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**MORPHOLOGY OF STREET NETWORKS IN URBAN NEIGHBORHOODS IN GHANA**

**Introduction**

Street networks form the vessels through which the lifeblood of human settlements (people, services, goods, and information) flow. They underlie commutes, discretionary trips, and the location decisions of households and firms (Boeing, 2018a). More importantly, they help shape the urban structure and shape the way human interactions happen in space.

Understanding the composition, configuration, and decisions underlying the way urban neighborhoods and cities are shaped helps shape future planning decisions and provides an avenue to scrutinize and better evaluate the effects of urban transportation planning efforts in Ghanaian cities and urban neighborhoods.

This study seeks to take the computational network and data science approach to examine the structural configuration of street networks in urban neighborhoods in Ghana, concentrating on the two neighborhoods of the most developed and populated cities in Ghana. Accra and Kumasi are selected as the study areas because they possess fine-grained road networks comparable to cities on a global scale based on intersections and street densities (Dumedah & Garsonu, 2021)

**Problem Statement**

Rapid urbanization and its associated pressures on street networks and urban form have been widely studied and reported in Ghana. Coupled with the ad hoc approach to transportation planning that usually involves the expanding of street networks in cities to accommodate the increasing traffic with limited consideration for spatial configurations of street networks (Dumedah & Garsonu, 2021) the problem is becoming harder to ignore.

Even though there exists very little literature studying urban street networks in Ghana, many studies have been emerging all over the world studying topological relations, connectedness, and resilience of street networks (Boeing, 2018a, 2018b; Zhao et al., 2019), using empirical methods that are open and reproducible and can be taken advantage of by urban planners, researchers, and pedagogy to better understand street networks and how they affect and shape human interactions and settlement decisions.

The lack of reproducible and open methods for street network analysis in Ghana makes it harder to understand how transportation and all urban planning, in general, is carried out. There exist few empirical studies on urban networks making it harder to break into the field, especially for interested undergraduate students. Adopting a computational science approach to analyzing and understanding urban networks coupled with open data and tools gives students at all levels the opportunity to take advantage and to study and produce research that seeks to understand urban street network form.

**Research Questions**

1. Which source can be used to get replicable and accurate data on street networks in Ghana?
2. Which relevant tools can be used to accumulate data, model, and visualize data to be able to tease out the metrics that help understand urban street networks.
3. How relevant are the measured metrics to understanding the form and structure of street networks in urban neighborhoods?
4. How can we effectively and sustainably operationalize the open and reproducible computational science approach to studying urban street networks and incorporate it into transportation planning and urban planning to achieve desired results?

**Research Objectives**

1. This research aims to seek out reproducible and open ways for securing and analyzing street network data.
2. The research aims to take a modern computational data science approach by the use of portable computational notebooks to create replicable and verifiable analyses and comparisons of street networks across the study areas.
3. The study aims to employ a graph theoretic approach to analyzing street networks using the OSMnx and NetworkX (Boeing, 2017, 2019).
4. This study aims to assess the relevance of the approach to be used in this research in pedagogy, research and practice.

**Methodology**

The study area comprises 4 urban neighborhoods from two of the most urban cities in Ghana, Accra, and Kumasi. The density, topological and geometric differences across these neighborhoods are contrasted with each other and occasionally with others on a global scale.

The data for the study is downloaded from OpenStreetMap, an open and collaborative project that provides spatial data for almost all places in the world. The credibility of data from this open repository is debatable but it has been used in major research works in urban informatics over the years (Boeing, 2017, 2020, 2021; Dumedah & Garsonu, 2021)

This study also makes heavy use of GIS tools; QGIS, the Python programming language, and the Jupyter Lab computation notebook for downloading, aggregating, analyzing, and visualizing open and freely available spatial data.

**Conclusion**

The world is changing rapidly and technology has opened up new avenues for people in research, and pedagogy to understand our environments and our relations in space better. Using these new approaches in urban informatics it is possible to simulate future changes before rolling them out into physical space for human interaction. Street networks form the substrate for all human dynamics in space and understanding how their effects on human interaction will help to make better decisions in city and neighborhood planning.

The importance of research seeking to understand street network form and morphology cannot be overstated in public health where researchers are showing the strong correlation between health and walkability and bike-ability of neighborhoods (Marshall et al., 2014), and in disaster management where understanding street network structure and form is helping plan better incident response (Zamanifar & Hartmann, 2021).

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