

Comparative Space-Time Dynamics of Idea Diffusion

Xinyue Ye, Ph.D. Assistant Professor

Center for Regional Development & School of Earth, Environment and Society
Bowling Green State University, Bowling Green, OH 43403 Email: xye@bgsu.edu

Being a participant of the specialist meeting “Mapping Ideas: Discovering and Information Landscape”, I would like to address the following research question in the workshop (<http://mappingideas.sdsu.edu/events.html>): how to quantify and map space-time changes of idea diffusion? By definition, “quantify” means computation, while “map” indicates visualization. In addition, “change” suggests the “dynamics” of idea diffusion over space and across time. Furthermore, it is valuable to compare the pattern and trend of such dissemination in different contexts, since comparison lies at the heart of human behavior and reasoning. Comparative analysis is a method to observe and interpret both virtual and physical spaces. Hence, the focus of my position paper is about comparatively visualizing and computing idea propagation in the dynamic space-time framework.

As an economic geographer and geographic information scientist, my research addresses questions in economic inequality and its dynamics across multi scales and various dimensions (statistical, spatial, and temporal) through the design and implementation of new visualization and analytical methods. I focus mainly on the geographical and temporal characteristics of socioeconomic activities in a comparative environment, and the development of open source toolbox to facilitate the dialogue between scholars and policy-makers (Rey and Ye 2010; Xie and Ye 2007; Ye, 2010a; Ye and Wu, 2011). The above efforts have been funded (or partially supported) by National Science Foundation Doctoral Dissertation Improvement Grant (2008-2009), Department of Commerce (2009-2012), Department of Energy (2011-2012), China Natural Science Foundation (2011-2012), and Faculty Research Committee Faculty Mentoring and Enrichment Award at Bowling Green State University (2011-2012). With the support, I have been developing an open source package C.A.R.E.: Communities At Risk under Economic downturn. C.A.R.E. is designed as an integrated package which focuses on event series (such as chained unemployment), flow (such as journey-to-work), dynamic network (such as changing social network in industry cluster), and government documents on the Internet (such as warn notices) (Ye 2010b; Ye and Carroll 2011a; Ye and Carroll 2011b).

With the dramatic improvement in computer technology and the increase in volumes of geographically referenced socioeconomic data, the importance of geographical space to many socioeconomic processes has been gaining a growing recognition. At the same time, short- and long-term impacts of idea diffusion and peer effects through the cyber space begin to attract enormous attention from various disciplines. For example, research on adolescent substance use has consistently identified a strong relationship between adolescent behavior and the behavior of peers. Peers are those staying close in the cyber space (such as friends on facebook) and/or geographical space (such as those in the same school or neighborhood). As such, the booming cyber activities greatly influence the space-time dynamics in the geographical space through an uneven and ever-changing manner, and vice versa. Hence, the mutual interaction between these two spaces (virtual/cyber space and geographical/physical space) can be better understood through mapping idea flow across scales and dimensions.

The most crucial step is to systematically understand such information flows before testing hypothesis of idea diffusion. However, the definitions of the unit of analysis and the unit of observation should be distinguished before the structure of space-time diffusion data set can be organized and characterized. The unit of analysis is the major entity that is being analyzed in the research, while the unit of observation is the basic entity that the data is reported upon. The unit of

analysis is the “what” that is being studied, which is designed by the researcher. Nevertheless, the unit of observation is decided by the way how the data set was collected, which cannot be fully controlled by the researcher. The various formats of ideas and their spreading styles are the unit of observation, while unit of analysis involves the issues of scales and aggregation of these data, which are vital on mapping and quantifying space-time change of idea diffusion. Various spatial partition schemes (virtual space and geographical space) generate different types of unit of analysis, which in turn lead to different perspectives of looking at the same data. Hence, it is valuable to consider all possible spatial perspectives while designing research questions, as well as all possible temporal configurations (Ye 2010). In addition, the dimensions of space (where), time (when), and attributes (how) should be treated as the context in which an idea flow is observed, instead of specifying a single space and/or time as the context. Furthermore, it is essential to recognize the issue of scales. Four scales can be taken into consideration: global, meso, local, and individual. For example, “the individual scale” signifies where, when and how an idea was initiated; “the local scale” explores how follow-up events respond to a focal idea; “the meso scale” studies a group of idea diffusions which shares similar feature(s) in spatial, temporal or statistical dimensions; “the global scale” examines the distributions of all the dispersions regarding regions (where), times (when), or attributes (how).

New geometric measures can be developed to characterize the dimensions and scales of idea diffusion. Comparative analysis can then be carried out on a probability base to check whether idea dispersions are significantly different (or have striking similarity) regarding those new indicators in the following scenarios: same ideas in different geographical spaces (scales); same ideas in same geographical spaces (scales); different ideas in same geographical spaces (scales); and different ideas in different geographical spaces (scales). A framework can thus be identified to address the research question highlighted in the first paragraph: (a) an emphasis on the knowledge discovery in a multi-scale and multi-dimensional virtual and real worlds; (b) a recognition of the need to develop and implement novel space-time analytical methods for dynamically visualizing and exploring the complexities of idea dispersion and (c) a concern for the social, political and policy outcomes of cyber activities in the context of globalization.

References

- Rey, S. and X. Ye. (2010) “Comparative Spatial Dynamics of Regional Systems.” In A. P’aez, J. Le Gallo, R. Buliung, and S. Dall’Erba (eds.) *Progress in Spatial Analysis: Theory, Computation, and Thematic Applications*. Springer.
- Ye, X. and M. Carroll. (2011a) “Exploratory Space-Time Analysis of Local Economic Development” *Applied Geography*. 31: 1049-1058.
- Ye, X. and M. Carroll. (2011b) “Warn Notice Toolbox: Open-Source Geovisualization of Large Lay-off Events”, *Proceedings of GeoInformatics 2011 (IEEE GRSS)*.
- Ye, X. and L. Wu. (2011) “Analyzing the Dynamics of Homicide Patterns in Chicago: ESDA and Spatial Panel Approaches” *Applied Geography*. 31: 800-807.
- Ye, X. (2010a) “Comparative space time dynamics,” Ph.D. thesis, University of California-Santa Barbara and San Diego State University.
- Ye, X. (2010b) “Identifying Communities at Risk: Space-Time Data Analysis and Toolbox Implementation,” Funded proposal, Faculty Research Committee Faculty Mentoring and Enrichment Award, Bowling Green State University.
- Xie, Y. and X. Ye. (2007) “Comparative Tempo-Spatial Pattern Analysis: CTSPA.” *International Journal of Geographical Information Science*. 21:49-69.