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Within the Flows: Participatory 3D Scanning in Asian Techno-Industrial Hinterlands

Richard Müller

Department of Geography, University College London, UK

Correspondence: Richard Müller (richard.muller.13@ucl.ac.uk)

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Abstract

The peri-urban remains a slippery category, widely used to describe spaces at the edges of cities yet rarely pinned down in ways that enable meaningful readings across contexts. This article argues that both literature and methods pertaining to peri-urban spaces require frameworks capable of holding two positions in tension: an embedded, place-based lens that centres on-the-ground narratives and experiences, and a comparative approach that sustains the peri-urban as an umbrella term across contexts. Tracing the scholarship of peri-urbanisation through notions of the hinterland and "hyperbuilding," the article examines two state-planned industrial enclaves at the rural/urban margins of Chennai, India and Hsinchu City, Taiwan, drawn into comparative focus as interconnected nodes within global high-tech supply chains, exemplifying a mode of peri-urbanisation characterised by the circumvention of everyday urban realities and sustained by exceptional governance. Drawing from lens-based methodologies that centre walking and sensorial engagement, this article proposes participatory 3D scanning (photogrammetry) as a method to engage the transformations occurring at this interface of the ordinary and the exceptional, the local and the planetary. This method is operationalised via two workshops, revealing a perceived and comparative sense of inexorability across participant outputs. The article concludes by detailing the aggregation of workshop outputs onto a web-based platform (Techno-Urban Atlas), reflecting upon the circulation of digital objects to extend the epistemological scope of peri-urban transformations and generate new opportunities for user-led comparison.

Keywords

3D scanning; comparative urbanism; hinterlands; India; participatory methods; peri-urban; photogrammetry; Taiwan

1. Introduction: The Peri-Urban

With the rapid expansion of urban areas worldwide, peri-urban spaces have emerged at the peripheries of cities, characterised by rural-to-urban transformations generating a mosaic of mixed morphologies, livelihoods, ecologies, and practices (Iaquinta & Drescher, 2000). Especially within the rapidly urbanising landscapes of Asia, peri-urbanisation is marked by increasingly heterogeneous socio-economic composition, accompanied by the uneven interaction between economically asymmetrical industries, land speculation, ecological destruction, and increased informalisation (Webster & Li, 2020). Peri-urban spaces are characteristically regarded by sectoral and institutional actors as blank canvases for the exertion of civic interests (Allen, 2014), configured as strategic resources for metabolic flows, receiving waste and landfill while storing the key resources required to maintain urban energy, food, and water security (Gallent & Shaw, 2007). As expanding cities exert growing pressure on contiguous areas, peri-urban spaces are defined by stark contrasts: Hyper-development exists alongside vast underserved tracts, enclaves of wealth border expanses of marginality, and forward-looking visions of urban futures coexist with contested legacies of the past.

An overarching definition of the peri-urban remains uncertain due to the differences that are observed across urban and rural systems, generated and persistently shaped by regionally specific dynamics. Drawing from McGee's (2015) formative efforts to inscribe situated specificity into the peri-urban lexicon, Wu and Sui (2016) argue that the rural–urban interfaces of Asian urbanisms require a lens capable of engaging the abundant ambiguous typologies that exceed classical Western models premised on a distinct rural–urban dichotomy. From this perspective, the lack of discursive consensus suggests a concept that overly emphasises the rural–urban interface as an a priori hypothesis detached from empirically driven modes of knowledge generation. This is not to cast doubt on the theorisation of urban peripheries, but rather to reframe the epistemological ambiguity as a lack of understanding of the embedded socio-spatial and political forces that mediate the outcome of urban and rural spaces.

Recognising this complexity demands that the peri-urban be operationalised in ways that are responsive to, rather than abstracted from, the empirical conditions in which it is encountered. In this sense, the peri-urban serves as a crucial lens through which a conceptual typology can be developed, one enriched by empiricism and attentive to urban difference. Operationalising the peri-urban here is extended as a means to bridge the lacuna that often exists between imported theory and empirical conditions within the scholarship of southern cities (Lawhon & Truelove, 2020). This mirrors Ghertner's (2015) cautionary critique that while gentrification as an analytic assists in identifying outcomes such as rising rent and market-induced displacement as global phenomena, it fails to chart the more fundamental interactions of land privatisation, the often contradictory actions of the state, and the overlapping socio-political dynamics of residents. Likewise, peri-urbanisation risks labouring at a generalised model that misses the fundamental dynamics occurring at the interface of rural and urban systems. Scholarship has therefore proposed positioning the peri-urban as an umbrella concept that works with empiricism to compose polyvocal and variegated processes, directed by a lens that makes legible the fragmentary, the multiple, and the particular (Follmann, 2022).

It is from this position that scholars have called for a "peri-urban turn" that re-engages peri-urban areas as a settlement typology composed as a dynamic assembly at multiple scales (Rajendran et al., 2024). From one distance it is critical to account for the relationships and reciprocities of peri-urban spaces amongst

increasingly planetary flows of resources, capital, people, and knowledge (Brenner & Katsikis, 2020), while simultaneously incorporating a granular "place-based" conceptualisation that emphasises peri-urban areas as a dynamic matrix for everyday life, identity, and social occurrence (Rajendran et al., 2024, p. 10). Drawing from formative debates on comparative urbanisms, the trajectory of this peri-urban turn aligns with the necessity to think across contexts so as to engage processes and outcomes that are at once diverse, featuring specific historical and socio-spatial dynamics, and differentiated, interconnected iterations within circuitries of urbanisation and globalisation (Robinson, 2023, pp. 4–5).

Within recent years, academic, artistic, and creative voices have borne witness to peri-urban spaces by centralising human storytelling and local worlds amongst the flows and circuits of the planetary (Beelen & Ganesan, 2016; Jayaraman et al., 2025). Within this growing body of thought and praxis, this article maintains that there is an opportunity to enhance this dual-lens of place and flow by integrating participatory, walking-based, and sensorial modes of place-based action with digital tools that widen the field of comparison. The article discusses the application of smartphone-based 3D reconstruction, popularly termed 3D scanning, to produce mobile digital objects that tilt the gaze towards the materials, objects, and landscapes of peri-urban spaces while additionally enabling the commingling of realities through web-based platforms. While non-specialist 3D scanning has been discussed as a tool for recording and surveying the built environment for heritage conservation (Tait et al., 2016) and citizen science in data-scarce contexts (Chmielewski et al., 2019), there remains little scholarship on the technology's capacity for generating embodied engagements with landscapes or as a component within ethnographic or walking methods, akin to other lens-based technologies such as photography or film.

This article turns to two peri-urban spaces at the edges of Hsinchu City, Taiwan and Chennai, India (see Figure 1), selected for their specialised positions within a critical supply chain of consumer smartphones, in which advanced components produced in the former by the world leader of fabrication (Taiwan Semiconductor Manufacturing Corporation [TSMC]) are assembled into finished products in the latter by the world leader in electronics manufacturing (Foxconn). In addition to this nodal connection, the sites exemplify a mode of peri-urbanisation particular to techno-industrialism in which factory enclaves are governed through what Ong (2011) identifies as a rule of exception, a flexible instrument of sovereign practice that holds them materially, economically, and territorially apart from the functioning of their surrounding regions. This separation is compounded by an ordering process in which the enclaves' role within planetary networks of high-tech production is elevated above the needs and realities of nearby residents and settlements. Read together, these conditions align the two sites with scholarship of the hinterland, an additional mode of peri-urbanisation generated through insistent logics that strategically bypass the coordinates, realities, and imaginaries of the everyday city (Arabindoo, 2020; Rajan, 2019). Tracing this interplay of exceptional rule and bypass through the emergence of functioning of both techno-industrial landscapes draws into focus the obscured encounters and practices of everyday life composed around and within the enclave.

It is here that the article proposes participatory 3D scanning as a means of engaging this peri-urban tension by discussing the method as a walking-based and sensorial encounter, situating smartphone photogrammetry alongside adjacent lens-based approaches. This discussion is proceeded by detailing two 3D scanning workshops conducted outside of Chennai and Hsinchu City that operationalise this proposition, leading to the production of the Techno-Urban Atlas (https://www.latentspace.com/TUA.html), a web-based platform built for composing and comparing participant outputs. The article then reports on the

workshop results through the emergent theme of inexorability, read in relation to concepts of exception and bypass, before turning to what 3D scanning methods offer to comparative work across peri-urban contexts.

Figure 1. Geographical locations of the two case study areas. Source: Adapted from Google Earth (Google, 2026).

2. Asian Techno-Industrial Hinterlands

As the global reliance on technology intensifies through the dispersion of precision technologies into myriad dimensions of human life, high-tech supply chains have become both extraordinarily complex and a matter of intense state competition (So, 2006). Miller (2022) declares the 21st century has emerged as an epoch in which the military and economic security of nations depend on access to one of the industry's few chokepoints, occupied by a handful of companies. This is especially relevant within Asian urban systems, already considered the factory of the world (Zreik, 2024), where state-led initiatives in collaboration with multinational companies have sought to capitalise on the high-tech sectors of a fourth industrial revolution (Miah et al., 2024), increasing the intensity and pace of urban expansion.

The contemporary high-tech production sectors can be divided into capital-intensive fabrication and labour-intensive assembly (Hao & Bu, 2022). This division is replicated territorially through the offshoring of production stages within supply chains where demands can be met with greater supply, forming constellations of global processes that converge into final products. Peri-urban areas across Asia, already key sites for transnational non-digital industries due to proximity to both urban and rural workforces, cheaper land, and often weaker governance regimes (Gururani & Kennedy, 2021), have witnessed novel modes of development and governance as the high-tech era has intensified the urgency and investment of industrial transformation. Where scholarship conceived of the peri-urban as a territory, process, or interface mediating rural and urban systems, the techno-industrial configurations more accurately align with the conceptualisation of hinterlands (Arabindoo, 2020), in which strategically state-constituted enclaves at the edges of cities are staged as territories of frictionless optimisation and distribution within criss-crossing

networks of industrial forms equally configured to smooth the global movement and processing of goods. This quality of unfettered movement is sustained by a logic of bypass, in which existing social, territorial, legal, and ecological realities are rendered through extrastatecraft (Easterling, 2014) as inconvenient frictions to be circumvented and subverted. Bypass is at once understood as a material deviation in which physical infrastructure is built to prioritise certain forms of movement over others (Arabindoo, 2020, pp. 217–218), and as an instrument of marginalisation which encloses and subordinates the claims and narratives of hinterland residents (Rajan, 2019).

In this regard, techno-industrial enclaves are best understood not as passive entities upon which flows of global processes organically converge, but as products of what Ong (2011, pp. 206–207) terms the rule of exception, through which state actors exercise political flexibility for economic and political ends. Spaces become sites of variegated governance and political exception that facilitate the "hyperbuilding" of two intractably global constructions: the mechanisms of economic capture and a geopolitical profile of national emergence (Ong, 2011). The techno-industrial hinterland locates this process through a protocol of geographical, economic, and ideological bypass oriented towards the geopolitical and economic aspirations of state actors while marginalising adjacent settlements and residents. The following subsections detail the emergence of two industrial enclaves within the peri-urban areas of Hsinchu City and Chennai as two distinct hinterlands oriented towards techno-industrialism, each enacting unique practices of bypass and exception.

2.1. The Hsinchu Science Park

The centre of Taiwan's techno-industrial industry is the Hsinchu Science Park (HSP), situated in the island's northwest. The HSP is built across nearly 10 square kilometres overlapping the administrative bodies of Hsinchu City (primarily urban) and Hsinchu County (primarily rural; see Figure 2). The genesis of the park can be traced to the establishment of the first Export Processing Zone in 1966 in the southern city of Kaohsiung, as the Kuomintang government sought to shift the focus of Taiwan's newly reconstituted economy from agriculture towards industry. The periphery of Kaohsiung was selected as an attractive location within which the enclave could fit into the existing urban infrastructure, including airport and shipping nodes, while drawing from the nearby cheap labour (Wong & Chu, 1984).

Two years later, emboldened by the success of the Export Processing Zone, the then Minister of Economic Affairs, Kuo-ting Li, proposed a research park in the Hsinchu region. Although the proposal initially failed to gain traction, it resurfaced in the 1970s in response to increasing international competition in manufacturing, rising labour costs, and geopolitical fallout from worsening relations with the US and derecognition by the UN (van Hoesel, 2003). An area at the edges of Hsinchu City and Hsinchu County was selected for its proximity to the Industrial Technology Research Institute, and Chiao Tung and Tsing Hua Universities, replicating the agglomeration pattern observed by government officials in the US's Silicon Valley between research institutions such as Stanford University and private sector ventures.

While Silicon Valley would emerge as the model prima facie, the Kuomintang government pursued a strong state-planning regime more reminiscent of the Kaohsiung Export Processing Zone than the softer touch practiced in California (Hsu, 2018b). The result was a hybrid entity combining the suburban entrepreneurial imaginary of the US West Coast with the enclave governance model of a free-port. This spacious and

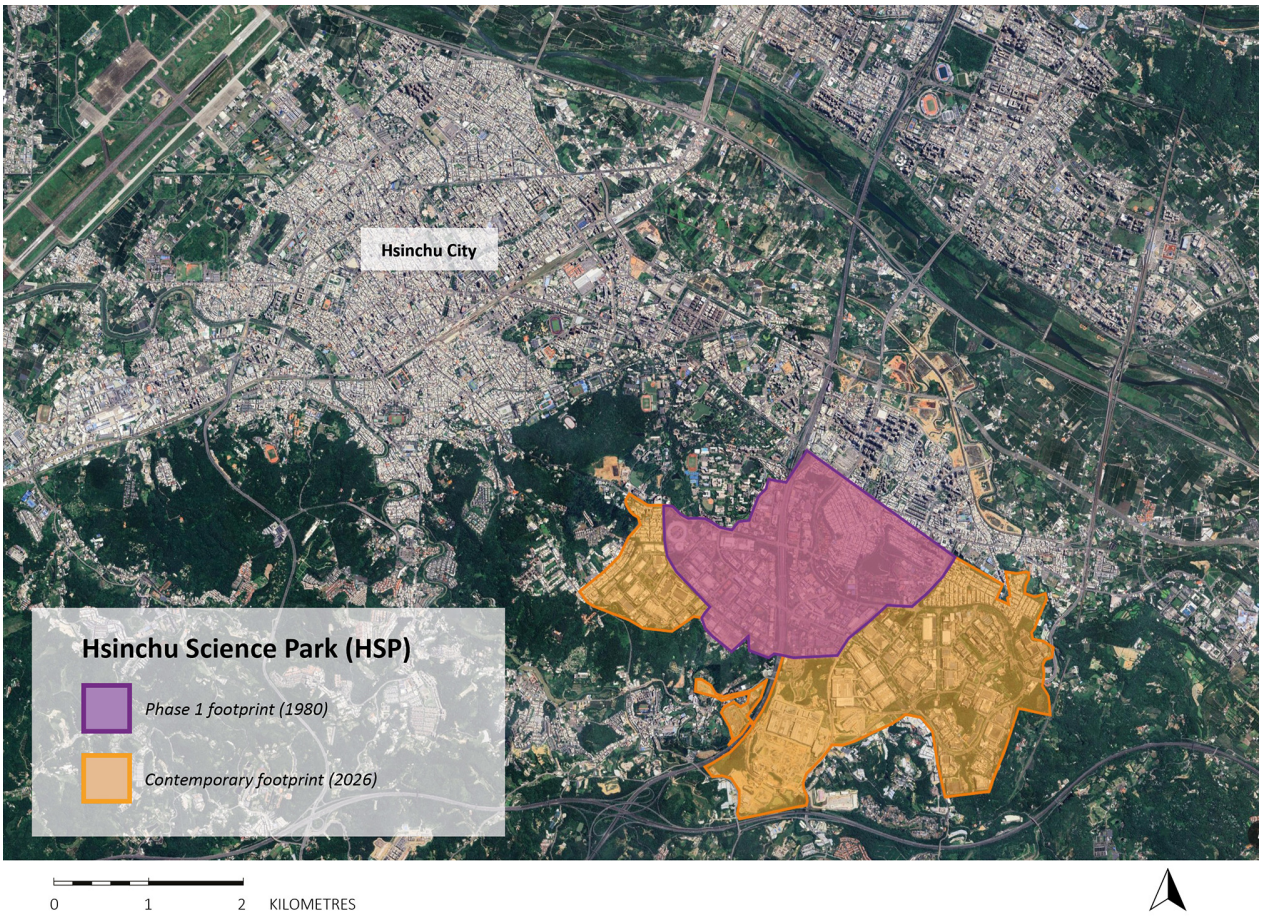

Figure 2. Hsinchu region with growth of HSP. Source: Adapted from Google Earth (Google, 2026), and data from International Demonstration Irrigation Processing Center (2026).

cosmopolitan landscape of bungalows and glass factories stood in visual contrast to the dense urban landscape of Hsinchu City and the traditionally rural Hakka villages of Hsinchu County. The territorial distinction was enhanced through material, economic, and regulatory means by the construction of perimeter walls and controlled access gates requiring special permits (Hsu, 2018a, p. 492). Additionally, a separate administrative entity subject to the National Science and Technology Council, unaffiliated with the governments of Hsinchu City or County, was created to oversee the park (So, 2006, p. 70), precluding local governments from directly sharing in its wealth creation.

The HSP entered a new era in the mid-1980s with the emergence of the integrated circuit (IC) sector as semiconductors increasingly became vital components of everyday technologies. Although United Microelectronics Corporation was the first semiconductor company established in the HSP, it was TSMC's rise as the world leader of IC fabrication that cemented the park's trajectory. Over subsequent decades, as the digital revolution brought the popularisation of personal computing, a near-global proliferation of smartphones, followed by the AI boom, the high-tech output of the HSP has come to take on a rhetoric of both economic miracle and salvation. As Taiwan's IC sector revenue is expected to total 270.7 billion USD (Taiwan Semiconductor Industry Association, 2026), the industry has additionally strategically positioned Taiwan amidst the US–China "Techno-Cold War," gaining the moniker the "silicon shield" (Lin et al., 2025).

This narrative of national redemption is an insistent presence within multiple levels of state functioning. In an address marking his first year in office, President Lai evoked Taiwan as "the world's silicon island" (Office of the President, 2025), totalising the imaginary of the HSP to a national scale. At a local level, the transformative power of this techno-industrial imaginary emerges through an enduring pattern of prioritisation over nearby rural and urban systems. National security, industrial urgency, and global competitiveness converge into an exceptional status that justifies the differentiation of the park, bypassing surrounding socio-ecological realities. Kollar (2026) describes how mandated fallowing of agricultural lands has become routine for rural farmers in surrounding counties as water resources are diverted to the HSP, with Taiwan's hydrological systems configured as mechanisms of techno-statecraft that legitimate exceptions and consolidate a spatial order centred on high-tech accumulation.

The position of the HSP as an instrument of marginalisation within the surrounding social configurations is distilled by the comments of former Hsinchu City mayor, Jen-chien Tsai, who satirised the area as a "technology colony" (So, 2006, p. 77). The comments reinforce a disarticulation that is observed by Wang (2023) in a study of the segregated mnemonic geographies of "old-timers," lifetime residents of the Hsinchu region, and the "newcomer" skilled workers employed within the HSP. The study notes that the HSP's ascendancy initiated a regional identity shift from historic city to technopole, creating a contested psychic landscape that hardened the social and economic divisions between the groups into an uneasy status quo. This was exacerbated by development plans oriented towards "globally influenced city expansion and improvement" (Wang, 2023, p. 258) that failed to generate inclusion between resident groups. Read alongside its economic, territorial, and material differentiation, these social rifts ground the HSP's functioning within an optimisation or bypass of local identity and memory, ordered against a capacity to smooth the planetary passage of commodities and state narrative.

2.2. Sunguvarchatram and State Industries Promotion Corporation of Tamil Nadu Sriperumbudur

Tracking the configurations of Chennai's urban edges, Gajendran (2016) distinguishes three phases: the colonial, the post-independence, and the post-neoliberal. Within the post-independence period, as part of a wider pattern of subnational state management of industrialisation, the State Industries Promotion Corporation of Tamil Nadu (SIPCOT) was created in 1972 to financially produce and administratively support industrial corridors. Through mechanisms such as tax holidays, credit entities, and import facilities, alongside a system of licensing, state entities held strong influence over the physical location of medium and large-scale industrial projects (Kennedy, 2007, p. 318). With the transition to neoliberalism in the 1990s, competition to attract lucrative international partnerships ramped up amongst individual Indian states, marking a period of deregulation, privatisation, and removal of administrative controls (Chandrasekhar, 2010). As the economy "opened up" at a national and state level, the role of the Tamil Nadu government was reconfigured into one of competitive gatekeeping, enacted increasingly through public-private partnerships with a "who's who" of transnational companies. The neo-liberalisation of state industrial planning had spatial ramifications, upending the prohibition of industrial estates within 50 kilometres of metropolitan areas due to concerns over pollution, saturation of urban infrastructure, and migration from rural areas. As controls loosened, SIPCOT corridors emerged in areas 30 and 40 kilometres outside Chennai, representing a shift towards state-driven anticipation of private demand for agglomerated growth pole configurations around the city's logistics and infrastructural networks (Kennedy, 2007).

The manufacturing plants of the 1990s provided an administrative rubric and territorial footprint for the intensification of SIPCOT parks in the 2000s, resulting in the formation of four key hinterlands ranging in focus from logistics hubs, power stations, watershed capture, and IT services parks (Woiwode et al., 2024). Economically and geographically central within this arrangement of hinterlands is the Chennai-Bengaluru Industrial Corridor, a mixed-sector strip extending west containing early SIPCOT parks, such as Ranipet, and some of the largest, including Oragadam. The emergence of this industrial formation, argue Homm and Bohle (2012), stems from two development strategies: a comprehensive IT policy produced by the state government in 2002, and the formalisation of existing incentive structures into territorialised Special Economic Zones (SEZs). Approved in 2012 and brought under SIPCOT's remit, the SEZ's standardised exceptional fiscal packages of tax and tariff relief into duty-free enclaves while minimising regulation. Fundamental to this incentive structure is exceptional access to water and electrical services, prioritising industrial consumers over everyday residents (Homm & Bohle, 2012, p. 292), further disarticulating the hinterland from its surroundings.

Within the Chennai-Bengaluru Industrial Corridor, this exceptional arrangement of economic and resource incentives encountered the digital revolution, ushering in techno-industrial actors including Samsung, Dell, and Nokia, all of which established operations in a SIPCOT park and SEZ outside of the small town of Sriperumbudur. Nokia set up the world's largest mobile handset manufacturing plant in January 2006, bringing suppliers such as Foxconn, a manufacturing and assembly company which dominates the offshore labour-intensive side of Taiwan's consumer electronics industry, complementing the "at-home" capital-intensive suppliers such as TSMC (Hao & Bu, 2022). By 2014, with the shuttering of Nokia's Sriperumbudur operations, Foxconn, now firmly the world leader in electronic manufacturing, was preparing to exit Tamil Nadu. By 2017, the geopolitical landscape had shifted, and the Tamil Nadu government sought to capitalise on Taiwanese companies looking to diversify manufacturing away from China (Venugopalan & Misra, 2025). Building on the existing SIPCOT framework and SEZ mechanisms, 49 acres were earmarked for Foxconn factories to begin iPhone production deeper into the Chennai-Bengaluru Industrial Corridor, next to the village of Sunguvarchatram (see Figure 3). For a community listing a population of 4,000 in 2011 (Directorate of Census Operations Tamil Nadu, 2011), the emergence and subsequent expansion of the Foxconn plant to 180 acres has been transformative. As the state seeks to deepen networks of world-class urban infrastructure, deploying what Goldman (2021) characterises as "a spectacular imaginary on *what could be*" (p. 6, emphasis in original), Sunguvarchatram faces the construction of a pending 5,746-acre greenfield airport 10 kilometres away and an incoming four-lane Bengaluru-Chennai Expressway less than a kilometre to the north.

In the present moment, the socio-spatial order of Sunguvarchatram is reconfigured by the sustained status quo of exceptional and parallel governance projected from the SIPCOT factories, rendering the village an afterthought against the functioning of the plant. The region faces ecological difficulties ranging from pollution associated with industrial effluents and vehicular emissions (Sundarrajan & Velmurugan, 2016) to continued strains on groundwater from the needs of SIPCOT factories (Gajendran, 2016). To service the labour needs of the factories, fragmented housing and transportation have shifted Sunguvarchatram towards absorbing workers, ferried to work every 8 hours at shift changes by a motorcade of employee shuttles. This housing question continues to usher in a wave of splintered land speculation as developers become key actors in a process of transforming agricultural land for urban real estate (Raman, 2016, p. 84). The public spaces of Sunguvarchatram have witnessed additional transformation as sites of protest and conflict spilling over from

nearby factories. As an attempt to become ever more attractive within an increasingly competitive global and intra-national field, Tamil Nadu reclassified SEZs as "public utility services," enabling strict parameters around de jure "legal" strike action for workers (Dutta, 2016, p. 45). This, in addition to highly securitised architectural mechanisms, has meant that labour disputes and organised protests are conducted within the public coordinates of Sunguvarchatram.

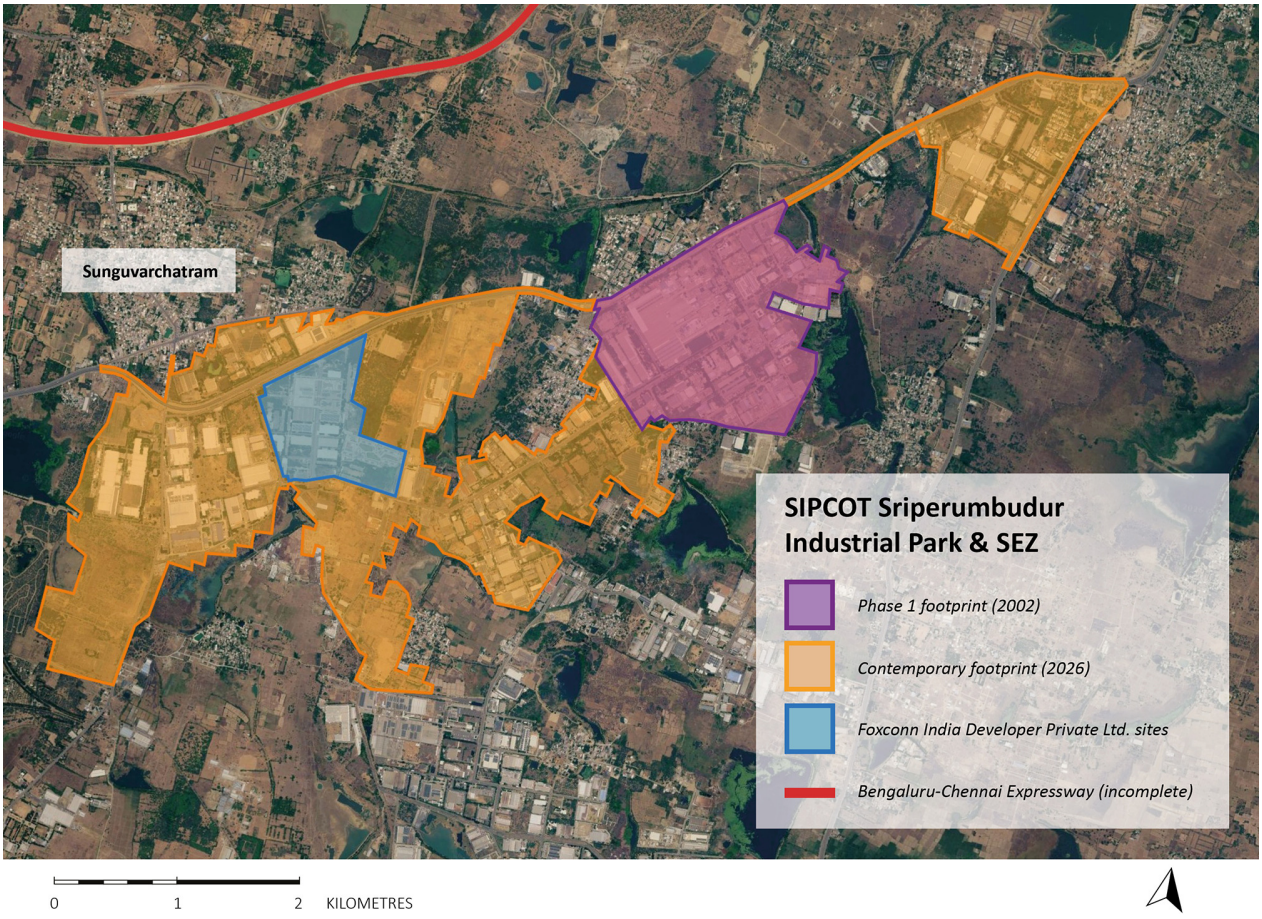

Figure 3. Sunguvarchatram region with growth of SIPCOT Sriperumbudur Industrial Park and SEZ. Source: Adapted from Google Earth (Google, 2026), and data from SIPCOT (2026).

3. Methods

Given the dense historical backdrops and layered present conditions of these two divergent hinterlands, the first step within the process of identifying relevant methods is assessing the mode of connection and comparison. Chen (2010, p. 215) maintains that understanding inter-Asian positions amidst modernisation is enhanced through ongoing processes that foster recognition of the similar pressures and trajectories experienced by, and impressed upon, others. Indeed, the connective tissue between these high-tech landscapes has become big news, gaining coverage in *The New York Times* (Travelli, 2024). Such accounts, however, predominantly compose contact at the register of the planetary, detailing the emergent economic, material, and corporate ties while upholding an empirical lacuna regarding the situated realities within which these flows converge. To comprehensively extend Chen's (2010) assertion into techno-urban hinterlands demands methods that foster comparison at two registers simultaneously: looking "upwards" as extended

modes of planetary movement constitute coordinated paths and nodes, and "below" where these processes are impressed and experienced within the geographies of ordinary life.

To engage this methodological concern, the study extends participatory smartphone 3D scanning employed at the interface of walking-based and sensorial reflection as an avenue towards outcomes that diversify frames of reference and multiply moments of contact between subjectivities. 3D scanning encompasses a range of techniques for generating 3D models from real-world subjects, including laser scanning, structured-light scanning, and photogrammetry. In contrast to the former modes of scanning, which require more specialised equipment, photogrammetry generates 3D models from 2D photographic data taken by a camera on the ground (terrestrially) or mounted to an aircraft or drone (aerially). Contemporary digital photogrammetry pipelines typically use a minimum of 20 photographs to be processed by cloud-based structure-from-motion (SfM) algorithms, which plot 3D points by locating homologous features across image data (Cascarano et al., 2025). Wilken and Thomas (2022) argue that photogrammetry's recent automation and increased availability via smartphone applications have opened up this technology, once monopolised by state cartographic organisations. From this perspective, 3D scanning can be seen to be maintaining a participatory moment in which access to the technology brings new opportunities of representation into urban research (Tait et al., 2016).

Much of the existing research regarding participatory photogrammetry presents aerial mapping as a countermapping technology which may unsettle the relations of power inscribed within cartography projects (Fish, 2020). Scholarship has yet to rigorously discuss the "on-the-ground" perspectives of terrestrial scanning. In absentia, this study looks to neighbouring lens-based practices to guide the discussion of embodied encounters with urban space. Notably, Cheng (2014) maintains that photographing spaces on foot brings our bodies into conversation with the environments it moves through by affected attraction (and distraction) to its ordinary socio-material components. The camera becomes a device that invigorates the relationship between the bodily senses, materials, and rhythms that frequently lie dormant within our daily encounters with a city, constituting a sensorial encounter that includes seeing, hearing, and feeling (Cheng, 2014, pp. 212–213). For Cheng (2014, p. 217), this perspective renders the act of photographing "from below" a generative and inventive praxis, one attuned to the felt presences and absences of the global as it inhabits the mundane objects and marginal spaces of the streetscape, presenting a means of sensing and feeling our way into alternative configurations of the planetary and the local. This article aligns terrestrial 3D scanning within this position, understanding the practice of smartphone photogrammetry as a walking-based encounter that likewise draws our perspective to the material and sensorial traces that constitute everyday urban life amongst the *felt* presence or absence unfolding of global flows that are always unfolding within the local sense of place (Massey, 1994).

3.1. Workshops and Website

In the Spring and Summer of 2024, two workshops were conducted in Chennai and Hsinchu City with the support of local stakeholder institutions: the Chennai Photo Biennale and the Hsinchu City Art Site of Railway Warehouse, respectively. A call for participants was disseminated in advance through each institution's networks, drawing a diverse group of local students and professionals alongside artists, activists, and architects (20 participants in Chennai and 15 in Hsinchu City). Each workshop followed a two-day multimodal structure. The first day provided technical training with a 3D scanning application on

participants' smartphones, pairing lecture-based overviews with hands-on practice in pairs (see Figure 4). In an effort to encourage participants to connect 3D scanning to sensorial reflection, the sessions drew from Arnold's (2019, p. 2) assertion that sensory ethnography, lens-based practices, and walking cooperate to become "not only a study of the city but also a study of the experience of the city," by accompanying technical learning with group worksheets prompting participants to direct their attention to what was experienced at the location of their scan. The workshops employed Polycam, a terrestrial 3D scanning application that creates high-quality 3D models via a photogrammetry pipeline that integrates analysis of images captured with a smartphone's camera with positioning data through an SfM algorithm (Cascarano et al., 2025, p. 215). The Polycam application was additionally selected for its free access, ease of use, and compatibility across iOS and Android platforms (see Table 1).

Figure 4. Participants practising 3D scanning in pairs in Hsinchu City.

The second day opened with a walking-sensing-scanning session along a pre-planned route through public areas of Sunguvarchatram and Hsinchu. Each route took participants through community areas near factory sites while avoiding entrance into dedicated industrial spaces. These routes were selected both because the industrial sites are highly securitised zones that restrict public access, and for the explicit aim of engaging with context-specific transformations occurring within everyday spaces that sit outside the exceptional status conferred on their techno-industrial neighbours. Participants operated in pairs for safety and technical support. Each pair received an information sheet with a route map and schedule, enabling self-determination of paths and timings, as well as a worksheet to structure their experiences, senses, and thoughts. The worksheet provided question and response sections encouraging participants to connect 3D scanning activities to wider socio-political ("What forces of transformation are at work?"), agentic ("What attracted you to this location?"), and sensorial contexts ("What do you hear, smell, feel, and think at this location?"). Upon completing the on-site session, the workshop relocated to a workspace where participants shared one 3D model. During this concluding session, participants cross-referenced their notes with their scans, framing their understanding of the encountered landscapes through personal affect and experience.

Table 1. List of smartphone devices and versions of Polycam used.

Smartphone Device	Polycam Version
Chennai Workshop—May 2024	
Apple iPhone 14 Pro Max	3.4.8 (iOS)
Apple iPhone 14 Pro	3.4.8 (iOS)
Apple iPhone 11 Pro	3.4.8 (iOS)
Apple iPhone 13	3.4.8 (iOS)
Apple iPhone 12 Pro	3.4.8 (iOS)
Apple iPhone 15 Pro	3.4.8 (iOS)
Hsinchu Workshop—July 2024	
Apple iPhone SE (3rd Generation)	3.5.3 (iOS)
Apple iPhone SE (2nd Generation)	3.5.3 (iOS)
Google Pixel 8	1.3.10 (Android)
Apple iPhone 15 Pro	3.5.3 (iOS)
Samsung Galaxy A15	1.3.10 (Android)
Apple iPhone 12	3.5.3 (iOS)
Apple iPhone 8	3.5.3 (iOS)
Apple iPhone 13	3.5.3 (iOS)

Unique to 3D objects, this later encounter enabled participants to intimately navigate the 3D space, developing and sharing their interest and motivations by panning and zooming in three dimensions.

Through the sharing of outputs, experiences, and reflections, parallel themes formed across the two research contexts. The nascent flow of symmetries and resonances, however, met friction against the difficulties of bringing the two sessions into closer dialogue due to geographical distance, language barriers, and participant scheduling. Through discussion with participants, it was decided that a website would be developed enabling workshop outputs to acquire thematic and digital proximity, while building on the walking-based dimension of the sessions by allowing users to navigate their own path through a web-based gallery of reflections and materials. In the proceeding months, a platform was built featuring workshop outputs in a gallery that could be navigated freely or sorted into thematic groupings (see Figure 5). Each image in the gallery led to a dedicated page featuring an interactive 3D model deployed using three.js and a short reflection written by the participant.

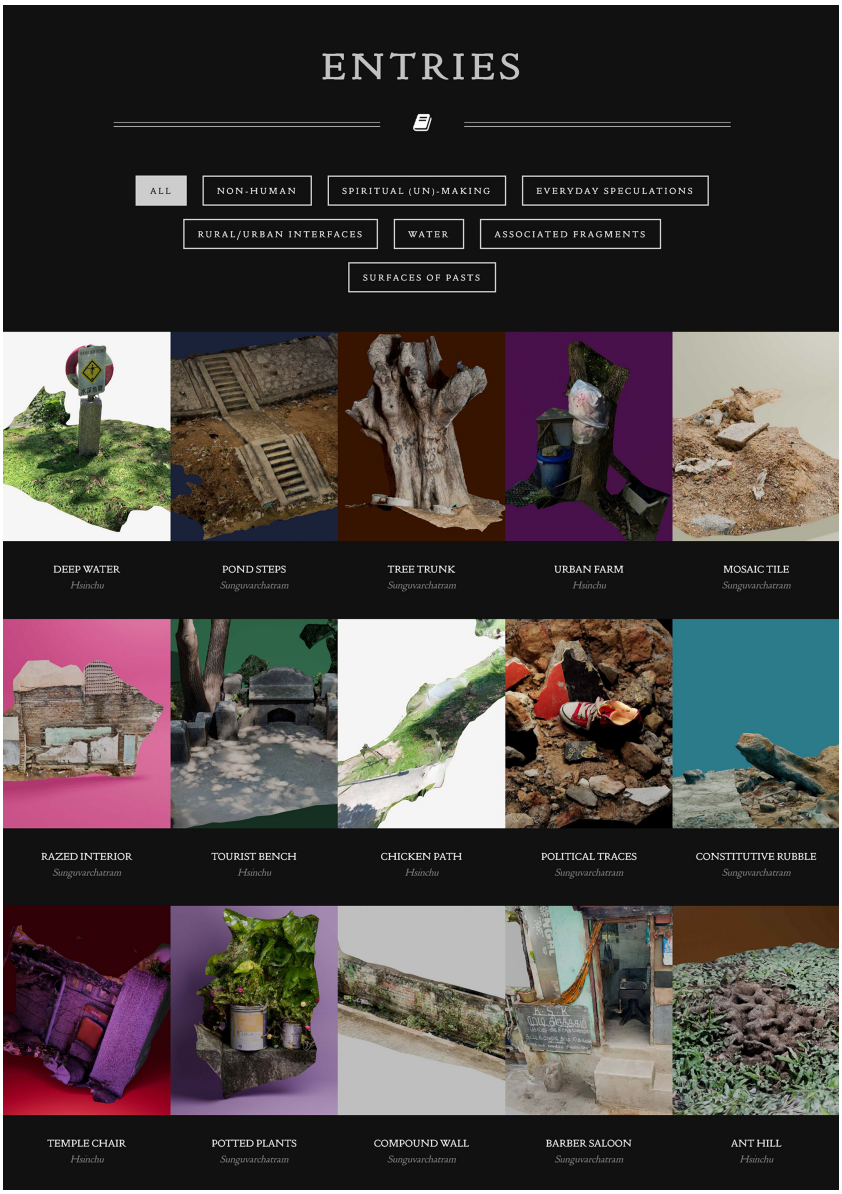

Figure 5. A screenshot of the Techno-Urban Atlas gallery with thematic groupings.

4. Results

Across both workshops, participants effectively used smartphone photogrammetry to record materials, bodies, objects, buildings, and landscapes. In both sessions, participants produced 3D objects and recorded sensorial observations expressing a felt tension between the regions as places composed through the quotidian practices of residents and the imposing logic of planetary flows associated with the tech industries. This tension rarely occurred through material juxtaposition within the same scan, instead registering to participants through the traces and residues indirectly associated with change and transformation. In the Hsinchu region, such tensions were predominantly sensed as a totalised urbanisation, with salience rising from extant non-industrial phenomena. While in Sunguvarchatram the tensions were sensed as ambient and fragmented, with the ordinariness of daily life looming under latent and uneven transformation associated with the expansion of the neighbouring industrial park.

In Sunguvarchatram, a central theme expressed by participants derived from feeling unsettled by the incomplete landscapes and debris remaining from ongoing transformations. This was exemplified by a participant who 3D scanned a half-demolished house, noting that its incomplete structure represented the violent interaction between the past and a developed and globalised future (Ruba; see Figure 6a). Another participant recorded fragments of a razed house in a pile of rubble, noting that something as concrete as a home could be removed and forgotten (Aaditya; see Figure 6c). Some participants felt hope from the perceived sense of community resilience to industrialisation, exemplified by a participant who 3D scanned a plant potted in a paint tin, feeling it represented new life growing precariously into the future (Ranjani; see Figure 6b). In Hsinchu, the feelings centred around surprise at finding extant human and natural phenomena that were perceived as disconnected from the artificial and totalised techno-industrial landscape. This feeling was located in anachoristic smells such as wet soil and cooking smells carried by the breeze and

Figure 6. Participant 3D scans relating to aspects of transformation: (a) Sunguvarchatram: Razed wall (*Ruba*); (b) Sunguvarchatram: Potted plants (*Ranjani*); (c) Sunguvarchatram: Mosaic tile (*Aaditya*); (d) Hsinchu: Anthill (*Chien*).

sounds such as the wind and birdsong. One participant concentrated on 3D scanning an anthill dug on an otherwise manicured and sterile lawn, a surprising and discordant presence within the abstracted space of the HSP (Chien; see Figure 6d).

A primary theme that emerged from the qualitative responses and 3D models was a texture of inexorability that extends from the totalising exceptionality of the techno-industrial hinterlands. As Follmann (2022) reminds us, an essential aspect of peri-urban regional variegations is a futurity that is spatially and temporally contingent upon forces that may never materialise. Analysis of the peri-urban must remain porous to the multiple and nonlinear processes of transformation that are *"not-always-transforming-into-urban"* (Follmann, 2022, p. 9, emphasis in original). Resonating with this point, inexorability perceived across the two sites manifested as questioning or identifying that non-industrial ordinary life was inevitably destined for reconfiguration. In Sunguvarchatram, this sentiment was evoked by reading everyday locations as on the cusp of loss or transformation. An outdated barber shop was read as a short-lived artefact surely to be lost with further development: "Such shops here will soon become a relic of the past with more branded shops of different sizes" (Anshul; see Figure 7a). Another participant was invited to 3D scan a cinema by its owner, who discussed how he was renovating in anticipation of new workers coming to the area. The participant reflected that "a decades-old traditional building renovated as speculation in the area grows. This reflects the broader changes happening in Sunguvarchatram due to the arrival of global capital. Even a small local region is connected by the world and economy" (Yuvan; see Figure 7b).

In Hsinchu, the notion of inexorability is expressed through the surprise of finding non-industrial practices persisting within the urban fabric. A group of participants was amazed to stumble upon a small unauthorised farm tucked amongst the backstreets, a practice found to be incongruent against the backdrop of the HSP. Here, a participant 3D scanned a developing fruit that had been carefully wrapped in a plastic bag, writing of it as a metaphor for such enduring irregularities: "This is an image of the city growing, yet not fully" (Yan-ze; see Figure 7c). Another participant found resonance with the HSP's own infrastructure as a "memento mori" of the techno-optimism that infuses the park: "A telephone booth built in the centre of the Hsinchu Science Park. Despite its sleek design, it has also become a fossil of a different time, and now out of place" (Yan-ling; see Figure 7d).

Across both workshops, the outputs converged on a shared relation to inexorability, registering the tension between planetary flow and place-based practice through a techno-industrialism that is grounded by a sense of totalizing reconfiguration. Through an embedded methodology that directed 3D scanning technologies "from below," the workshop outputs organised and expressed this sentiment into differing temporal orientations: In Sunguvarchatram, notions of place were unsettled by transformations perceived as emergent yet incomplete, whereas the Hsinchu region contained practices that were felt to have improbably remained.

Figure 7. Participant 3D scans relating to themes of inexorability: (a) Sunguvarchatram: Barber saloon (*Anshul*); (b) Sunguvarchatram: Cinema interior (*Yuvan*); (c) Hsinchu: Urban farm (*Yan-ze*); (d) Hsinchu: Phonebooth (*Yan-ling*).

5. Discussion

The following section reflects upon the topic of inexorable transformation emergent from the workshops in relation to two conceptual pairs, the rule of exception and hyperbuilding, and bypass and hinterlands, before reflecting on 3D methods in relation to existing lens-based methods and their potential for new framings of comparison and dissemination.

The theme of inexorability located across the workshops resituates our expectations of what exactly is being constructed within exceptional-ised landscapes of hinterlands in relation to futurity and the insistence by which it arrives. Returning to the rule of exception as the permissive foundation upon which the edifices of

global economic capture and state imaginary are (hyper)built, Ong (2011, p. 209) argues that the ultimate function is to secure the articulation of certain aspirations and expectations. The future, therefore, is restaged as an adamant guarantee of economic and state progress which is reflexively employed to justify further hyperbuilding and additional exceptional statuses. Read through this lens, participants encountered two sites in which an exceptional future is in comparative stages of emergence. Around the HSP, the rule of exception has been substantiated over five decades and totalised at a national scale, providing salience to materials, actors, practices, and objects that are perceived to have survived its consolidation. In Sunguvarchatram, where the techno-industrial assembly remains in varying states of arrival, a related logic is encountered as an anticipation of a future rendered as assured yet not fully constituted.

In composing the exceptional differentiation of the enclaves as a strategic technique of futurity retention, the workshop outputs open a lens to regard the hinterland's inscribed tensions between the local and the planetary as, in part, a variegated event of material and ideological construction. The totalising insistence of the techno-industrial landscape's inexorable future resonates as an additional mechanism by which hinterlands are spatially and epistemologically configured to bypass the unnetworked individuals who are externally rendered as frictions to be bypassed. The action of circumvention serves to marginalise the residents within the present as much as it facilitates the foreclosure of a right to futurity. This positions the methods and practices discussed within this article amongst Arabindoo's (2020, p. 220) urgent call for finding methods of visualisation that meaningfully compose the hinterland's "uneven capitalist development" and "unprecedented forms of creative destruction," as a pathway to digitally and sensorially bear witness to what remains outside of a supposedly inexorable presentation of a necessary future.

It is necessary here to raise certain challenges and opportunities that emerge from 3D scanning as a method. Rose (2014) argues that visual research methods must engage not only what visual materials represent, but their circulation and usage as communicational tools. Framing the 3D object as both a visual material and an instrument of visual research, the 3D object departs from other visual methods, namely photography, in two respects in relation to representation and circulation. First, unlike photography, which constructs a picture place through the relationship of foreground and background, photogrammetry models present subjects in isolation, detached from the spatial context that surrounds and contextualises the source object. This type of background data can be essential for representing socio-political contexts. Here we should consider the photograph of P. Kumar (see Jayaraman et al., 2025) in Chennai's Ennore Creek, where narrative is powerfully expressed by the juxtaposition of foregrounded fisherfolk and the backgrounded columns of the ecological catastrophe that is the Ennore Thermal Power Plant. To a degree, 3D objects may possess a self-contained juxtaposition with their subject matter, exemplified by the contrast between organic and anthropogenic materials (see Figure 6b). However, it is recommended that participatory 3D scanning take extra care to situate the isolated outputs amongst the richness of the environments that surround and inform them. Drawing again from Arnold (2019), the worksheets provided a useful means for participants to record personal experiences, strengthening the relationship between the 3D model and the unscannable encounters and feelings of being in the world.

Second, 3D objects gain new capacities to compose comparison as highly mobile fragments. In contrast to the photographic image, which presents representations within the framing device of a cropped border, outside of which the world presumably exists yet is not expressed, photogrammetry produces objects that exist in digital space as fragments, the only borders appearing at the edge of their own materiality. Unlike the more

complete photograph, the 3D object aligns with McFarlane's (2021) notion of the urban fragment, a disparate and disharmonious poetic entity that trades coherence for an ease of circulation between intersecting lines of thought. This fragmentary circulation underpins the Techno-Urban Atlas as an online arrangement that does not establish equivalence between the two hinterlands, but stages resonances between particular 3D objects, enabling a "looser form of juxtaposition" (McFarlane, 2021, p. xix) to proceed across multiple lines of comparison that are initiated by the user. This form of user-led comparison is guided by Chen's (2010, p. 212) assertion that emergent subjectivities, horizons, and perspectives may form through the processual contact of inter-Asian imaginaries, seeking to use the mechanics of the website to render for the user an open and navigable pathway to what Niranjana (2022, p. 106) terms the "other locations on the map."

6. Conclusion

This article has argued that peri-urban research scholarship requires frameworks capable of holding place-based and flow-based lenses in tension, a requirement that is as much methodological as it is conceptual. Approaching Sunguvarchatram/SIPCOT Sriperumbudur and the Hsinchu/HSP regions as techno-industrial hinterlands illuminates how such enclaves are sustained through a rule of exception (Ong, 2011) while bypassing the ordinary material and practised coordinates of the city (Arabindoo, 2020). Participatory smartphone photogrammetry is proposed as a potent means for encountering these conditions "from below" (Cheng, 2014), underpinned by two workshops within the regions that encouraged participants to position their 3D models within a broader sensorial landscape. The interaction of digital and embodied methods enabled the emergence of a comparative relationship to the inexorability of techno-industrial transformation through differing angles of fragmentation and totality. In detailing the workshops' secondary stage of building the Techno-Urban Atlas, the article has discussed how the outputs of 3D scanning methods, as both fragmented yet highly mobile digital objects, may circulate in web browsers to create novel modes of user-led and cross-context comparison and understanding.

Several matters for further action surface from the discussion of this fledgling and experimental methodology. Terrestrial scanning remains under-theorised against aerial mapping methods, beckoning further discussion as to what is afforded when technologies of 3D representation are at once opened up to the public and positioned towards everyday landscapes. This article has focused on the capacity for such methods and technologies to render the interfacing tensions of the planetary and the local within the unresolved epistemologies of the peri-urban. This author sees great potential in and eagerly encourages the deployment of integrated modes of digital and sensorial responses to additional urban contexts.

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Conflict of Interests

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Data Availability

All research data can be accessed at https://www.latentspace.com/TUA.html

LLMs Disclosure

Components of the three.js JavaScript library deployed within the website discussed in this article were coded using LLM assistance within Visual Studio Code.

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About the Author

Richard Müller is a PhD candidate at University College London's Department of Geography, researching themes of everyday para-formal transformation in Asian urbanisms. As an artist and research practitioner, he is interested in how art-making, practice-based engagements, and transdisciplinary collaboration can bear witness to urban processes.