Multifractal urban morphology of historic city centers and of typical metropolitan areas in Greece

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The morphology of urban environment, as defined by street layout, is highly heterogeneous. A city may comprise a historic center with small intersecting boulevards, areas with contemporal regular street patterns and even amorphous sprawling urban neighborhoods at the outskirts. Such heterogeneity gives rise to diverse aspects of social, economic and commercial activity in different areas that couple to the morphological characteristics of urban patterns. Our work investigates perspectives of such coupling.

The method we follow for the characterization of the urban morphology focuses on multifractal analysis, using Space Syntax tools on ArcGIS environment. In particular, we obtain Rényi spectra of generalized fractal dimensions for typical city districts, of area as small as $\approx 1\ km^2$. It appears that a single fractal dimension may not suffice to describe the street configuration, even in such relatively restricted region. Our results do not drastically vary when we analyze axial maps generated from the city street network compared to analysis of the original street network itself.

Two types of neighborhoods are considered: First, historic city centers (e.g. in Athens, Rhodes) with irregular morphology that reflects a century-long development, under diverse economic conditions and state administrations; second, contemporary districts, either residential or commercial, with more regular morphology. We find that the first type of areas exhibits multifractal behavior, while the second type is more similar to a monofractal description. Our analysis confirms the potential of the multifractal approach, as our results are consistent with examined cases in Spain (Ref. 1), albeit with a wider range of fractal dimension spectra.

Finally, we consider how the fractal dimensionality projects on the social activity and the technical infrastructure networks in the corresponding areas (e.g. transportation and telecommunication networks), by correlating their network metrics to the urban morphology.

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