spread of a transmissible disease significantly different.