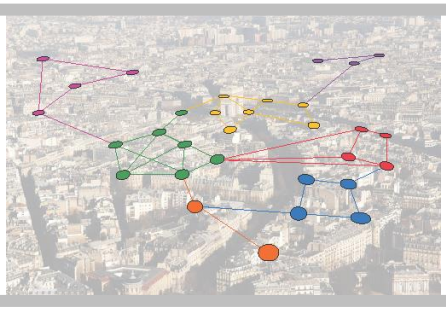


Training school in Gavle, Sweden June 13th- 17th 2016:

Topological and Scaling Ways of Thinking for Social Networks and Travel Behavior

Summary by Prof. Bin Jiang

Current geospatial analysis is highly constrained, consciously or subconsciously, by Euclidean geometry and Gaussian statistics in the sense of geometric details such as locations, directions, and sizes, and these geometric details are with a well-defined mean and small variance. These two ways of thinking – Euclidean geometric and Gaussian statistical – suffer from some major disadvantages that prevent us from developing new insights into the underlying complexity of geographic phenomena, e.g., social networks and travel behavior. On the other hand, topology without geometric details, fractal geometry, which is under the third definition of fractal: *a set or pattern is fractal if the scaling of far more small things than larges recurs multiple times or with the ht-index being at least three* (Jiang and Yin 2014), and power law statistics represent new perspectives for geospatial analysis, particularly in the era of big data, for better understanding social networks and travel behavior.

Given the circumstances, we organized the summer school on alternative geospatial analysis methods surrounding topological and scaling ways of thinking. These methods include for example head/tail breaks (Jiang 2013), ht-index (Jiang and Yin 2014), topological analysis (Jiang and Claramunt 2004), complex networks, and agent-based simulations in various applications of pedestrian modeling and human evacuation. The summer school was further motivated by the emerging big data harvested from the Internet and social media such as OpenStreetMap, Flickr, Twitter, and Brightkite, which provide a new instrument for transport research and human mobility (Jiang and Miao 2015). Big data differs fundamentally from small data in terms of basic data characteristics such as accurately measured or roughly estimated, individual-based or aggregated, and massive or small amounts. Big data also differs fundamentally from small data in terms of the data analytics that surround these two ways of thinking, geometrically and statistically.

The summer school was combined with lectures, hands-on exercises, discussions, and projects. We provided related data obtained from OpenStreetMap, Twitter, Brightkite, and Gowalla for the hands-on parts. We offered a brainstorm session that had led to some joint publications among the participants. Over 20 young researchers (PhD

students and postdoc researchers) and three senior instructors have one-week intensive discussions and exchanges during the five-day summer school.

For more details about the summer school, one can refer to this site: http://www.tu1305.eu/content/training-school

Organizer:

Bin Jiang, PhD and Professor
Faculty of Engineering and Sustainable Development, Division of GIScience
University of Gävle, SE-801 76 Gävle, Sweden. bin.jiang@hig.se

Trainers:

- Prof. Bin Jiang, University of Gävle, Sweden
- Dr. Marija Mitrovic Dankulov, University of Belgrade, Serbia
- Prof. Toshi Osaragi, Tokyo Institute of Technology, Japan
- Prof. Itzhak Omer, Tel Aviv University, Israel

Trainees:

Name	Country	Status	Institute	Research field
Joris Becker	Belgium	PhD student	University of Antwerpen	Geography
Gaëtan Montero	Belgium	PhD candidate	Université Catholique de Louvain	Geography
David Kocich	Czech Republic	PhD student	Institute of Geoinformatics, VSB - Technical University of Ostrava	Geoinformatics (physical geography)
Xiaoyan XIE	France	post doc	LVMT (Laboratoire Ville Mobilité Transport) École Nationale des Ponts et Chaussées (ENPC)	PT (modelling, simulation, evaluation); Trafic flow theory; Urban mobility
Jakub Krukar	Germany	post doc	University of Munster	Geo-informatic (Psychology & architecture)
Kornilia Maria Kotoula	Greece	PhD candidate	Centre for Research and Technology/Hellenic Institute of Transport (CERTH/HIT)	Transport research

Name	Country	Status	Institute	Research field
Dalit Shach Pinsly	Israel	Dr. (MC member)	Technion	Architecture + Urban Planning
Yoav Lerman	Israel	Dr.	Ben Gurion University	Geography (mba, computer sci)
Yuval Rubinstein	Israel	M.Sc. student	Technion	Architecture + Urban Planning
Nir Kaplan	Israel	PhD student	Tel Aviv University	Geography and urban planning
Karim Keramat Jahromi	Italy	PhD student	Milano University	Computer science
Stefano Pensa	Italy	post doc (MC Sub)	Politecnico di Torino	Architecture / geoVisualisation / accessibility of public spaces
Daniele Oxoli	Italy	PhD student	Dept. of Civil and Environmental Engineering, Politecnico di Milano, Como Campus	Geomatics // analysis and manipulation of geospatial data
Odette Lewis	Malta	Dr (2013) MC member	University of Malta	Transport engineering, decision making policy
Luis Fernando Santa	Portugal	PhD student	Universidade Nova de Lisboa	Geomatics
Francisco Pedro Luque	Spain	Researcher	CeDInt-UPM (Center of energy efficiency), Madrid	Telecomunications Engineering (M.Sc) Virtual Reality
Maria del Mar Alonso	Spain	Dr. (2007) (MC S member)	Autonomous University of Madrid	Economics and Business Administration, Tourism
Anastasios Koutoulas	Sweden	PhD candidate	KTH Royal Institute of Technologyת Stokholm, Sweden	Transportation engineering
Ding Ma	Sweden	PhD student	University of Gävle	Geospatial Information Science
Leonard Nilsson	Sweden	PhD student	Chalmers University of Technology	Architecture, Software development, GIS

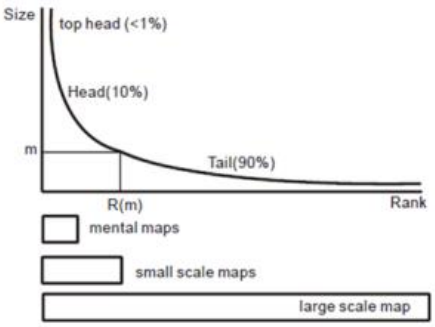
Training school summary

Presentation in London Meeting 10.11.16 by Arch. Yuval Rubinstein, Israel.

2 ways of thinking: Topology and scaling Paradigms | Fractal Theory

Head/tail division rule

Given a variable X, if its values x follow a heavy tailed distribution, then the mean (m) of the values can divide all the values into two parts: a high percentage in the tail, and a low percentage in the head.



Scale free; Average free; Differentiation;

Adaptation: Geometric, Topological, Semantic

2 ways of thinking: Topology and scaling Paradigms | Fractal Theory

Conclusion

- We need to shift our paradigm from geometric to topological, from the Gaussian thinking to something, which is "more normal than normal".
- The paradigm shift is a de fact shift from Newton's physics metaphor to a biological metaphor, focusing on the individual interactions from the bottom up.
- We need to shift our paradigm from computational science (since the invention of computers) to data-intensive computing (since the 21st century), in order to uncover the underlying forms and processes geographic space and society.

Linked to the COST Action

The duality of social networks

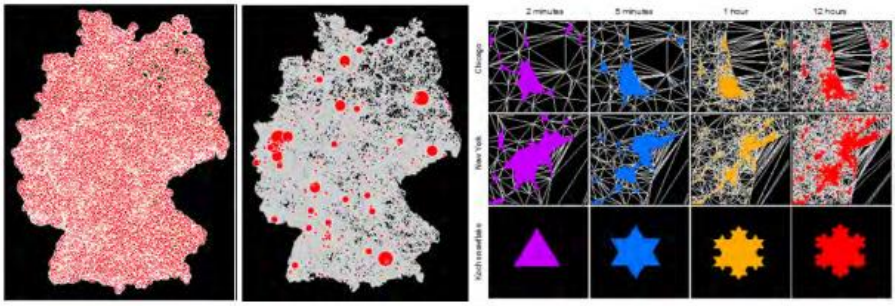
- A new method of analysis – a complex network approach to complexity of society, e.g., small world, scale free, community detection, hierarchy
- A new way of data collection – location based social media, e.g., Flickr, Twitter, and Brightkite

In terms of collective traffic flow, there is no much difference between human beings and random walkers.

Fractals or living structures emerged from big data; "Natural Cities" Lab

The notion of natural cities

Natural cities refer to objectively or naturally defined and delineated human settlements, or surface, human activities in general on the Earth's using massive geographic information of various kinds, and based on head/tail breaks.



Gaussian distribution | Head/Tail breaks | Natural cities from Tweets location data

Space Syntax Modeling and Urban Morphology

Space syntax principles

- large-scale space is beyond human body perception, and cannot be perceived from a single viewpoint;
- small-scale space is presumably larger than the human body, but can be perceived from a single viewpoint.

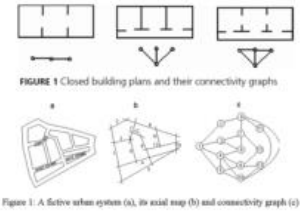
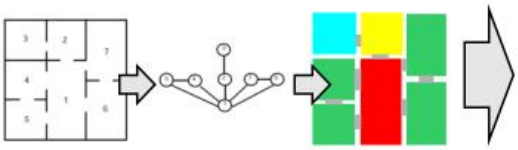
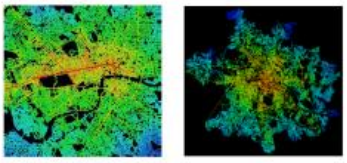


FIGURE 1 Closed building plans and their connectivity graphs

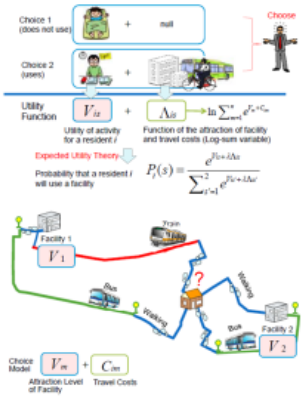
Figure 1: A fictive urban system (a), its axial map (b) and connectivity graph (c)





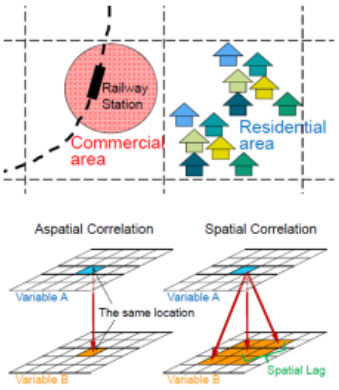
London | Berlin

Thoshihiro Osaragi: Choice Behavior Model; Spatial Correlation Analysis



Choice Behavior Model

Choice model = Attractiveness of facility + travel cost

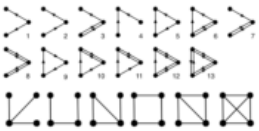


Spatial Correlation Analysis and its Extension to Road Network Spaces

Marija Mitrovic Dankulov: Complex networks theory: an introduction

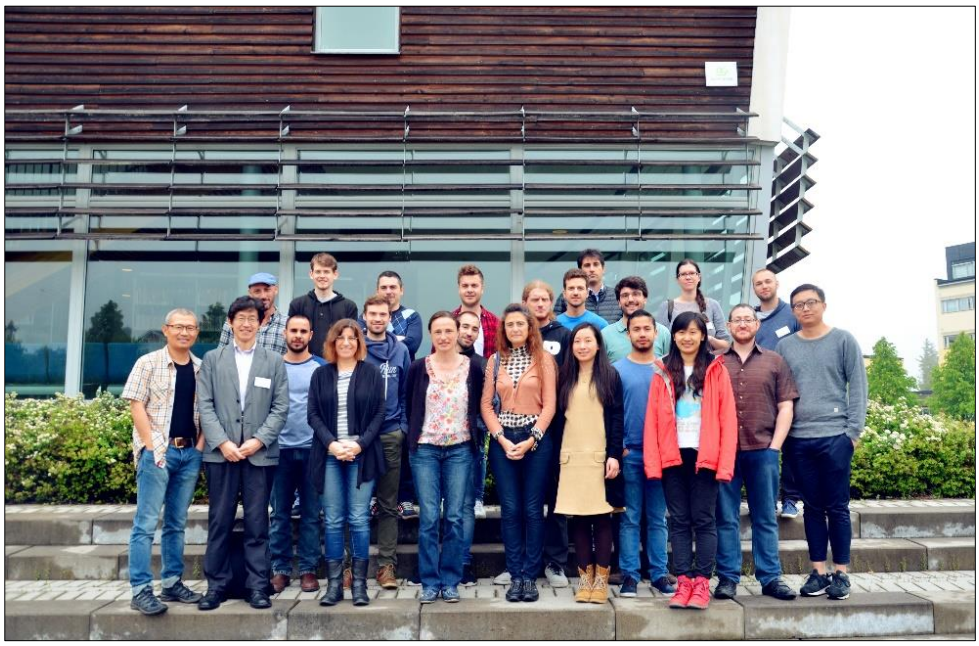
Complex systems

- Consists of large number of interacting components.
- Exhibits emergent, collective, behaviour which cannot be derived from behaviour of individual components.
- Self-organised behaviour.



Structure and dynamics of complex networks

- Structure influence network dynamics
- Dynamic influences network structure
- Understanding network structure => understanding dynamic of network/system




GAVLE 2016


What do I mean by scaling?
Scaling = far more small things than large ones, OR
Many many smallest, a very few largest, and some in between