ICCAUA Proceedings Journal
Proceedings of the international conference of contemporary affairs in architecture and urbanism-ICCAUA
Volume 9 (December 2026), 2610503

Journal homepage: https://journal.iccaua.com/

ICCAUA Proceedings Journal

DOI: https://doi.org/10.38027/ICCAUA2026EN0503

Fractal Morphology and Spatial Philosophy: Reconceptualizing Striated Spaces in Contemporary Urbanism

* [1] **Yanxi Zhou**
[1,] Department of Visual Cultures, Goldsmiths, University of London, London, UK
[1] E-mail: yzhou010@gold.ac.uk
[1] ORCID: https://orcid.org/0009-0000-7340-0556

Received: 21.04.2026
Revised: 21.06.2026
Accepted: 01.07.2026
Available online: 10.07.2026

This article has been selected and peer-reviewed for publication in this journal as part of the 9th International Conference of Contemporary Affairs in Architecture and Urbanism, held on 7–8 May 2026 in Istanbul, Türkiye.

Abstract

This study investigates the intersection of fractal geometry and the spatial philosophy of Gilles Deleuze and Félix Guattari to address sensory challenges in contemporary high-density urban environments. By bridging quantitative morphology and qualitative critique, the research operationalizes abstract philosophical concepts into measurable spatial attributes. Using a comparative case study, it examines the bottom-up generative fractals characteristic of Tokyo neighborhoods and contrasts them with the top-down pseudo-fractals of the Palm Jumeirah in Dubai. The methodology integrates the box-counting method (*D*), network branching ratios, and space syntax. Findings reveal that Tokyo's low branching ratio and high connectivity foster permeability, whereas Dubai's hierarchical, tree-like structure reflects centralized control. The paper proposes a "Fractal Politics" framework to interpret how spatial structures enable adaptive experiences or reinforce systemic control. Ultimately, this research provides an integrated methodological approach for interdisciplinary urban studies, demonstrating how spatial complexity supports urban resilience and multi-layered perception.
Keywords: Fractal Urbanism; Fractal Politics; Deleuze and Guattari; Space Syntax; Urban Morphology; Urban Resilience; Tokyo and Dubai.

1. Introduction

1.1 Complexity and Fractal Urban Systems

Accelerated globalization and capital mobility have pushed high-density urban environments toward a multi-scalar complexity that escapes traditional reductive analysis. For decades, Euclidean-based planning has treated the city as a closed, predictable, and homogeneous system. However, this linear framework is increasingly challenged by social scientists and complexity theorists who view the urban fabric as a dynamic and non-linear organism. Jane Jacobs (1961) argued this homogeneity, noting that vibrant cities are not patchworks of repetitious towns but systems sustained by localized character and economic diversity. Jacobs states urban health thrives on district specificity rather than standardized spatial units. Michael Batty and Paul Longley (1994) propose that cities operate according to fractal logic. They argue that urban growth is a recursive process exhibiting self-similarity across multiple scales, where the complexity of the global urban form emerges from local interactions. Batty (2007) further contends that urban development is fundamentally bottom-up process. The large-scale spatial order we observe is an emergent property of local self-organization rather than imposed design. The application of fractal principles in architecture and urbanism has evolved significantly over time. Historically, fractal aesthetics transitioned from symbolic ornamentation, such as the nested geometries found in Gothic cathedrals and Islamic architecture, to the organicism of Frank Lloyd Wright and the algorithmic expressionism of Greg Lynn. Yet, beyond aesthetics, contemporary urban challenges demand an investigation into the functional and political dimensions of these structures. As seen in the recursive layouts of the Ba-ila tribal villages in Zambia, fractal organization can provide a structural framework for communal resilience (Eglash, 1999). A critical distinction exists between morphological complexity and topological openness. In the era of the computational city, top-down planning frequently co-opts the recursive aesthetics of fractals to engineer a form of pseudo-complexity. Consequently, while an urban layout may appear visually intricate, its underlying network topology often remains hierarchical and restrictive, depriving the subject of cognitive affordances or the opportunity to navigate space spontaneously. When a city lacks recursive folds within its network, the subject' s movement is essentially reduced to a predictable and linear state of capture. This research interrogates the conditions under which fractal structures facilitate open-ended spatial agency versus those where they reinforce systemic enclosure.

1.2 Research Gap: Theory and Quantitative Metrics

Despite the utility of fractal urbanism, existing research suffers from two primary deficiencies that hinder a holistic understanding of the built environment. First, quantitative approaches centered on the box-counting method often reduce the fractal dimension (D) to a static indicator of morphological complexity. While these methods provide operable tools, they overlook the generative process and its subsequent impact on spatial utility. As contemporary superblocks evolve from defined architectural forms into what Wang (2025) describes as opaque spatial containers, they exacerbate a crisis of urban representation. Typically characterized by massive scale, internalized circulation, and a detachment from the surrounding street fabric, these superblocks prioritize programmatic density over morphological continuity. In these environments, large-scale morphologies often lack a coherent formal structure, struggling to achieve social recognition or symbolic legibility. This limitation stems from treating fractals as a predetermined geometric output rather than a dynamic process of becoming. Such a perspective ignores the essence of space as a power assemblage, which acts as an interface where morphology, capital, and subjective perception intersect to reshape behavioral patterns and affective rhythms at the micro-level. Second, philosophical critiques informed by Deleuze and Guattari (1987), while illuminating the power dynamics between striated and smooth spaces, often remain confined to abstract speculation. Lacking empirical correlation with specific morphologies, these theories are difficult to translate into verifiable design tools. Furthermore, under the prevailing smart city paradigm, planning relies excessively on linear efficiency driven by the principles of comfort, control, and commercialization. This way reduces complex spatial experiences to calculable flow vectors, ignoring the deep biological contributions of morphology to human well-being. Current neuro-urbanist findings suggest that fractal geometry acts as a physiological regulator, where specific dimensions (D $\approx$1.3-1.5) mitigate stress through fractal fluency, the innate human capacity to process recursive patterns with high efficiency (Taylor, 2006). Modern urban textures oscillate between sterile Euclidean grids and chaotic pseudo-fractals, creating a morphological sensory poverty that imposes excessive cognitive load. By overlooking non-linear fractals and the spatial details they generate across scales, current urban governance models strictly rigidify perceived environments. This mechanistic planning deprives pedestrians of spontaneous choices and ultimately undermines the psychological well-being of city dwellers. Hence, a disconnect remains between top-down macro-efficiency management and micro-level embodied perception. Current literature lacks a systematic framework that combines morphological metrics with spatial organizational logic to explain how fractal structures shape network connectivity and wayfinding behavior. This study seeks to bridge this gap by constructing an integrated analytical model that combines fractal parameters, network topology, and space syntax metrics.

1.3 Research Objectives and Questions

To address these gaps, this study conducts a comparative analysis of Tokyo and Dubai to examine the manifestations of fractal structures under divergent development models. Tokyo represents a typical bottom-up model characterized by high complexity and organic adaptability. In contrast, Palm Jumeirah in Dubai exemplifies an artificial, top-down form defined by rigid hierarchy and centralized control. By synthesizing fractal analysis with spatial structural tools, this research evaluates how these configurations influence connectivity, hierarchical organization, and path selection. This study provides an integrated analytical framework for understanding the role of fractal structures in urban space, offering theoretical and methodological insights for contemporary urban design.

The study is guided by three central research questions:

1. How do divergent development models (bottom-up vs. top-down) differentiate the morphological characteristics of urban fractal structures?
2. To what extent do fractal dimensions, network connectivity, and space syntax metrics correlate to reflect spatial hierarchy and navigation patterns?
3. How do variations in spatial permeability and path diversity across different fractal structures impact urban accessibility and modes of socio-spatial usage?

2. Materials and Methods

2.1 Spatial Philosophy and Fractal Morphology

Contemporary urban morphology often suffers from a structural disconnect between quantitative metrics and spatial theory. While fractals are active mechanisms of urban complexity, typical approaches frequently reduce the fractal dimension (D) to a static geometric attribute, neglecting its role in generative spatial organization. This study implements a theoretical-analytical integration approach to ope-rationalizes the spatial philosophy of Deleuze and Guattari into measurable variables. By adopting the concepts of smooth and striated space, the research uncover underlying power structures and organizational logic of the city. Smooth space represents an open, nomadic field defined by fluid transitions and generative autonomy, whereas striated space refers to a grid-like, hierarchical environment shaped by state-led regulation and controlled rigidity (Deleuze & Guattari, 1987). The relationship between the two is not a static binary but a continuous process of reciprocal transformation: deterritorialization and reterritorialization. In urban systems, deterritorialisation represents the loosening, dissolving, or subverting of rigid administrative grid lines, whereas reterritorialisation constitutes the mechanisms through which state-led governance or capitalist forces impose new codes and regulatory structures to recapture the urban fabric. Fractals serve as the essential morphological medium for these operations. Through the mechanism of micro-folding, generative fractal structures enact a perpetual deterritorialization of the striated urban grid. In the context of Tokyo's organic fabric, high-dimensional fractal complexity functions as a "war machine" that dissolves rigid, state-led boundaries into a series of holey spaces. These holey spaces allow the smooth to permeate the striated, creating liminal zones where top-down systemic order is subverted by bottom-up nomadic agency. Conversely, when fractal logic is co-opted into a fixed, singular scale, as seen in commercial pseudo-fractals, it becomes an instrument of reterritorialization, capturing the subject within a pre-encoded, striated hierarchy that reinforces centralized control. To move beyond abstract speculation, this methodology utilizes a cross-verification pathway that pairs the box-counting fractal dimension with Space Syntax metrics, specifically integration and choice. This dual-layer analysis observes fractals as dynamic spatial regulators modulating the urban system between the freedom of smooth space and the constraints of striated space. Drawing on the concept of assemblage, as developed by Deleuze and Guattari (1987), this study views the city as a dynamic constellation of heterogeneous parts rather than a static artifact. This perspective treats the urban fabric as a functional multiplicity characterized by the interplay of extensive and intensive properties. Extensive properties constitute the metric and divisible attributes of urban form, which are captured here through fractal dimension analysis to measure cross-scale variation and morphological complexity. The intensive properties represent the non-divisible, relational pressures and thresholds that govern the system's evolution. Space syntax metrics serve as an empirical proxy for these intensive forces, uncovering the movement potentials and power structures that modulate urban life. Translating these philosophical constructs into a rigorous indicator system allows the study to move beyond abstract speculation toward empirical evidence. Within this framework, generative capacity and spatial controllability cease to be merely theoretical; they become verifiable data points that map the transition from the fluid agency of smooth space to the rigid capture of striated space.

2.2 Conceptual Mapping and Indicator System

To operationalize the theoretical framework, this study constructs a three-tiered Concept–Morphology–Indicator system. mapping abstract spatial philosophy onto quantifiable urban metrics. As summarized in Table 1, the analytical system bifurcates urban logic into two distinct spatial modes:

- Generative (Smooth) Systems: These function as decentralized, distributed networks where high path redundancy and recursive growth foster an adaptive, resilient urban fabric. In this mode, multi-scale fractal stability and high cycle density facilitate spontaneous movement and spatial agency.

- Coded (Striated) Systems: Defined by hierarchical organization and centralized control, these systems employ line structures to reinforce systemic order. Here, path dependency and concentrated integration patterns serve to restrict navigation to predetermined vectors.

To quantify these structural differences, the methodology integrates the box-counting fractal dimension D with space syntax metrics, specifically connectivity, cycle density, choice, and integration. While the fractal dimension captures morphological complexity and scale in variance, the space syntax indicators reveal the underlying movement potentials and power structures inherent in the network.

Table 1: Theoretical–Morphological–Indicator Mapping Framework.

Theoretical Concept	Spatial Structural Feature	Observable Attribute	Corresponding Indicator
Smooth Space	Distributed Network	High Connectivity	Connectivity
	Path Redundancy	Multi-loop Structure	Cycle Density
	Recursive Generation	Cross-scale Stability	Stable D
	Decentralization	Uniform Accessibility	Integration (Low Concentration)
Striated Space	Centralized Structure	Hierarchical Control	Integration (High Concentration)
	Tree-like Network	Path Dependency	Choice (High)

2.3 Data Sources and Processing

To analyze spatial variations driven by differing generative mechanisms, this study compares segment of Shimokitazawa in Tokyo with a radial branch of the Palm Jumeirah in Dubai. Each case utilizes a 1.5 km² representative unit (Figure 1), a scale meticulously parameterized to balance localized grain with macro-structural consistency according to established morphological standards. For Shimokitazawa, the study area encompasses approximately two-thirds of the district's core urban fabric, specifically delimited to capture the highest density of its organic, non-linear street network. Data synchronicity is maintained through spatial layers compiled in the first quarter of 2025. Shimokitazawa embodies an evolutionary, bottom-up urban fabric, where historical accretion and localized interactions have produced a highly connected, polycentric configuration. This site serves as a manifestation of spontaneous growth, where local topological properties remain consistent even within a partial sample. In contrast, the Palm Jumeirah serves as a definitive case of top-down planned urbanism. Its structure derived from a singular master plan, follows a rigid tree-like topology in which a central axis bifurcates into a strictly hierarchical road system.

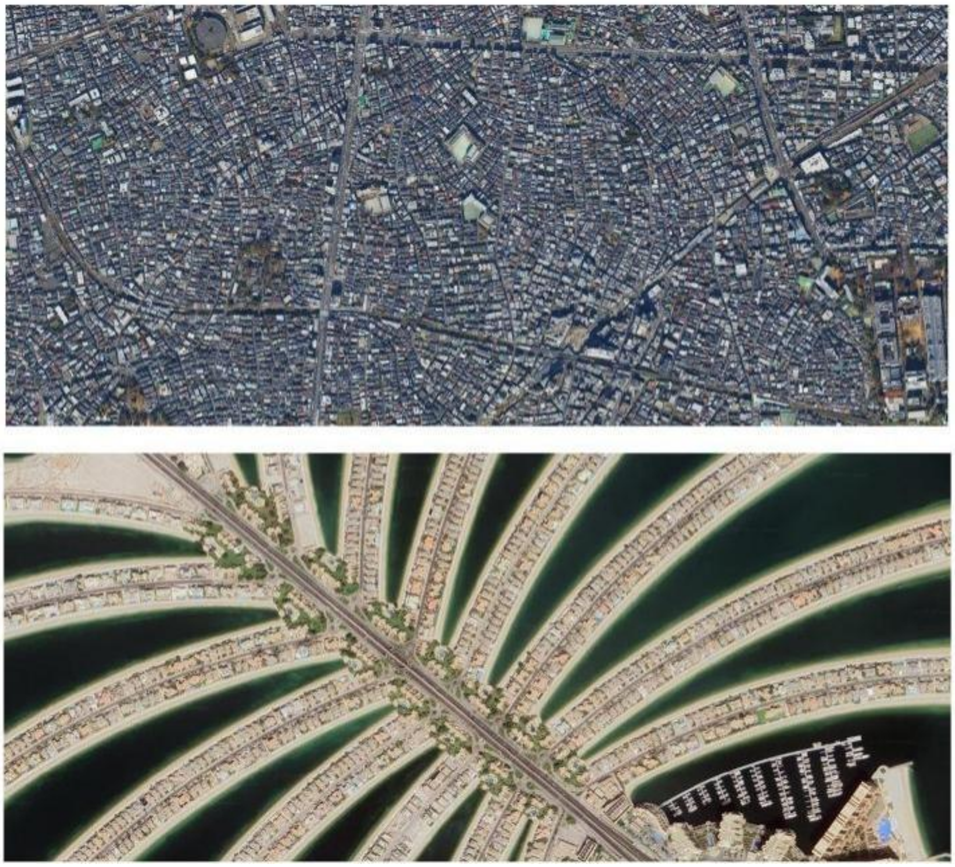

Figure 1. Selection of analytical units: (Top) High-density organic core of Shimokitazawa, Tokyo, reflecting a representative segment of its generative morphological logic; (Bottom) Radial branch of the Palm Jumeirah, Dubai, illustrating a hierarchical master-planned structure. (Source: Developed by the authors; baseline spatial datasets adapted from OpenStreetMap and Google Earth Pro, cross-verified per Haklay & Weber, 2008).

2.3.1 Data Sources

High-resolution geospatial and environmental vector data were retrieved from primary geographic information platforms. High-fidelity road network configurations were extracted from OpenStreetMap (OSM) via automated data-parsing protocols, while morphological boundaries and three-dimensional structural characteristics were cross-examined using historical and contemporary satellite imagery sourced from Google Earth Pro. These data layers provide rigorous spatial foundations validated under standard quantitative urban morphology frameworks (Gorelick et al., 2017; Haklay & Weber, 2008).

2.3.2 Processioning

To ensure structural comparability across the disparate urban contexts, the datasets underwent a standardized prepossessing workflow focused on morphological and topological extraction.

(1) Building Morphology Extraction (Figure–Ground Analysis)

A figure-ground binarization was performed on the satellite imagery, where building masses are encoded as “1” and open spaces as “0.” All data were resampled to a uniform resolution of 1 m/pixel to maintain spatial consistency. This process generated building morphology maps (see Figure 2) to facilitate the analysis of spatial infill structures. This step transforms the physical urban form into a computable spatial matrix, supporting subsequent quantitative analysis.

(2) Spatial Network Construction (Network Transformation)

The road systems were converted into node-edge network models, where intersections function as nodes and road segments as edges. To minimize analytical noise, a topological simplification removed redundant micro-nodes and non-essential edges (Figure 3). This preprocessing workflow ultimately yields a unified analytical dataset, a combination of binarized spatial matrices and standardized node-edge graphs, optimized for the subsequent computation of fractal dimensions (D), network connectivity, and space syntax metrics.

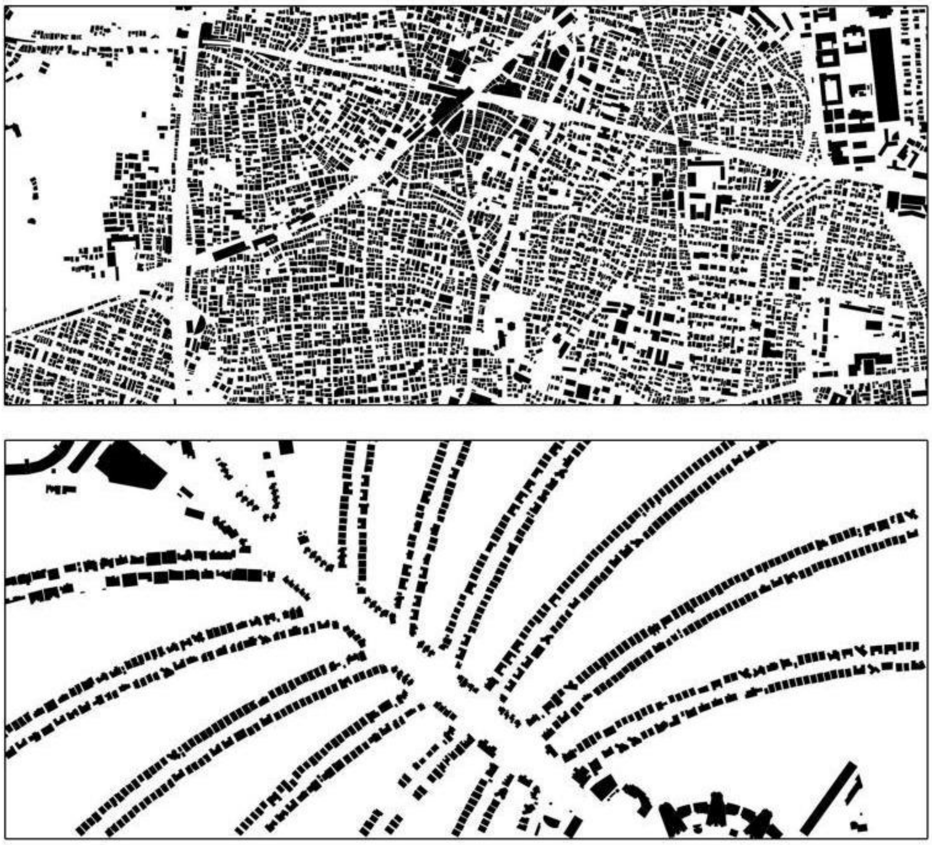

Figure 2. Comparative morphological binarization of the study areas. (Top) Shimokitazawa, Tokyo, exhibiting high-dimensional granular complexity and textural "folds" characteristic of organic accretion; (Bottom) Palm Jumeirah, Dubai, revealing a pre-encoded, tree-like branching structure and rigid hierarchical order. The binarized figure-ground maps highlight the distinction between generative connectivity and master-planned fragmentation. (Source: Developed by the authors).

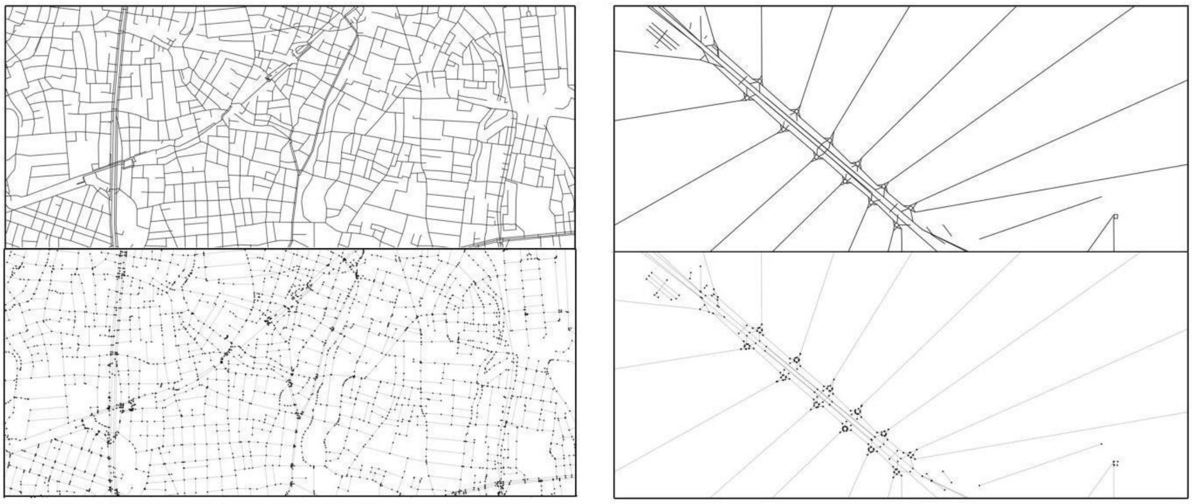

Figure 3. Comparative analysis of road layouts and node distributions. (Left) Shimokitazawa's distributed mesh structure, characterized by high path redundancy and decentralized connectivity; (Right) Palm Jumeirah's dendritic topology, where centralized nodes and singular paths enforce a predetermined, controlled navigation logic. The transition from a reticulated network to a tree-like hierarchy quantifies the shift from spatial openness to systemic enclosure. (Source: Developed by the authors).

2.4 Mixed-Methods Research Design

Following data processioning, this study employs three complementary methods to conduct a multi-level analysis of urban space. This approach cross-verification across morphological structure, network topology, and behavioral potential, ensuring consistency across analytical scales and enhancing the robustness of the empirical results.

2.4.1 Fractal Morphological Analysis

At the morphological level, this study utilizes the integrated box-counting algorithm in ImageJ (v1.54) to calculate the fractal dimension D of the standardized 2D figure-ground maps. The analysis targets the infill efficiency and textural folds of the urban plane, identifying the topological constraints that govern embodied path choices and accessibility.

Algorithmic Process and Calculation

The methodology utilizes a multi-scale grid-covering approach to recursively partition the binarized spatial matrix across a range of scales ϵ. The algorithm counts the number of effective boxes, $N(\epsilon)$, required to cover the building pixels. The fractal dimension D is then estimated as the slope of the linear regression of against $\log(1/\epsilon)$, defined by the formula:

$$D = \frac{log\ log\ N\ (\epsilon)}{log\ log\ (\ 1/\epsilon)}$$

Analytical Output

The primary indicators derived from this process include:

- Fractal Dimension (D): A quantitative measure of morphological complexity and spatial infill density.

- Scale Stability: An assessment of the linear regression consistency, which serves to distinguish between authentic, recursive generative structures and artificial, geometrically coded configurations (Figure 4).

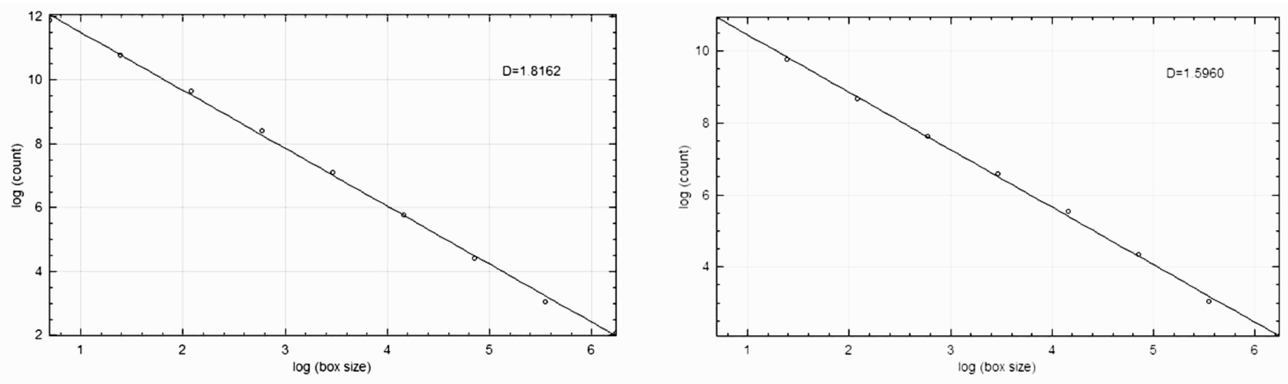

Figure 4. Comparative fractal analysis through box-counting regression. The steeper slope and higher D value of Shimokitazawa, Tokyo (left) quantify its recursive urban folding and structural redundancy. Conversely, the lower slope of Palm Jumeirah, Dubai (right) illustrates a reduction in cross-scale complexity, consistent with the top-down, tree-like logic of planned urbanism. (Source: Developed by the authors).

2.4.2 Network Topology Analysis

At the structural network level, this study employs QGIS (v3.28) to construct node–edge graphs from extracted road networks (Figure 5). To quantify the relational properties of these networks, two primary indicators are utilized:

- Cycle Density: This metric measures network redundancy and multi-path accessibility. A high cycle density indicates a distributed network with abundant path choices, supporting the non-linear movement characteristic of smooth space.

- Hierarchy Depth: This measures structural nesting and path dependency. A high hierarchy depth reveals a rigid, tree-like branching system where movement is restricted to unidirectional vectors, reflecting the structural discipline inherent in striated space.

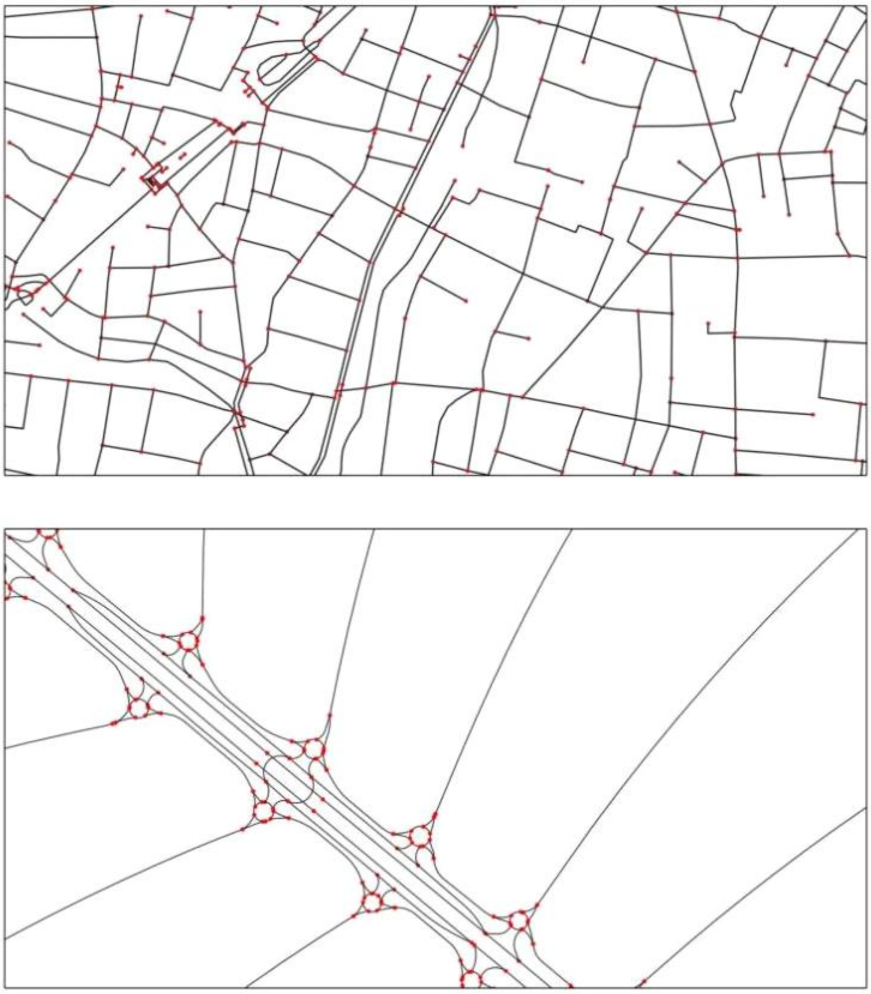

Figure 5. Comparative analysis of topological features at a localized scale. Top (Shimokitazawa, Tokyo): The fragment illustrates a high-density distribution of nodes. The proximity of junctions offers multiple path choices within short physical distances, manifesting the high spatial non-linearity of a mesh-like network. Bottom (Palm Jumeirah, Dubai): The fragment demonstrates significant hierarchical dependency. Nodes are restricted to primary arterial junctions, connected by elongated linear edges that limit spontaneous redirection. This configuration prioritizes efficient, unidirectional transit over exploratory navigation, reinforcing a striated spatial logic. (Source: Developed by the authors).

2.4.3 Space Syntax Analysis

To simulate pedestrian navigation and path-choice behavior, this study utilizes DepthmapX (v0.8.0) to perform segment map analysis based on angular deviation. This method prioritizes two core indicators: integration and choice. Integration measures the potential of a space to serve as a destination (to-movement), identifying central hubs for urban public activity. Choice, conversely, measures the potential of a space to function as a through-route (through-movement), reflecting the shortest angular paths typically selected by individuals.

The analysis is conducted at a local radius of 400 to 800 meters, a scale representing a 5-to-10-minute walk. This specific parameter allows for the simulation of embodied perceptual experience within micro-environments. By comparing these local indicators, the study demonstrates how distinct urban fractal structures govern subjective perception. The generative grid of Tokyo provides smooth guidance for navigation, facilitating spatial agency, whereas the tree-like hierarchy of Dubai represents a striated capture of the subject, where movement is funneled through predetermined corridors (see Figure 6).

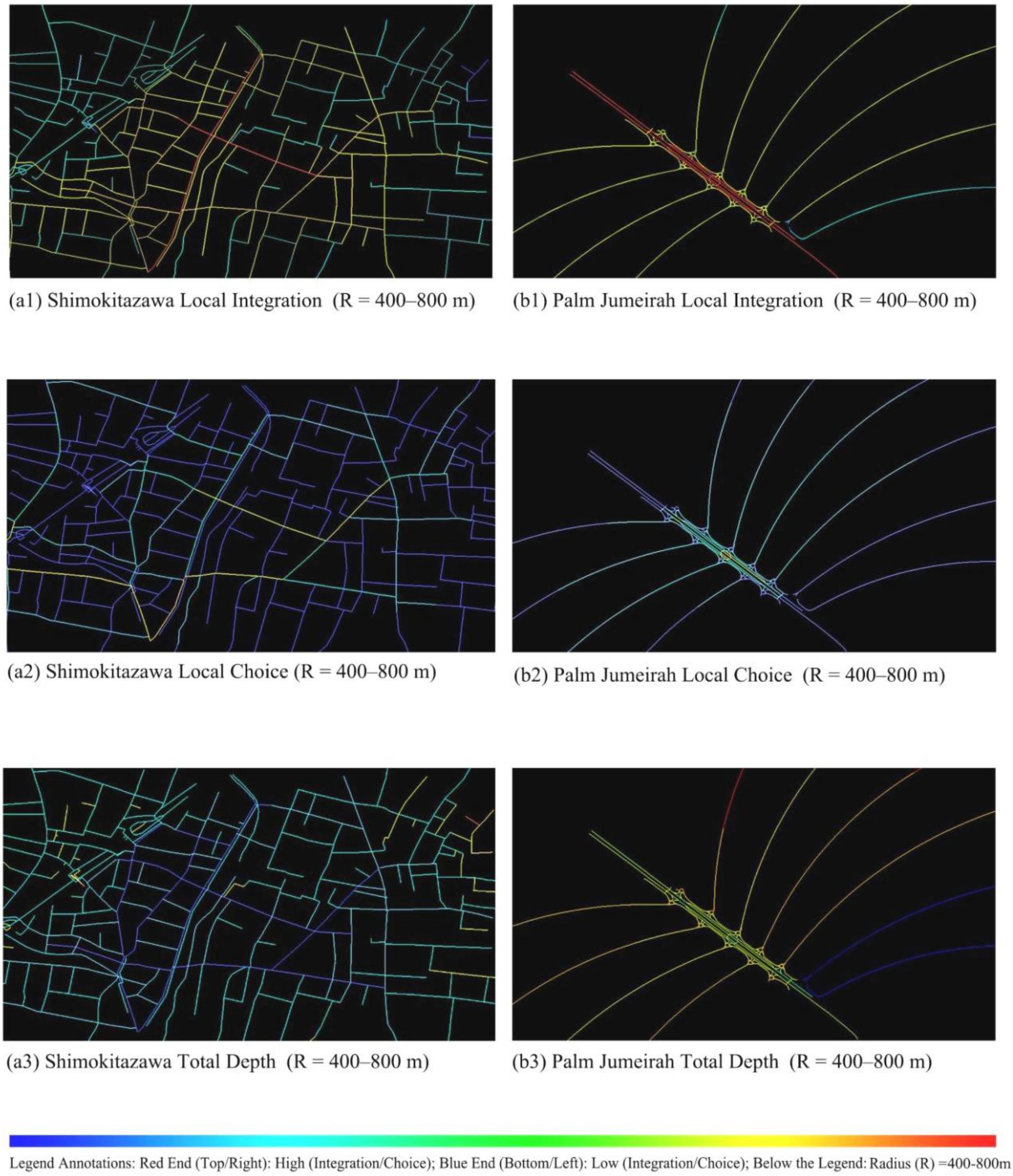

Figure 6. Multi-dimensional Space Syntax analysis at a local radius (R = 400–800 m). (a1–a3) Shimokitazawa, Tokyo: Exhibits a distributed integration pattern and high path redundancy, which facilitates non-linear movement and exploratory navigation. (b1–b3) Palm Jumeirah, Dubai: Demonstrates localized, fragmented integration and extreme topological depth at the network extremities, reflecting a constrained and hierarchical spatial logic. (Source: Developed by the authors).

2.5 Evaluation Strategy: Topology of Spatial Control

This study constructs a comprehensive evaluation framework that transcends binary oppositions, situating urban space along a continuous spectrum between generative and controlled states. Within this framework, fractal morphology is treated not merely as a geometric representation, but as a core variable regulating system openness and behavioral potential.

To facilitate a paradigm shift from descriptive morphology to multi-dimensional structural analysis, the study establishes the following cross-verification pathways:

- Generative Potential Measurement (Fractal Analysis): Quantitatively evaluates the infill efficiency and fold complexity of physical textures. High-dimensional scale stability is utilized as morphological evidence of a space's capacity for micro-folding and self-organized evolution.

- Perceptual Orientation Analysis (Space Syntax): Utilizes Integration and Choice to reveal the distribution characteristics of movement flows, determining whether a spatial configuration provides smooth guidance,facilitating agency or imposes a striated capture through predetermined path.

- System Openness Definition (Network Topology): Employs cycle density and branching ratios to define the topological redundancy of the system. This determines whether power is disseminated through a distributed, reticulated structure or anchored to a centralized, tree-like hierarchy.

Through the overlay mapping of these multi-dimensional indicators, this study establishes a rigorous empirical chain. This provides a robust structural foundation for exploring how spatial fractal logic intervenes in the reshaping of power mechanisms and the micro-embodied experience of the city.

3. Results

3.1 Coded Fractal Systems

The Palm Jumeirah exhibits a rigid hierarchical structure where morphological measurement, network topology, and space syntax converge to enforce a top-down administrative logic.

(1) Morphological Measurement

Box-counting analysis yields a fractal dimension $D \approx 1.596$ (see Figure 4), which is lower than the Tokyo sample. While the high linear fit at he macro-scale suggests proportional consistency, a critical scale collapse occurs as the observation narrows toward the micro-level. This morphological stagnation confirms that the Palm Jumeirah is a product of mechanical encoding rather than generative growth. In this striated space, geometry functions as a predetermined container, lacking the structural refinement necessary to support autonomous spatial occupation.

(2) Network Topology

The study area utilizes a dendritic topology where a singular skeletal axis bifurcates into sixteen repetitive branches (Figure 3). This configuration is characterized by a cycle density near zero and high hierarchy depth, transforming each “frond” into a topological dead-end. Such a structure systematically eliminates lateral connectivity, achieving perceptual exclusion by shielding non-core operational zones from view. The result is a closed, pyramidal management logic that prioritizes spatial predictability over the subject's agency.

(3) Space Syntax Analysis

Space syntax metrics (Figure 6, b1-b3) reveal a cliff-like drop in local integration (R=400-800m)from the primary trunk to the extremities.

- Local Integration (b1): The spatial configuration exhibits a sharp hierarchical gradient, with peak integration values (dark red) strictly confined to the primary arterial spine. Upon transitioning into the residential fronds, integration levels experience a precipitous decline, dropping to intermediate yellow-green and localized blue tones at the extremities. This distribution quantifies the absolute dominance of the central axis, reflecting a systemic enclosure where peripheral connectivity is suppressed in favor of center-oriented control.

- Choice (b2): The analysis reveals an extreme lack of path redundancy at the local level. Predominantly deep blue tones across the residential fronds provide empirical evidence that path selection is maximally constrained. Due to a near-zero cycle density, the system lacks alternative routes, resulting in a state of topological poverty. This structural rigidity effectively functions as an apparatus of capture, where the absence of cross-connectivity enforces preset, unidirectional trajectories and eliminates the potential for spontaneous movement.

- Total Depth (b3): The concentration of warm tones at the branch extremities quantifies a high degree of topological distance, validating the perceptual and physical isolation of the subject within the network. This localized accumulation of depth demonstrates how extreme path dependency creates a state of structural detachment. Collectively, these results provide visual evidence of scalar discontinuity, revealing that the pseudo-fractal structure functions as a disciplinary device that enforces spatial segregation through topological distance.

In summary, the pseudo-fractal nature of Palm Jumeirah’s urban form lacks generative growth characteristics; its fractal logic has shifted from a mechanism of organic development to a tool of rigid spatial organization. While the system maintains high Global Integration values to preserve its macro-accessibility as a spectacle of capital, it captures the subject within a one-dimensional logic of consumption and discipline at the pedestrian scale. This striated grid serves as both an operational interface for power and a product of aesthetic instrumentalization, illustrating how fractal geometry can function as a spatial tool for capital surveillance and symbolic territorialization.

3.2 Generative Fractal Systems

In contrast, the Shimokitazawa (Tokyo) sample embodies a Generative Fractal System characterized by distributed connectivity and recursive growth, facilitating a bottom-up morphogenesis.

(1) Morphological Measurement

The fractal dimension of Tokyo is $D \approx 1.816$ (see Figure 4), significantly higher than that of Dubai. This high value mathematically confirms the capacity of its architectural fabric to infill urban interstices. Within the *10m* to *1,000m* scale range, the curve maintains exceptional linear stability. This cross-scale stability does not originate from macro-level proportional control but from multi-scalar recursion. Physically, this morphology manifests as a dense, folded complexity where spatial details continuously emerge at the micro-scale, creating an abundance of permeable micro-voids. These folds break down massive urban volumes into human-scale increments, effectively mitigating the psychological pressure typical of monolithic structures. By decentralizing the visual field, this morphological transition shifts the urban experience from a macro-level spectacle to the tactile, embodied grain of smooth space. These interstices function not merely as physical voids but as liminal zones latent with undetermined social possibilities.

(2) Network Topology

The area presents a mesh network defined by evenly distributed nodes and abundant lateral redundancy (Figure 3). The combination of high cycle density and minimal hierarchical depth ensures a heterarchic, non-prescriptive network. This recursive mesh topology encourages frequent, spontaneous decision-making, enhancing the system's resilience through localized adaptations. A definitive example is the emergence of "Pet Architecture" (Tsukamoto et al., 2002), tiny, opportunistic structures that occupy residual urban gaps, along with other localized street-corner interventions that continuously reconfigure the urban assemblage from the bottom up (Figure 7).

Figure 7. Empirical manifestations of a high fractal dimension (D) and distributed connectivity in Tokyo's organic fabric. The images show how high-frequency path bifurcations and localized territorialization (e.g., signage, potted plants) create holey spaces that resist centralized visual discipline. This granular complexity provides the structural basis for the high Local Choice values identified in the Space Syntax analysis. (Source: Compiled by the author).

(3) Space Syntax Analysis

Analysis of Figure 6 (a1–a3) validates Shimokitazawa's non-hierarchical spatiality.

- Local Integration (a1): The sample displays a diffuse and decentralized distribution of high-integration values. Unlike the hierarchical model, this pattern does not rely on a singular primary axis. Instead, it achieves spatial coherence through an intricate mesh of localized connections. This distributed integration manifests as a topologically smooth space, where movement potentials are omnipresent rather than channeled through a predetermined backbone.

- Choice (a2): Values remain consistently high and are distributed with notable uniformity across the walking scale. This topological redundancy ensures a high frequency of bifurcation points, providing pedestrians with continuous opportunities for decision-making. Such a configuration validates what Deleuze and Guattari conceptualizes as deterritorialized exploration, where the urban fabric encourages a non-linear, nomadic traversal rather than a predetermined path.

- Total Depth (a3): The prevalence of cool tones (representing low mean depth) indicates that most locations within the network enjoy high relative accessibility at a walking distance. This spatial proximity, unimpeded by topological or perceptual barriers, fosters a sense of omnipresent reachability, allowing the subject to navigate the urban assemblage with minimal resistance.

Through local infilling and micro-folding, the Shimokitazawa (Tokyo) fabric dissolves striated boundaries to form a series of holey spaces. This recursive texture ensures that movement trajectories are not predetermined but emerge dynamically from the subject's interaction with the immediate environment. Within this configuration, the individual is no longer a passive recipient of top-down spatial instructions but an active agent reconstructing the urban experience through real-time navigation. Tokyo's fractal logic suggests that the city functions as a self-generating ecosystem; through high-frequency path bifurcation and micro-spatial redundancy, it facilitates embodied perceptual freedom for the pedestrian. Such a structure embodies the non-hierarchical traits of smooth space, effectively reclaiming sensory sovereignty against the hegemony of visual discipline and rigid administrative control.

3.3 Comparative Summary

Through quantitative measurement and topological analysis of the Tokyo and Dubai samples, this study identifies two diametrically opposed spatial organization paradigms: an open system oriented toward recursive generation and a coded system oriented toward hierarchical control. A comprehensive assessment of the three indicator categories reveals that the fundamental difference lies not only in morphological geometry but also in the coherence of scale effects and the legitimacy of difference production.

(1) Scale Self-Consistency and Produced Difference

The Tokyo neighborhoods exhibit profound scale self-consistency. Within the micro-scale range, the fractal logic does not collapse; rather, it maintains a stable linear fit through cross-scale recursive emergence. This scalar continuity demonstrates the morphological coherence of the urban fabric, functioning as a smooth space where complexity is maintained across all levels of observation.

- Multiplicity of Becoming: The Tokyo model aligns with a mesh-based multiplicity of becoming, utilizing porous spatial thresholds (such as transitional zones between private and public realms) to harmonize the relationship between individual element and the collective whole.

- Affirmative Deterritorialization: This structure fosters spatial heterogeneity driven by bottom-up forces. By dissolving the rigid boundaries of closed, master-planned systems, it enables subjects to engage in affirmative deterritorialization within micro-folds, such as the spontaneous adaptation of narrow alleys and residual spaces.

- The Power of Repetition: Its generative structure manifests the power of repetition through decentralized, incremental actions. While maintaining a cohesive collective rhythm, the streets-cape achieves local reterritorialization through micro-level interventions, such as signage, potted plants, and diverse facade treatments. These actions safeguard the sensory sovereignty of the subject against the monotony of industrial standardization.

(2) Scale Collapse and Induced Difference

In contrast, the Dubai model exhibits a pronounced scalar disjunction. Its morphological logic undergoes significant topological decoupling as the scale decreases toward the pedestrian threshold: the macro-level fractal order disintegrates into rigid, striated dead-ends at the micro-scale.

- Visual Apparatus: This structural rupture confirms the model's essence as a visual apparatus, an administrative encoding optimized for distant observation (the spectacle) rather than embodied navigation. The resulting urban form represents induced difference, characterized by mechanical iteration within preset parameters designed to mask systemic limitations through formalist aesthetics.

- Striated Capture: The model validates the logic of spinal urbanism, where spatial experience is excessively internalized and dictated by the architectural form. This striated space, established through top-down planning, eliminates spontaneous urban variables to achieve the absolute anchoring of trajectories and the perceptual capture of the subject.

(3) Integrated Indicator Matrix

To synthesize these findings, a multi-dimensional matrix (Table 2) is established to correlate empirical metrics with their corresponding philosophical implications.

Table 2: Multi-dimensional Logical Comparison Between Generative and Coded Fractals.

Dimension	Indicator	Tokyo (Generative)	Dubai (Coded)	Spatial Attribute Tendency
Geometry	Fractal Dimension (*D*)	High	Low	Infill density & fold complexity
Geometry	Scale Stability (R-squared)	High (Recursive)	Low (Discontinuous)	Legitimacy of generative mechanism
Topology	Cycle Density	High (Mesh)	Low (Dendritic)	Network permeability & openness
Syntax	Local Choice (*R=400-800m*)	Uniformly high	Fragmented / Polarized	Autonomy of embodied path decision
Philosophy	Spatial Logic	Smooth Space	Striated Space	Power operation & perceptual mode

4. Discussion

4.1 From Geometry to Spatial Agency

This study contends that contemporary urban fractals have transcended geometric measurement to serve as critical media for micro-political expression. By aligning mathematical indicators with Deleuze and Guattari spatial philosophy, this research deciphers the divergent power mechanisms embedded within urban logic. In Tokyo, the recursive folds generated by a high fractal dimension *D* and high cycle density do more than increase physical path diversity. This configuration evolves into a rhizomatic meshwork where power is diluted through distributed connectivity. Unlike the rigid grids of master-planned cities, the generative fractals of Shimokitazawa preserve a multitude of micro-folds and non-utilitarian zones (terrain vague), born from fragmented land ownership and historical accretion. These interstices function as sensory refuges that evade visual discipline, facilitating non-purposive wandering. Because Local Choice values (*R=400-800m*) are uniformly high, the subject constantly encounters spontaneous bifurcations. This structural uncertainty compels the body to shed preset functional encodings, namely the striated habits of urban life, transforming the individual from a controlled executor into a nomadic subject (Deleuze & Guattari, 1987). In these dense folds, the urban fabric produces what *A Thousand Plateaus* (1987) describes as "holey space," heterogeneous zones puncture the vertical web of power control, enabling a micro-resistance of sensory sovereignty against the hegemony of the visual. Here, the fractal structure acts not merely as a decorative pattern but as a spatial regulator, modulating the tension between disciplinary capture and the reclamation of sensory sovereignty.

4.2 Visual Spectacle vs. Embodied Sovereignty

The results for Dubai reveal a critical paradox: a "spectacular" urban image that yields a relatively low fractal dimension ($D \approx 1.596$). This quantitative gap confirms that the complexity of the Palm Jumeirah operates primarily as a single-scale hyper-reality, a macro-visual spectacle engineered for the aerial gaze rather than the pedestrian. Drawing on David Harvey's(1986) theory of capital accumulation, this morphology serves as a vehicle for spatial commodification, converting geographic form into high-premium real estate. Here, the fractal branches do not foster organic urban life; instead, they maximize the privatization of the seascape, acting as geometric instruments for accelerated capital extraction. However, as the fractal dimension measures cross-scale filling efficiency and recursive stability, Dubai's lower *D* value and its micro-scale rupture expose its essence as a pseudo-fractal. Its structural logic disintegrates below the walking threshold, where macro-order collapses into striated dead-ends. Unlike Tokyo's generative folds, Dubai's complexity constitutes an induced difference, a mechanical iteration designed to mask systemic rigidity through formalist aesthetics. Space syntax metrics empirically demonstrate how structural power is exercised through spatial configuration. By eliminating alternative routing pathways (resulting in low Choice) and erecting topological barriers (resulting in high Depth), this layout forces pedestrian movement into a single, predictable trajectory that feeds directly into commercial axes. Through this configuration, the physical environment is transformed into a calculable, striated network that systematically captures human mobility within predefined parameters. Ultimately, while the macro-outline of the master plan creates a visual spectacle of capital investment, it weaponises the topological isolation of its internal structure to enforce strict behavioral control.

In summary,these two models represent distinct modes of power operation:

- The Dubai Coded System: Aligns with the traditional disciplinary grid, favoring fixed hierarchical divisions to achieve the annihilation of space by time for maximum extraction efficiency.

- The Tokyo Generative System: Embodies the qualities of a sieve in a control society, where variable micro-folds and high-frequency path bifurcations achieve elastic power operations through real-time environmental modulation.

The Fractal Politics framework established here provides empirical weight to the philosophical speculations of Deleuze and Guattari. By quantifying how urban form modulates the tension between discipline and freedom, this research demonstrates that fractal structures are not merely descriptive; they are active agents in the potential return of the subject's sensory sovereignty.

4.3 The Embodied Effects of Spatial Structure

The regulation of power via fractal structures transcends direct coercion, operating instead through the subtle reshaping of individual experience, a process defined here as embodied modulation. In this mechanism, spatial structure functions as a physical filter that modulates sensory input in real-time, dictating the subject's cognitive and behavioral parameters. Under the dendritic logic of the Dubai model, the extreme inflation of topological depth flattens the subject's cognitive map into a series of highly linear trajectories. This systemic lack of path redundancy produces a decision vacuum during navigation, rendering the subject a passive recipient of a pre-authored capital landscape. Here, action is compressed into the repetitive execution of an optimal path. While such low uncertainty may enhance navigational efficiency, it systematically erodes the potential for exploratory behavior, culminating in the striated discipline of subjectivity and a hollowed-out sensory ecology. In contrast, the mesh-like folds of the Tokyo model utilize high-frequency path-selection points to ensure the subject constantly encounters navigational bifurcations (see Figure 8). This structure supports nomadic movement, an experience without beginning or end that introduces deviation and serendipity, transforming the subject from a controlled tourist into an improvisational participant. The recursive folds of Tokyo's neighborhoods provide a micro-level tactile rhythm through the granular texture of street interfaces. Research suggests a cross-modal consistency between individual preferences for medium-complexity visual features and tactile preferences for fractal-like surfaces. This reinforces the positive guidance that generative fractals provide to the subject's embodied perception. This experience, grounded in multi-path redundancy, facilitates a return to sensory sovereignty through fractal folding. In this process, subjective perception shifts from the optical (the distant and spectacular) to the haptic (the tactile and force-based). As Melo (2022) emphasizes, counter-hegemonic spatial practices must prioritize force over form and rhizomes over representation. By fostering a process of chaosmosis (Guattari, 1995), the Tokyo model enables the subject to extract a heterogeneous aesthetic subjectivity from geometric "chaos." Through continuous interaction with the micro-environment, the individual no longer merely occupies space but actively participates in its constant re-becoming.

Figure 8. Left (Tokyo): The multi-directional pedestrian flows demonstrate how high-frequency path choice and distributed connectivity empower the subject with spatial agency. The complex visual and haptic grain encourages nomadic exploration rather than predetermined movement. Right (Dubai): The street-level experience reveals a striated capture, where the lack of path redundancy and extreme topological depth reduce human movement to linear, controlled vectors within a commercial orbit. (Source: Compiled by the author).

4.4 Theoretical Contribution

The core theoretical contribution of this research lies in the proposal of Fractal Politics as a conceptual framework. This marks a significant shift, transforming fractal geometry from a descriptive morphological tool into a political analytical lens for deciphering power operations in the contemporary built environment. This study argues that in the era of late capitalism, fractal logic has transcended the paradigm of natural growth to become a sophisticated manifestation of governmentality. Fractals are no longer limited to geometric self-similarity; they represent the micromanagement of subjective perception through the extreme subdivision and regulation of scale. By establishing a taxonomy between generative and coded fractals, this research moves beyond the reductionist tendency to categorize all complex forms as universally fractal. This distinction provides a critical quantitative dimension for interrogating the generative mechanisms or the lack thereof within urban space. Drawing upon Deleuze's (1992) thesis on societies of control, the framework of fractal politics reveals the seamless and invisible mechanisms underlying the Dubai model. In this context, control is no longer exerted through physical walls or overt enclosures but through the rigid anchoring of movement via fractal encoding. By funneling all trajectories into a singular, high-depth spine, the model ensures that any attempt at deterritorialization (such as spontaneous wandering or lateral shortcuts) is suppressed by prohibitive topological costs. In the Palm Jumeirah, the systemic lack of cross-connectivity transforms a five-minute visual proximity into a thirty-minute physical detour, effectively capturing the subject within a preset commercial orbit through purely geometric constraints. Furthermore, the tension between becoming and capture is rendered visible through this framework. Tokyo's generative fractals resonate with the concept of becoming (Deleuze & Guattari, 1987), where space unfolds through continuous relational reorganization. Conversely, the coded fractals of the Dubai model align with the apparatus of capture, transforming the urban environment into a predictable, closed system of surveillance and consumption. Ultimately, fractal politics extends into the ethico-aesthetic realm. Integrating the perspective of social ornamentation (Lee, 2025), this study posits that generative fractals consolidate unique territories through micro-scale creative expressions, such as localized street-side adaptations and signage. This active deterritorializing force promotes communal solidarity and psychological resilience, demonstrating that the ultimate stakes of fractal politics lie in the return of sensory sovereignty to the urban subject.

4.5 Limitations and Future Research Directions

While this study integrates multi-dimensional methodologies into a unified framework, several limitations warrant further investigation. First, the geographical scope is currently restricted to Tokyo and Dubai. To test the universality of the fractal politics framework, future research should encompass diverse urbanisms in the global south, examining how different political-economic systems and social governance models influence fractal morphogenesis. Additionally, while this study focuses on visual and topological dimensions, urban experience is inherently multi-modal. Future models should incorporate multisensory integration, including soundscape and olfactory mapping, to capture the full atmospheric complexity of the city. A significant trajectory for future inquiry lies in the intersection of spatial philosophy and neuro-urbanism. By linking Deleuze and Guattari theory with the ecology of embodied cognition, subsequent studies could employ wearable electroencephalogram (EEG) sensors to monitor physiological stress and neurological responses in real-time. Such empirical data would provide the necessary biological evidence to determine how generative micro-folds and Fractal Fluency alleviate the cognitive load associated with high-density environments. A critical avenue for future research lies in the convergence of fractal morphology and digital technologies, specifically within the framework of fractal surveillance. As urban governance shifts toward algorithmic governmentality, the logic of the fractal extends beyond physical forms into the infinitesimal subdivision of urban big data. This emergent mode of control operates through the recursive monitoring of micro-scale behaviors, enabling a more granular striated capture of the smooth flows of daily life. Future inquiries must examine how digital twins and automated systems might eliminate the holey spaces of resistance, potentially co-opting fractal politics into a digitized apparatus of capture. Finally, as the smart city paradigm expands, urban design must address the potential erosion of sensory sovereignty by automated systems. Establishing ethical frameworks that protect the individual's right to spontaneous deviation, nomadic movement, and perceptual liberty remains a critical challenge for future urban practice. The goal of future design must be to ensure that fractal complexity serves as a commons for diversity rather than a tool for totalizing surveillance.

5. Conclusions

Situated at the intersection of fractal geometry and spatial philosophy, this study constructs an integrated "Concept–Morphology–Indicator" analytical framework to reassess fractal forms an ontological perspective. The findings demonstrate that fractals are far more than static geometric attributes or visual ornaments; they function as dynamic mechanisms of spatial organization and sensory modulation. By restructuring connectivity, scalar relationships, and topological depth, fractal structures actively regulate the generative logic and power distribution within contemporary high-density cities. At the methodological level, this research translates the qualitative nuances of smooth and striated spaces into precise quantitative measurements through a multi-dimensional topological matrix. The empirical results invalidate the legitimacy of the Dubai model as an authentic fractal city. Its scalar rupture and path monopoly at the micro-scale reveal a pseudo-fractal disciplinary apparatus masked by aesthetic complexity. In contrast, the Tokyo model defined by its bottom-up recursive mesh, providing a morphological paradigm for the return of sensory sovereignty in resilient urban design. Theoretically, this paper establishes the conceptual prototype of fractal politics. By distinguishing the structural divergence between coded and generative fractals, the study reveals how fractal logic alternates between an apparatus of capture and a medium of becoming. This discovery enhances the verifiability of spatial critical theory, offering a replicable interdisciplinary methodology that provides empirical weight to Deleuze and Guattari philosophical speculations within the built environment.

Recommendations for Urban Practice and Perceptual Governance

Based on these findings, the study proposes the following strategic directions for future urban development:

1. **Prioritize Sensory Sovereignty over Visual Spectacle**: Urban design must resist pseudo-fractal encoding that prioritizes superficial image-making. Designers should foster embodied environments with smooth space characteristics by increasing micro-scale path redundancy and cycle density, thereby enhancing both sensory richness and psychological resilience.

2. **Establish a Sensory Ecology Evaluation System**: Planning authorities should move beyond traditional floor-area-ratio (FAR) controls toward the regulation of perceptual quality. Adopting topological indicators, such as fractal stability and local choice, provides a scientific basis for evaluating behavioral freedom and spatial quality.
3. **Advance Toward an Embodied Ecology of Perception**: Future research should move beyond singular geometric analysis. By integrating mobile big data with biofeedback technologies (e.g., stress-perception modeling), scholars can investigate the deep coupling between urban structure and the physiological experiences of subjects.

In summary, by transforming fractal geometry from a descriptive tool into a dynamic analytical framework, this paper expands the horizons of urban studies. Future urban design must transcend visual discipline to affirm sensory sovereignty. This shift is both aesthetic and political. Reimagining fractal space as a commons for diversity and equality ensures a theoretically rigorous pathway for the evolution of inclusive, generative, and sovereign urban environments.

Acknowledgements
The author would like to express sincere gratitude to my supervisor for the invaluable guidance on the theoretical and philosophical framework of this research. The author also thanks the anonymous reviewers whose insights and constructive comments greatly improved the clarity and methodological rigor of this manuscript. Special appreciation is extended to the ICCAUA 2026 editorial committee for their professional support during the review process.

Funding, Conflicts of Interest
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.The author reports no conflicts of interest.

Data Availability Statement
All data generated or analysed during this study, including the binarized urban plans and calculated fractal dimensions for Tokyo and Dubai, are included in this published article and its supplementary files. Further inquiries regarding the specific datasets can be directed to the corresponding author.

Institutional Review Board Statement
Not applicable. This study did not involve human participants or animals and was based on the analysis of public urban morphology and architectural theory.

CRediT Author Statement
Yanxi Zhou: Conceptualisation; Methodology; Formal analysis; Investigation; Resources; Data curation; Writing – original draft; Writing – review & editing; Visualisation. All authors have read and approved the final version of the manuscript.

References
Al-Dabbagh, A. A., & Ismail, K. J. A. (2024). Using fractal geometry in studying architectural and urban patterns. International Journal of Sustainable Development and Planning, 19(6), 2145–2156. https://doi.org/10.18280/ijsdp.190605
Brielmann, A. A., Buras, N. H., Salingaros, N. A., & Taylor, R. P. (2022). What happens in your brain when you walk down the street? Implications of architectural proportions, biophilia, and fractal geometry for urban science. Urban Science, 6(1), 3. https://doi.org/10.3390/urbansci6010003
Batty, M. (2007). *Cities and complexity: Understanding cities with cellular automata, agent-based models, and fractals*. The MIT Press.
Batty, M., & Longley, P. A. (1986). The fractal simulation of urban structure. *Environment and Planning A*, *18*(9), 1143–1179. https://doi.org/10.1068/a181143
Batty, M., Longley, P. A., & Fotheringham, A. S. (1989). Urban growth and form: Scaling, fractal geometry, and diffusion-limited aggregation. *Environment and Planning A: Economy and Space*, *21*(11), 1447–1472. https://doi.org/10.1068/a211447
Batty, M., & Longley, P. A. (1994). *Fractal cities: A geometry of form and function*. Academic Press.
Drumm, L. (2024). Becoming rhizome: Deleuze and Guattari's rhizome as theory and method. Research on Professional Learning and Technology, 10, 45–60. https://doi.org/10.1108/S2056-375220240000010003
Deleuze, G., & Guattari, F. (1987). A thousand plateaus: Capitalism and schizophrenia. Bloomsbury publishing.
Deleuze, G. (1992). Postscript on the Societies of Control." 1990. *Cultural theory: An anthology*, 139-142.
Eglash, R. (1999). *African fractals: Modern computing and indigenous design*. Rutgers University Press.
Guattari, F. (1995). *Chaosmosis: An ethico-aesthetic paradigm*. Indiana University Press.
Gorelick, N., Hancher, M., Dixon, M., Ilyushchenko, S., Thau, D., & Moore, R. (2017). Google Earth Engine: Planetary-scale geospatial analysis for everyone. *Remote Sensing of Environment*, 202, 18–27. https://doi.org/10.1016/j.rse.2017.06.031
Hillier, J. (2023). Deleuze, Guattari and power. In *Handbook on planning and power* (pp. 74-89). Edward Elgar Publishing. https://doi.org/10.4337/9781839109768.00012
Harvey, D. (1986). The Limits of Capital. *Science and Society*, *50*(1),108-110.
Haklay, M., & Weber, P. (2008). OpenStreetMap: User-generated street maps. *IEEE Pervasive Computing*, 7(4), 12–18. https://doi.org/10.1109/MPRV.2008.80

Holland, E. W. (1991). Deterritorializing "Deterritorialization": From the "Anti-Oedipus" to "A Thousand Plateaus"". *SubStance*. **20** (3): 55–65. https://doi.org/10.2307/3685179

Jahanmiri, F., & Parker, D. C. (2022). An overview of fractal geometry applied to urban planning. Land, 11(4), 475. https://doi.org/10.3390/land11040475

Jacobs, J. (1993). *The death and life of great American cities* (Modern Library ed.). Random House. (Original work published 1961).

Kacha, L., Abdessemed, M. A. E., & Matsumoto, N. (2022). Fractal features of urban fabrics and urban landscapes in Algiers, Tokyo and New York. Cybergeo: European Journal of Geography, 1012. https://doi.org/10.4000/cybergeo.38984

Kolesnikova, D. A. (2024). Grids: Re-considering infrastructural politics of urban space. Journal of Frontier Studies, (1), 187–210. https://doi.org/10.46539/jfs.v9i1.547

Lee, L. (2025). Ornamental behaviour: Mechanisms of repetition in urban communities. Deleuze and Guattari Studies, 19(1). https://doi.org/10.3366/dlgs.2025.0580

Melo, L. de F. (2022). Another Urban: Considerations Across Solà-Morales and Careri. VIRUS, (24), 123–132.

Manfredini, M. (2022). Affirmatively reading deterritorialisation in urban space: An Aotearoa/New Zealand perspective. In A. M. Brighenti & M. Kärrholm (Eds.), Territories, Environments, Politics: Explorations in Territoriology (pp. 111-135). Routledge. https://doi.org/10.4324/9781003196365-6

Amen, M. A., & Ali, F. A. (2025). Analyzing the impact of spatial centrality and courtyard diversity on tourist attractions in the walled city of Lefkoşa. PLOS One, 20(8), e0330956. https://doi.org/10.1371/journal.pone.0330956

Muminovic, M. (2022). Intensity mapping: A non-essentialist approach to methods in urban morphology. In I. Geddes, N. Charalambous, & A. Camiz (Eds.), Cities as assemblages: Proceedings of the XXVI International Seminar on Urban Form 2019 (Vol. 3, pp. 143-154). tab edizioni. http://cyprusconferences.org/isuf2019/

Ospina, T. G. (2025). The city in the city: A fractal pattern language for self-organising urbanism. VAS-Visionary Architecture Studies, 1(1), 8–23. https://doi.org/10.48619/vas.v1i1.1207

Segovia, C.A. (2024). From Deterritorialization to Determinability: Guattari's Chaosmic Ontology in Schizoanalytic Cartographies and His Unpublished Notes for What Is Philosophy?. In: Guattari Beyond Deleuze. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-031-70572-4_3

Taylor, R. P. (2006). Reduction of physiological stress using fractal art and architecture. Leonardo, 39(3), 245–251. https://doi.org/10.1162/leon.2006.39.3.245

Tsukamoto, Y., Tsukamoto Architectural Laboratory, & Atelier Bow-Wow. (2002). *Pet architecture guide book*. World Photo Press.

Viengkham, C., & Spehar, B. (2022). Beyond visual aesthetics: The role of fractal-scaling characteristics across the senses. Journal of Perceptual Imaging, 5, 000406-1 – 000406-14. https://doi.org/10.2352/J.Percept.Imaging.2022.5.000406

Amen, M. A., Afara, A., & Nia, H. A. (2023). Exploring the Link between Street Layout Centrality and Walkability for Sustainable Tourism in Historical Urban Areas. Urban Science, 7(2), 67. https://doi.org/10.3390/urbansci7020067

Viswanathan, H. S., & Miller, M. L. (2023). Tourist, local, and broker perceptions of Abu Dhabi and Dubai, United Arab Emirates: Tourist gazes, ultra-artifacts, and hyperreality. The Arab World Geographer, 26(2), 142–179. https://doi.org/10.64903/1480-6800-26.2.142

Virilio, P. (1989). *War and cinema: The logistics of perception*. Verso.

Wang, L. (2025). Towards multiplicity in urban form: Two models of building the superblock. Journal of Urban Design, 1–23. https://doi.org/10.1080/13574809.2025.2574360

Whitford, S., & Brearley, J. (2024). Designing networks cities: inclusive, hyper-connected, emergent, and sustainable urbanism. Routledge. https://doi.org/10.4324/9781003426011

Wellner, G. (2022). Becoming-Mobile: the Philosophy of Technology of Deleuze and Guattari. Philosophy and Technology, 35(2). https://doi.org/10.1007/s13347-022-00534-2