

PhD in ARCHITECTURE. HISTORY AND DESIGN

Research Title: ALGORITHMS OF URBAN MORPHOLOGIES Urban form and building types from Nolli map to machine learning, via Space Syntax

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Contact	https://full.polito.it/research/
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Context of the research activity	<p>The PhD research proposal is part of a network between FULL, DASP PhD Program, “Transitional Morphologies” Joint Research Unit and ISUF.</p> <p>The PhD Program “Architecture. History and Project” (DASP) at Politecnico di Torino has been recognized by the Italian national evaluation council ANVUR, for the 37th cycle (2021-2024), as INNOVATIVE in its international, interdisciplinary and (for the first time) inter-collaborative approaches.</p> <p>The new recognition for inter-collaborative approach is due to the link with some development enterprises and research centers. Among them, FULL (the Future Urban Legacy Lab), hosts and tutors some DASP PhD Candidates each year since 2018.</p> <p>To the “Transitional Morphology” Joint Research Unit, established in 2018 between Politecnico di Torino and Southeast University Nanjing, are connected around 10 DASP PhD dissertation (some already discussed, some others on going). TransMo JRU is operative in the framework of ISUF (the International Seminar on Urban Forum), taking part in national (Italy and China) congresses and in international Conferences (the last one, online held at University of Strathclyde, Glasgow, from June 29th to July 2nd 2021 was devoted to “Urban Form and the Sustainable Prosperous City”).</p>
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The contents and the aims of the proposal arises (in the framework of DASP missions in researchers' education) from the comparison between the most updated discussion topics within urban morphologies' studies and the goals and expectations of FULL and TransMo JRU.

Objectives

The aim of the research proposal is exploring the possible transition from a figurative urban cartography (Nolli map, Muratorian map) to a mathematical description of urban ontologies, by going through (and over) the experience and the still unverified potentialities of Space Syntax practices and tools.

The main challenge stays in working on the conjecture that the typomorphological approach, because of its taxonomic nature and its 18th century rational cognitive foundation, could be described by a series of mathematical applications coming from different branches of the logic thought: topologies, morphometrics, cellular automata, fractals, neural networks.

The description of urban objects (not only streets' network, but above all urban fabric patterns and building types) using a mathematical language is the first step to adopt machine learning practices and to develop a "science of cities" that, even if not new, nowadays can be supported by a new availability of data and technologies (as Michael Batty, Centre for Advanced Spatial Analysis declared in 2018). Of course, the highlighting of possible frontiers of computational design within the urban design activities will also be part of the outcomes of the research.

In the analysis of the state of the art, the research will be the occasion to organize the two last decades of studies, spread amongst three main groups: one oriented towards inferential statistics rather than formal theory and models, one oriented towards mathematical models rather than empirical ones, one oriented towards the complexity paradigm-based approach (after having abandoned both statistical and mathematical theoretical modelling).

After the study of the state of the art, the verification/falsification in parallel of a series of approaches (on the same study cases) will constitute the second phase of the investigation.

The research will be discussed together with Lamberto Rondoni (Full Professor of Mathematical Physics at Politecnico di Torino, Department of Mathematical Science "Giuseppe Luigi Lagrange").

	A six months internship at Space Syntax Limited (London) will be organized in the framework of a possible co-tutorship by Tim Stonor (Managing Director of Space Syntax Ltd).
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Skills and competencies for the development of the activity	<p>Deep knowledge of the two references:</p> <p>Karl Kropf, <i>The Handbook of Urban Morphology</i>, Wiley, Chichester (UK) 2017</p> <p>Luca D’Acci (ed.), <i>The Mathematics of Urban Morphology</i> (foreword by Michael Batty), Birkhäuser/Springer nature, Basel 2019</p> <p>Michael Batty, <i>Cities and Complexity. Understanding Cities with Cellular Automata, Agent-Based Models, and Fractals</i>, MIT Press, Boston 2007</p>
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