

Mapping the Spatial Diffusion of Innovations and the Distortion Effects of Social Media in Cyberspace

Tsou Ming-Hsiang, Department of Geography, San Diego State University,

Email: mtsou@mail.sdsu.edu

Cyberspace (including web pages, social media, and online communities) is a powerful platform for collective social communications, personal networking, and idea exchange. Scientists now can trace, monitor, and analyze the spreads of radical social movements, protests, political campaigns, etc. via social media. These research efforts can help us understand the diffusion of innovations (Roger 1962), a dynamic process whereby new concepts, ideas, and technologies spread through our society via cyberspace and digital social networks over time.

This position paper will introduce a new research method, called the Spatial Web Automatic Reasoning and Mapping System (SWARMS) (<http://mappingideas.sdsu.edu>). SWARMS is designed to track spatial patterns of publically-accessible web pages and semi-private social media (such as Twitter or Facebook) based upon searching predefined clusters of keywords determined by domain experts. Web pages and tweets associated with the same keywords were converted into visualization maps using GIS analysis functions and geolocation methods.

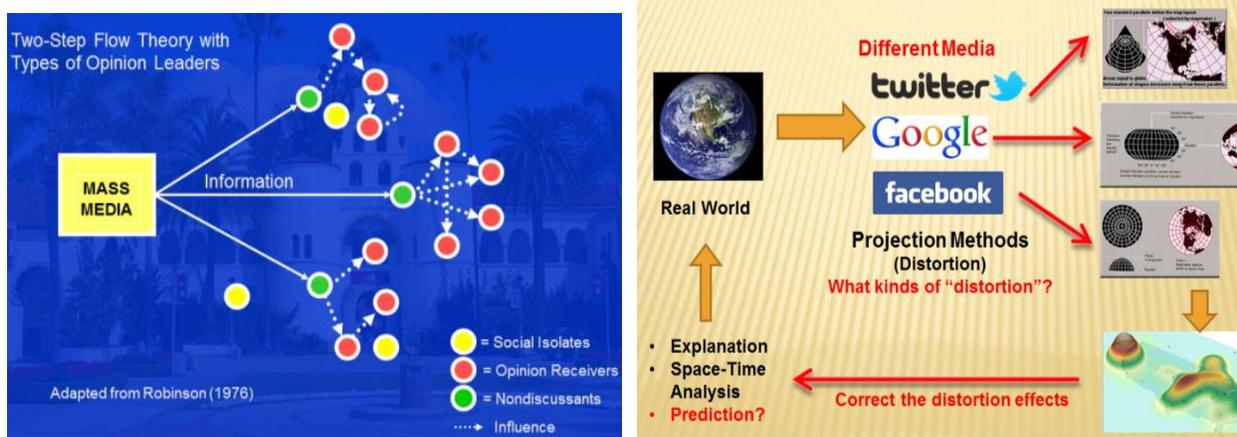


Figure 1. *The Two types of communication channels: public mass media vs. private networks (left) and the distortion effects of cyberspace maps by different media (right).*

Following the concepts of diffusion innovation by Roger (1962) and Hägerstrand (1967), the SWARMS prototype focuses on mapping two types of communication channels: public channels (mass media) and private channels (personal communication networks) (Figure 1) (Robinson 1976). In traditional communication research, the public channels are TVs, newspapers, radios, etc. The private channels are face-to-face conversations, local community meetings, personal letters, etc. In cyberspace, our SWARMS prototype utilized web search engines (Yahoo and Bing) to analyze the spread of similar web pages associated with keywords as semi-public

channels. Higher ranked web pages are more “public” to users. Lower ranked web pages are less public. On the other hand, we analyzed the spread of tweets associated with keywords by Twitter API as semi-private channels. Most tweets readers are the friends of Twitter users as “followers”. Occasionally, some celebrities may have over millions of followers and their tweets become more public than private messages. Figure 2 illustrates two types of communication channels (media) we collected in SWARMS. The top one is the web pages ranked by Yahoo search engines (representing the semi-public channels). The bottom one is the tweets collected by Twitter API and python scripts (representing the semi-private channels).

a) Web page search results (by Yahoo Engine with keyword “Digital Earth”.

| | A | B | C | D | E | F | G | H |
|---|------|---------------|----------------|-------------|--------------------------------------|---|----------|-----------|
| 1 | Rank | Search Engine | Keyword | Search Date | URL | Title | Latitude | Longitude |
| 2 | 1 | Bing | Digital Earth™ | 4/25/2012 | http://digitalglobe.com/ | DigitalGlobe - Satellite Imagery and | 40.1718 | -105.1052 |
| 3 | 2 | Bing | Digital Earth™ | 4/25/2012 | http://www.digital-earth.com/ | Digital Earth | 40.0548 | -75.4083 |
| 4 | 3 | Bing | Digital Earth™ | 4/25/2012 | http://en.wikipedia.org/wiki/Digital | Digital Earth - Wikipedia, the free e | 38 | -97 |
| 5 | 4 | Bing | Digital Earth™ | 4/25/2012 | http://www.ai.sri.com/digitalearth/ | Digital Earth - Artificial Intelligence | 37.459 | -122.1781 |
| 6 | 5 | Bing | Digital Earth™ | 4/25/2012 | http://www.digitalearth.com.au/ | Digital Earth Weblog | 38 | -97 |
| 7 | 6 | Bing | Digital Earth™ | 4/25/2012 | http://digitalearthmusic.com/home | Digital Earth | 54 | -2 |
| 8 | 7 | Bing | Digital Earth™ | 4/25/2012 | http://digitalearthnetwork.com/ | ONE FIRST IMPRESSION | 29.4889 | -98.3987 |
| 9 | 8 | Bing | Digital Earth™ | 4/25/2012 | http://www.digitalearth.nl/ | Digital Earth B.V. - Intelligent Autor | 37.4192 | -122.0574 |

b) Tweets search results (by Twitter API with keyword “Mitt Romney”.

| 1 | text | from_user_name | to_user | location | from_user | created_at |
|------|--|---------------------|-------------|-------------|----------------|---------------------------|
| 1086 | Romney Making a Big Push Days Before Iowa Caucus: Republican Presidential | FOX 42 News (KPTM) | | Omaha, NE | fox42news | Mon, 02 Jan 2012 02:48:08 |
| 1087 | @LarrySabato Will Newt or Santorum bring up Bain Capital against Romney sir | Kevin Olson | LarrySabato | Iowa | baseballPOL | Mon, 02 Jan 2012 02:34:09 |
| 1088 | 21 voicemails from Mitt Romney. #st0p | Erin Swartzendruber | | loooowwaaa! | erin_swartze | Mon, 02 Jan 2012 02:27:27 |
| 1089 | A closed-down Blockbuster on Ingersoll. That's Mitt Romney's campaign HQ. B | Marc Hogan | | Des Moines | DesNoise | Mon, 02 Jan 2012 01:53:31 |
| 1090 | RT @HawkeyeJosh: Mitt Romney just makes my skin crawl. #phony #corporatelehi | | | Iowa | lehimesa | Mon, 02 Jan 2012 00:46:34 |
| 1091 | Mitt Romney just makes my skin crawl. #phony #corporateshill #hatemittromne | Josh | | Iowa | HawkeyeJosh | Mon, 02 Jan 2012 00:34:21 |
| 1092 | Five-plus Occupy protesters at Mitt Romney's headquarters on Ingersoll. They t | Nicole R. Paseka | | Iowa | npaseka | Mon, 02 Jan 2012 00:13:30 |
| 1093 | Mitt Romney thinks "it could be worse" is same as "let them eat cake". Trying to | LindaMcSchuler | | USA, Iowa | LindaMcSchuler | Mon, 02 Jan 2012 00:12:06 |
| 1094 | About five protesters at Mitt Romney headquarters #occupy #occupycaucus http: | Nicole R. Paseka | | Iowa | npaseka | Mon, 02 Jan 2012 00:12:04 |

Figure 2. Two types of communication channels (media) collected by SWARMS.

Our preliminary analysis indicates that there is a strong spatial correlation between cyberspace communications/messages and the real world events (such as flu outbreaks and the 2012 U.S. Republican Presidential Primaries). However, the cyberspace maps created by SWARMS are somehow “distorted” from the reality via different media. For example, in our U.S. Republican Presidential Primary analysis, Ron Paul has great support from younger adults and he always has much higher popularity in our tweet datasets comparing to the actual election results. But the other three candidates’ tweet popularities are very similar to their final election results. One possible explanation is that when people use different types of media (channels) to communicate, different media may have unique “projection methods” to represent the spatial distribution of innovations and communication messages in the real world. Therefore, our cyberspace maps may inherit some “distortion effects” made by different media and their different projection methods (Figure 1, right side). If we can figure out what types of “projection methods” used in these media (such as Twitter, Weblogs, and Facebook), we may be able to correct these distortions and to explain the diffusion of innovation more effectively.

Reference:

Hägerstrand, T. (1967) Innovation Diffusion as a Spatial Process. The University of Chicago Press.
 Robinson, J. (1976), “Interpersonal Influence in Election Campaigns: Two-Step Flow Hypotheses”, *The Public Opinion Quarterly*, 40, 304–319.
 Rogers, E. M. (1962). Diffusion of Innovations. Glencoe: Free Press.