AutoCarto 2022 Workshop

WS2- Living Structure as a Scientific Foundation of Maps and Mapping

Living structure is a physical phenomenon and mathematical structure that has two distinguishing properties: *"more or less similar things"* at each scale, and *"far more small things than large ones"* across all scales ranging from the smallest to the largest. These two notions underlie the two fundamental laws of living structure: Tobler's Law and the Scaling Law. The Earth's surface is essentially a living structure, in which these two notions recur at different levels of scale, e.g., at the global scale, at the continental scale, at the country scale, at the city scale, at the building's facade scale, and down to the ornament scale. In essence, it is these recurring living structures that make maps and mapping possible. Given the right perspective and scope, living structure can be pervasively seen in our surroundings: not only in nature, but also in the things we human beings make or build. In some situations, however, we are not able to see the kind of living structure, particularly if we are constrained by a certain perspective or scope. For example, a street network is not a living structure, when seen from the perspective of street segments or junctions. Instead, the street network is indeed a living structure if seen from the perspective of individual streets, because across all scales, there are *"far more short streets than long ones"* geometrically or *"far more less-connected streets than well-connected ones"* topologically, or *"far more meaningless streets than meaningful ones"* semantically, whereas at each scale, there are *"more or less similar"* streets. What underlies the phenomenon of living structure is the new *third view of space*: space is neither lifeless nor neutral, but a living structure capable of being more living or less living.

In this workshop, we will attempt to challenge the current paradigm of cartography or GIScience, by advocating a new mapping paradigm. We will use the two concepts – natural cities and natural streets – to demonstrate the ubiquity of living structure and Scaling Law, and further demonstrate the automatic generation of all small-scale databases from a single large-scale database. The generated databases are not only for discrete map scales, but also for any scale in between. Some hands-on work will be demonstrated with two tools: Axwoman and head/tail breaks.

Objectives:

- To advocate living structure as a new scientific foundation of maps and mapping
- To introduce two fundamental laws of geography: Scaling Law and Tobler's Law
- To discuss why objectivity is favored over subjectivity in map making

Tools to be used:

- Axwoman (http://giscience.hig.se/binjiang/axwoman/)
- Head/tail breaks (https://en.wikipedia.org/wiki/Head/tail_Breaks), and
- NaturalCitiesModel (http://www.arcgis.com/home/item.html?id=47b1d6fdd1984a6fae916af389cdc57d)

Keywords: Third view of space, Tobler's Law, Scaling Law, head/tail breaks, big data

References:

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Jiang B. (2015), Geospatial analysis requires a different way of thinking: The problem of spatial heterogeneity, *GeoJournal*, 80(1), 1–13.
Jiang B. (2019), *Axwoman in a Nutshell*, https://www.researchgate.net/publication/337656401_Axwoman_in_a_Nutshell
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Tobler W. (1970), A computer movie simulating urban growth in the Detroit region, *Economic geography*, 46(2), 234–240.

Sponsors:

- ICA Working Group on Digital Transformation (https://nationalmapping.icaci.org/)
- ICA Commission on Geospatial Analysis and Modeling (https://gam.icaci.org/)
- International Society for Urban Informatics (ISUI) (http://www.isocui.org/)
- IGU Commission on Modeling Geographical Systems (http://www.igu-geomodeling.com)

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Delivery mode: Hybrid (in person and virtual)

Length of workshop: 3 hrs

Computers: Participants need to bring their own laptop

Software (if laptops will be used): no special software is required

Links to related web page:

- http://giscience.hig.se/binjiang/axwoman/
- https://en.wikipedia.org/wiki/Head/tail_breaks