

# **A Spatial-Temporal Model for Identifying Dynamic Patterns of Epidemic Diffusion**

Tzai-Hung Wen, PhD

Associate Professor, Department of Geography, National Taiwan University

Most of the space-time analyses were developed to detect space-time clusters from an epidemic outbreak. However, these methods failed to detect the dynamic behaviors of the diffusion process. Our objective is to propose an analytical procedure to track the dynamics of space-time clusters from a contagious diffusion process. We used locations and illness onset time of dengue fever cases as a case study to demonstrate the framework of analytical procedure. For each pair of cases who are close in time and space, we defined them as clustering and infection pairs based on their space-time distance. We assigned a probability of infection to each infection pair, and developed an index called 'Common Origin Probability (COP)' for determining the 'origin' of an epidemic which could be the individuals or locations that infected others, and the index measured the probability that two nodes infected by the same origin. We tracked their temporal progression based on the probability of infection, and identify different dynamic behaviors. Areas displaying splitting and merging behaviors represent different risk patterns. The former represents places with dangerous and high-risk environment, and the latter represents vulnerable places surrounded by high-risk environments. Identifying dynamic behaviors of sub-clusters can provide spatial and temporal insights into epidemic progression of disease clustering.

Keywords: space-time analyses, dynamic behavior of disease clustering, spatial epidemiology, diffusion process.