A mathematical consideration on the contribution of city structure to the epidemic dynamics

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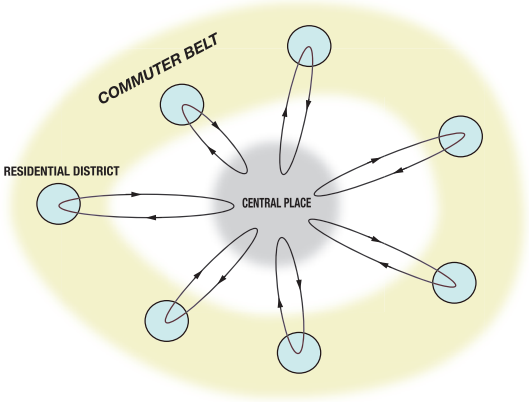
Human quotidian mobility is a common phase of the human activity, which is considered as one of main factors that could cause the dispersal of a disease such as influenza and SARS (WHO, 2018). It is reported that, in 2003, SARS broke out with some infection in an airplane: There was one person infected with SARS, and nine persons around him were infected during the transportation. SARS broke out with the cause of such a kind of transport-related infection. There have been many investigations concerning the effect of transportation (or population dispersal) on the spread of a 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 an innegligible contribution of transport-related infection.

One choice to model such a transport-related infection is to use a disease transmission model based on the well-known patch models, which may be of so-called metapopulation model, described by ordinary differential equations with a geographically divided population. In many of such previous modelings, the transport-related infection has been modeled mathematically as an instantaneous event, which may be regarded as an oversimplification or a mathematical convention, while the mathematical groundwork would have been meaningful and useful in order to discuss the nature of transport-related infection.

As the first stage of our research project, we are going to propose a specific multi-patch model with a simple epidemic dynamics 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 interact to each other. The focus of our analysis about our model will be on the contribution of city structure to the likelihood of the epidemic outbreak, so that we will try to discuss the city design to make the likelihood smaller, that is, to have its higher resistance to the epidemic outbreak.

In this colloquium, after presenting our idea of mathematical modeling concerning to this problem, we will show some results of the preliminary analysis on a simple model, and would like to discuss them with a view to improve this project.



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