Performing an urban digital twin: Diffracting the city imaginary

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Abstract

Urban digital twins are described as virtual replicas or representations of physical space. Through an autoethnographic encounter with Digital Twin Victoria alongside visual demonstrations by and interviews with spatial industry professionals, this paper analyses two performances of the digital twin to diffract the city imaginary it presents. By visualising the city within the computational standards and selective layering of geolocated datasets, the digital twin produces a singular vision of a perpetual present. When navigated with digital skill and aligned through a 'comforting' aerial view, the digital twin performs an expected, beautiful city. Yet as I, lacking such skill, clumsily descend to street level, it performs an increasingly monstrous city. With reference to Australian artist Stelarc's *Exoskeleton* and French artist ORLAN's surgical performances, I analyse my failure to perform the coherent city to demonstrate how such performances reveal the politics of failure and challenge normalised expectations of what it is to be human, to be beautiful or to be a city. I argue that paying attention to the visions revealed within moments of failure, or gaps within the standards, contributes to reframing such moments as openings to alternative city imaginaries.

Keywords

Urban digital twins, urban imaginaries, visualisation, representation, standardisation.

Introduction

In August, 2022 the State Government of Victoria launched Digital Twin Victoria (DTV), an urban digital twin with a publicly–accessible online platform. [1] Urban digital twins are data–driven 3D models that are being developed in cities including Singapore, Tokyo, Helsinki and Rotterdam, amongst others, to differing levels of capability and for different purposes. They are often described as virtual replicas or representations of physical space; they include multiple datasets (including real-time datasets) that can be loaded as separate layers in the model. As a government–owned and managed infrastructure platform, Digital Twin Victoria includes over 4000 datasets including local, state and national government datasets together with data produced through partnerships with private industry and community groups. It is intended to contribute to decision making and enable greater collaboration for the planning and management of the state by bringing all data relating to the state together in the one digital platform. This paper is based on research that has involved analysing this platform and its promotional videos, and interviewing spatial and technical professionals involved in developing the digital twin. Presenting two performances of the digital twin, I discuss how its visualisation is a performative practice enacted through the collaboration of various actors, including the person using the digital twin. While Digital Twin Victoria includes data about the whole state, my focus in this paper is on the visual representation of the city of Melbourne and my aim is to demonstrate how the skills, intentions and capacities involved in this visualisation can reveal very different visions of what the city might be.

The foundation of the digital twin is a Geographic Information System (GIS) and all data in the platform is geolocated; the base maps are constructed from satellite and aerial imagery; there are 3D photomeshes created through photogrammetry; there are Building Information Models (BIM); and there are vector graphics and tabular statistics that represent data created through various collection methods including Internet of Things sensors, planning regulations and the national census (see Figure 1). Some of these datasets update in real time. If the digital twin can be described as 'seeing' the city it's because all this data is presented to the user as a visual representation—a visualisation enabled and produced through computational standards. As Bowker and Star have defined them, "A 'standard' is any set of agreed-upon rules for the production of (textual or material) objects." [2] Standards persist across communities and over time and, once agreed, can be very difficult to change. Participants interviewed in this research emphasised that creating data standards that enable diverse datasets to be visualised within the one digital platform has been one of the main priorities (and challenges) in developing the digital twin. As many feminist and science studies scholars have
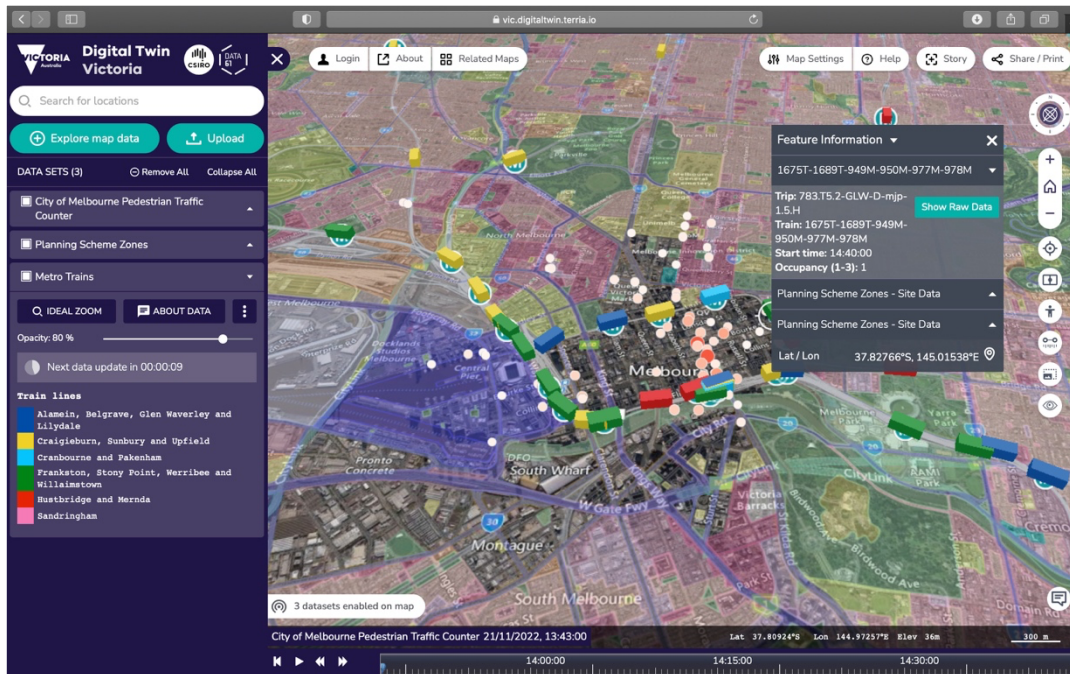
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Figure 1: Digital Twin Victoria screenshot with Pedestrian Traffic Counter, Planning Scheme Zones and Metro Trains datasets loaded. Screenshot taken by the author.

representation of the real world, and yet this claim also asserts that the city is knowable through what Briggs et al. have argued is a quantified representation of space but not place. [4] This limits the kinds of cities that can be envisioned and planned through the digital twin and it also limits the potential for the digital twin to become the place for collaboration that research participants hope it will because, as Brian Massumi and Bruno Latour have both argued, politics does not happen in standardised spaces. [5] [6]

Performing the City

The Coherent City

In a public webinar run by the Digital Twin Victoria team to promote the digital twin to potential users, a DTV staff member's demonstration in the platform showed how their expert navigation produced coherent views of the city (Figure 2). The demonstration, which involved switching between a selection of prepared datasets and perspectives, presented the digital twin in constant motion, conveying a dynamic sense of control over the city and

argued, the computational standards on which the platform is based have been developed in particular socio-historical contexts and reproduce gendered, racist and imperial epistemologies and ontologies. Similarly, visual studies scholars, sociologists and geographers have analysed the geopolitical effects of western cartography and satellite imaging to demonstrate how these enact a visuality constructed through what Martin Jay has called the scopic regimes of modernity. [3] The digital twin combines these technological and visual standards in its aim to render the complexity of the city visible on a single screen. Promotional materials and research participants both claim that such a standardised visualisation is a
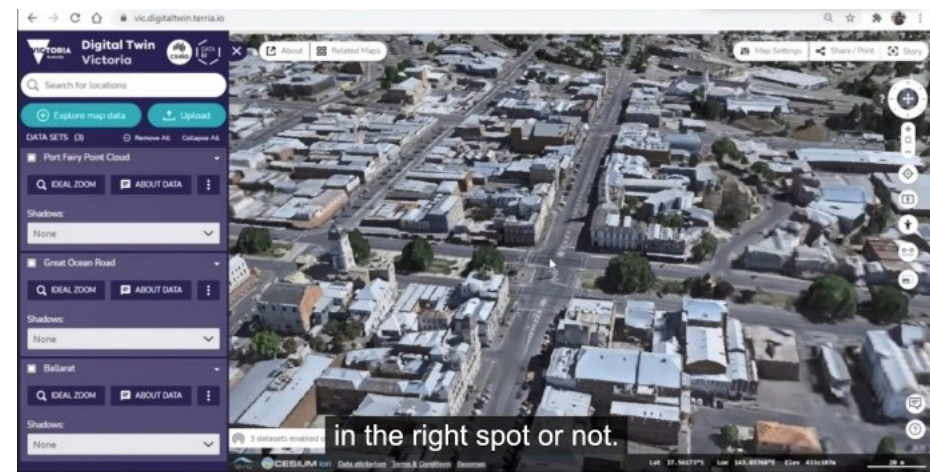

Figure 2: Digital Twin Victoria showcase (13 October 2022) screenshot. Expert navigation produces a coherent view of the city. Screenshot taken by the author.
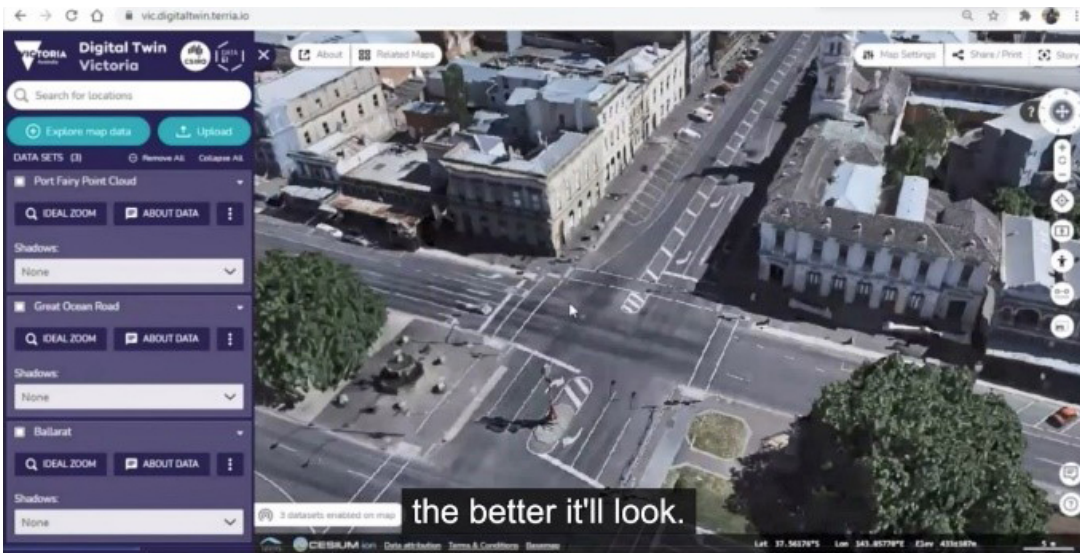
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Figure 3: Digital Twin Victoria showcase (13 October 2022) screenshot. The city viewed from the 'comforting' oblique aerial perspective. Screenshot taken by the author.

broader environment. Even though the demonstrator jumped between different places and perspectives, each selected location presented a coherent view, almost always from the oblique aerial perspective that Gillian Rose has described as 'comforting' because it generates "the pleasure of seeing things together, pictorially composed." (Figures 3) [7] The one time the demonstrator did descend to the Pedestrian mode offered in the digital twin, it was within a very high–resolution dataset of the Great Ocean Road, a dataset that was discussed often in both demonstrations and interviews as an example of the beauty of the digital twin visualisation.

Beauty is considered crucial to building trust and attracting users to the platform. As one research participant said, decisions are made about the visualisation "depending on many different factors and one of them is definitely, it should look good." Beauty in the context of the city can be understood as the realisation of what has been described as the "coherent concept of the city as an object" and this is the idea of the city usually evoked within smart cities imaginaries. [8] Promotional videos for the digital twin present a future Melbourne that is liveable, sustainable and efficient, and the official performance of the digital twin participates in the production of a smart cities imaginary of this data–driven Melbourne as a city that can be known, planned and managed by the digital twin. Such visions, or what Ayona Datta and Tariq Jazeel have called utopian urbanism, have been critiqued as economic projects for the expansion of neoliberal profit–making and for participating in legitimizing the violent exclusions and displacements enacted by smart cities developments. [9] Visually, this notion of beauty also reinscribes what many feminist and visual studies scholars have demonstrated to be the gendered, racist and imperial effects of what is presented as, yet has never been, a 'view from nowhere'. [10] Rather, this view represents beauty as the visualisation of Eurocentric associations between nature, desire and capitalist accumulation.

The Monstrous City

In contrast with this official demonstration, my own performance of the city produced a much less coherent place (Figure 4). In response to claims the digital twin would enable greater citizen participation in urban planning processes, I wanted to analyse the accessibility of the platform for people without technical training in relevant fields. I therefore deliberately did not do any GIS training prior to engaging with the digital twin and situated my autoethnographic encounter in the familiar
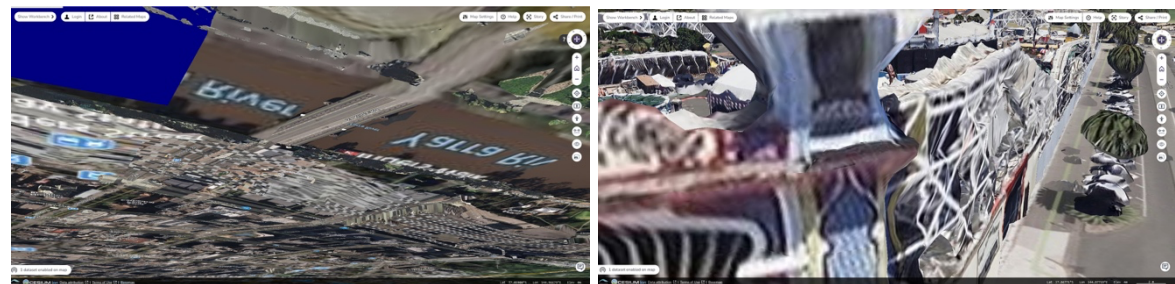

Figure 4: Digital Twin Victoria screenshots. My clumsy navigation produces a visually distorted place. Screenshot taken by the author.
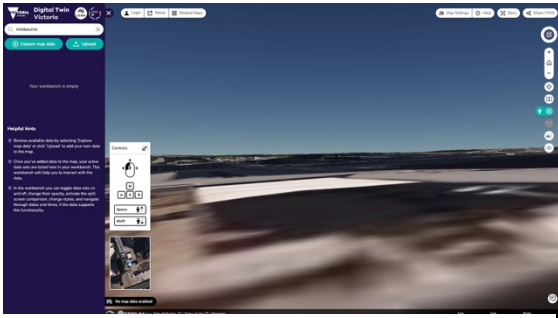
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Figure 5: Digital Twin Victoria screenshot, Pedestrian mode view. Screenshot taken by the author.

environment of my home, accessing the digital twin through the browser on my laptop. In this context, when trying to navigate the digital twin, I often, accidently, zoomed in too far or found myself in certain, possibly wrong, locations, producing a visually distorted place.

I assume that visual distortion is not unexpected in the digital twin because Pedestrian mode is always an option and when I click on it without any datasets loaded, the satellite image of the base map stretches and blurs, creating a distortion that the platform doesn't attempt to hide (Figure 5). And yet there's an expectation that users will have a certain level of digital skill that will enable them to navigate the platform in a way that produces coherence. This makes my clumsy navigation a mistake, leaving me feeling that I'm looking at the city in the wrong way or from the wrong place. With a 3D photomesh of the city loaded into the twin, Pedestrian mode comes closer to resembling the coherent city, but this view is still a fractured and blobby version of what I see when I stand on that particular corner in the city (Figure 6).

I'm aware that it's unfair of me to expect the digital twin to replicate the visual experience I have when I am physically present in the city, partly because embodied experience is never purely visual and partly because research participants repeatedly emphasised that the digital twin is predominantly a representation of the physical environment. The aim of the digital twin, however, is to produce an accurate representation of the city as it is. Even though the inclusion of live datasets entangles the city and its digital twin in bi-directional co-production of both the city and the twin, the digital twin (like the city) is its own place. When read as a representation, however, the visualisation seen on screen is understood to retain objectivity because this co-production is understood to be an exchange of data rather than a sociotechnical process in which people participate.

The digital twin visualisation is also not just the street surface but includes multiple datasets,

for example below ground infrastructure, planning zones or historical flood data, and into which a planner can insert a new building design or model possible evacuation scenarios. So, I'm not denying that this representation can be useful for prediction and management, particularly for emergency and disaster scenarios, or the shadowing effects of new planning developments. Yet, representations, even when they are understood to act as well as reflect, come with the expectation that they refer to an already existing 'object' in the world. Relying on the digital twin visualisation to be the representation that is used for these city planning and management purposes assumes that the standards through which it is constructed can accurately represent the city, as well as any potential problems and solutions. Yet, as Bowker and Star argue, "Each standard and each category valorizes some point of view and silences another." [11]

Figure 6: Digital Twin Victoria screenshot, Melbourne Central 2021 3D Photomesh, shows a blobby, fractured view of the street in Pedestrian mode. Screenshot taken by the author.
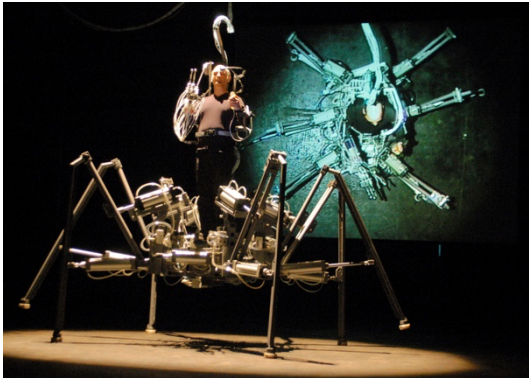
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Figure 7: *Exoskeleton*, Stelarc, Hamburg 1997, Photographer: Igor Skafar

Figure 8: *La Réincarnation de Sainte ORLAN ou images nouvelles-images / 7th Surgical Operation-Performance known as Omniprésence*, November 21th 1993, New York, USA. © ORLAN [22]

If the digital twin visualisation is assumed to be an accurate representation of the real city, then what is it my distorted visualisations represent? Against the beautiful, coherent ideal these visualisations could be described as monstrous in their (mis)representation of the city. And, as Haraway reminds us, "monsters have the same [etymological] root as to *demonstrate*" meaning that 'monsters signify'. [12] Within the framework that posits the official demonstration as a smart city vision of a coherent city, my performance of this monstrous city suggests a city that is repellent to an everyday normality, a city that is 'Other'. Yet looking at these visions I'm reminded of two art projects that question normative expectations of, respectively, what a human body is and what feminine beauty is: *Exoskeleton* (1999) by Australian artist Stelarc (Figure 7) and the performance series, *The Reincarnation of Saint-ORLAN* (1986, 1990, 1991, 1991, 1993, 1993) by French artist ORLAN (Figure 8).

Stelarc's *Exoskeleton*, when compared to the figure of the autonomous, liberal human, fails to be a human body walking, instead presenting a monstrous distortion or abomination of the expected human form. Similarly, ORLAN herself fails to be beautiful when viewed in

relation to a constructed feminine ideal. These performances not only actively reveal the impossibility of these ideals by demonstrating the entangled interdependence and sociotechnical production of being, they also demonstrate beauty of different kinds in both form and motion. My performance of the city in the digital twin, by failing to enact a coherent city, similarly challenges this normative concept of what a city is. And yet, in failing to produce this coherent city, I do not fail on my own.

Envisioning the City

Singular Vision

The 'ideal zoom' position for many datasets is the aerial view which Nicolas Mirzoeff (2006) describes as the view of the hero and calls Visuality 1 (Figure 9). It's the view of the figure that Sylvia Wynter (2015) has called Man 1, seeing what Dipesh Chakrabarty (2000) called History 1 and, when looking at the city, seeing what Kate Derickson (2014) calls Urbanization 1. [13]
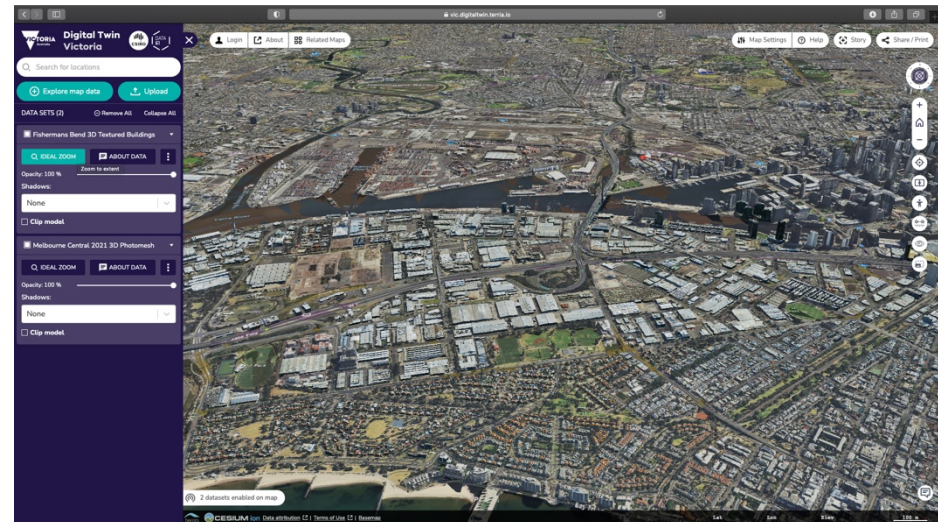

Figure 9: Digital Twin Victoria screenshot, Fishermans Bend 3D Textured Buildings dataset, Ideal zoom view. Screenshot taken by the author.
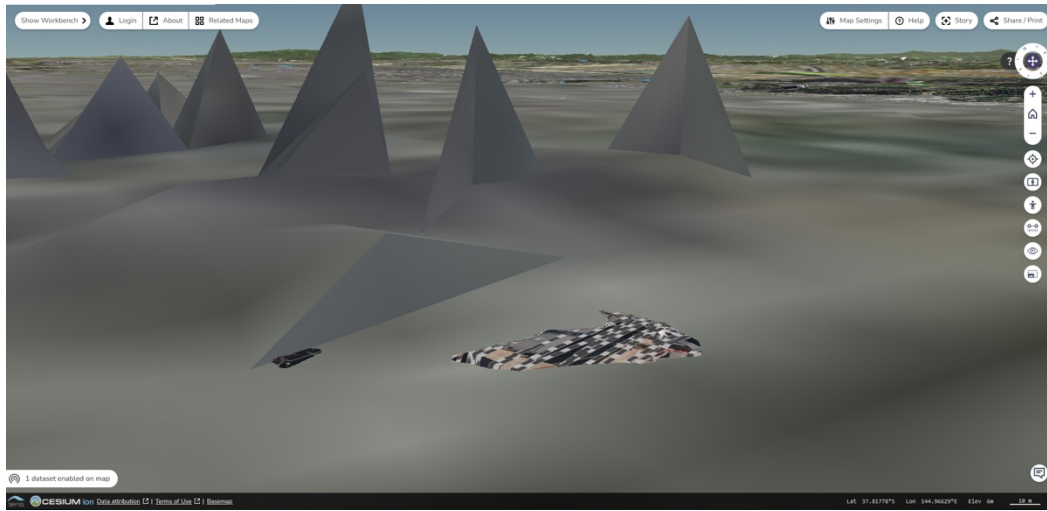
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Figure 10: Digital Twin Victoria screenshot, Melbourne Central 2021 3D Photomesh, a rendering pause. Screenshot taken by the author.

These 1's are, unsurprisingly, singular, and they present this coherent vision as a goal to be attained. Such spectacular visions have a history of use in urban planning through the presentation of utopian urban futures. They are visions of the utopia that Ursula Le Guin called the Euclidean utopia—that is, a utopia that is always not here and not now. [14] The digital twin, however, is not yet able to effortlessly visualise this coherent city; it has to pause and can only jumpily resolve its datasets into coherence (Figure 10 & 11). In the official demonstration these rendering pauses were spoken and moved through in a way that naturalises these partially rendered views as steps along the path towards achieving the coherent vision. This reflects the way the digital twin itself, within a smart cities narrative, is naturalised as a technological step along the path towards a manageable, data–driven city.

When I encountered these rendering pauses, however, I also paused, watching, waiting and taking screenshots in order to extend the moments in which these different visions were visible — visions that also differ depending on where and when I use the digital twin, and the capacities of the internet connection and computer that are participating. These visions are more reflective of the 2s (Visuality 2, History 2 and Urbanization 2) which, with the exception of Wynter's Man 2 (who is a reconfiguration and secularisation of Man 1), resist the singularity of the 1s they counter. Rather, they constitute a plurality of visualities, histories, and urbanizations that do not fit into the standardised space created by such singular vision.

Diffracting Vision

Following Arjun Appadurai and Neta Alexander, I'm interested in considering how actions that participate in enacting such visions—actions usually judged as failure because they are 'too slow' (waiting, buffering, or rendering) or 'too much' (excessive zooming or flipping)—can be reconfigured as revealing alternative visions of what the city might be. [15] This includes reconfiguring culturally specific expectations of what digital skill is and what a city is. It also discards the future as the goal to be attained by paying attention to actions occurring in the present.
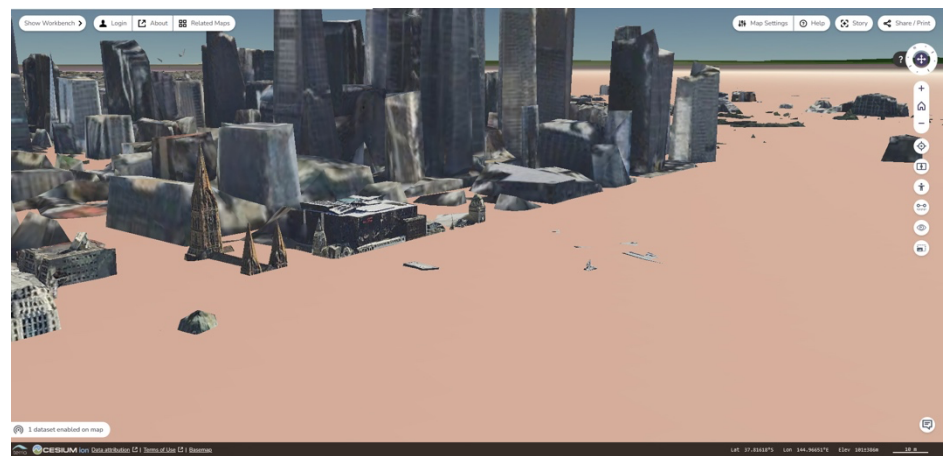

Figure 11: Digital Twin Victoria screenshot, Melbourne Central 2021 3D Photomesh, a rendering pause. Screenshot taken by the author.
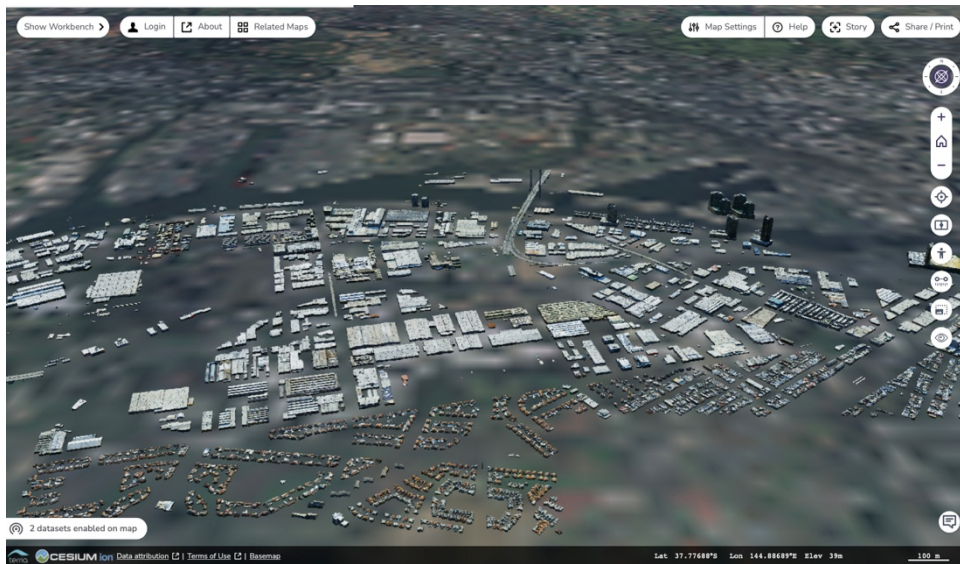
Figure 12: Digital Twin Victoria screenshot, Fishermans Bend 3D Textured Buildings dataset, partially rendered. Screenshot taken by the author.

only temporally towards a potential future but also spatially to already existing presents and/or pasts in other places, and opening up, as Lauren Berlant has said, "the present to a lived alternativity in the present". [16] Such already existing alternatives are reminders that how we conceptualise and theorise what a city is often remains based, as Ananya Roy argues, in Eurocentric conceptions that form "the foundational and fundamental categories of urbanization, those that constitute … [the] 'coherent concept of the city'." [17] So, while calls to recognise monsters that inhabit the gaps are important, it's also important to remember that monsters are always defined in relation to an expectation. Always positing such differences as counter to Western expectations of what a city is risks rendering this difference as a socio-historical, developmental step along a path towards urbanisation rather than recognising these as already existing alternative urbanisations.

In this image of a partially rendered dataset for the urban renewal area in Melbourne called Fishermans Bend, the buildings look solid but unmoored, making them appear vulnerable, temporary and indefinite (Figure 12). The lack of stability in this floating city represents a very different neighbourhood from the bounded landscape envisioned in the official urban renewal Vision. Seeing this image helped me imagine an alternative future, populated by flexible forms of habitation that would shift and move with the tides, suggesting a reciprocal relationship between inhabitants and the environment in which they live. This image also reminded me of a photograph by Dutch photographer Iwan Baan of the city of Ganvie situated in the centre of Lake Nokoué in Benin in West Africa (Figure 13). The unresolved image in the digital twin points, therefore, not

Figure 13: City of Ganvie, Lake Nokoué, Benin, Photo © Iwan Baan

The unresolved image of Fishermans Bend also hints at another, longer past that nonetheless persists in the present. The Mapping Aboriginal Melbourne project developed by the City of Melbourne in partnership with Wurundjeri Woi Wurrung and Bunurong Boon Wurrung Traditional Owners tells me that the place now called Fishermans Bend was once an area of low-lying swamps, sand ridges and seasonal lakes (Figure 14). [18] This is not a landscape seen in any resolved visualisations of datasets available in the digital twin. The closest I find to a dataset that indicates this place has a past not represented (or representable) within the standardised visualisation is the 'Areas of Cultural Heritage Sensitivity' dataset (Figure 15). This dataset represents, however, only some of the cultural connections that exist (and continue to exist) between Indigenous peoples and the land that is mapped in the digital twin in a way that implies all other areas are, therefore,

not 'culturally sensitive'. In this dataset, all of Fishermans Bend is marked as culturally sensitive. When I click on a marked location in the dataset to find out more, the information provided is, "Sensitivity: Yes", written on screen and in a CSV file I can download.

As a possible refusal to be mapped (and therefore, measured, quantified and incorporated) within the digital twin, this represents a refusal to include in a publicly available city model traditional and sacred knowledge that I (and many other users of the digital twin) have no rights to. Such refusal can (like the unresolved image) present an opening onto recognition that the digital twin is only one way of representing and knowing the world—but only if a user is already aware that there is something they're not seeing. The digital twin does not alert users to this. Rather, representing the past in the digital twin by allowing users to

Figure 15: Digital Twin Victoria screenshot, Areas of Cultural Sensitivity dataset showing Fishermans Bend. Screenshot taken by the author.

combine multiple datasets together (as visual elements) in spatial and temporal simultaneity, is a selective process that can provide clarity of vision yet also means, as one participant expressed it, "[if] you turn a layer of it off, or you turn a component off, you don't have to have it—you don't have to think about it." This ability to render certain pasts and presents invisible is further complicated by datasets that represent the past through archived photographic visual materials, which have been shown to often re–enact sexist, racist and colonial histories by constructing, through selective violence, a particular narrative as objective truth. The layering of different temporal datasets (including real–time datasets) within the digital twin represents an attempt to establish a general archive and produces a visualisation of a perpetual present based within the visuality of Western modernity. While partnerships with Indigenous communities have produced project–based data for community–managed datasets in the digital twin, Indigenous people and perspectives were not participants in developing the foundations that define the digital twin platform and the visualisation it produces.
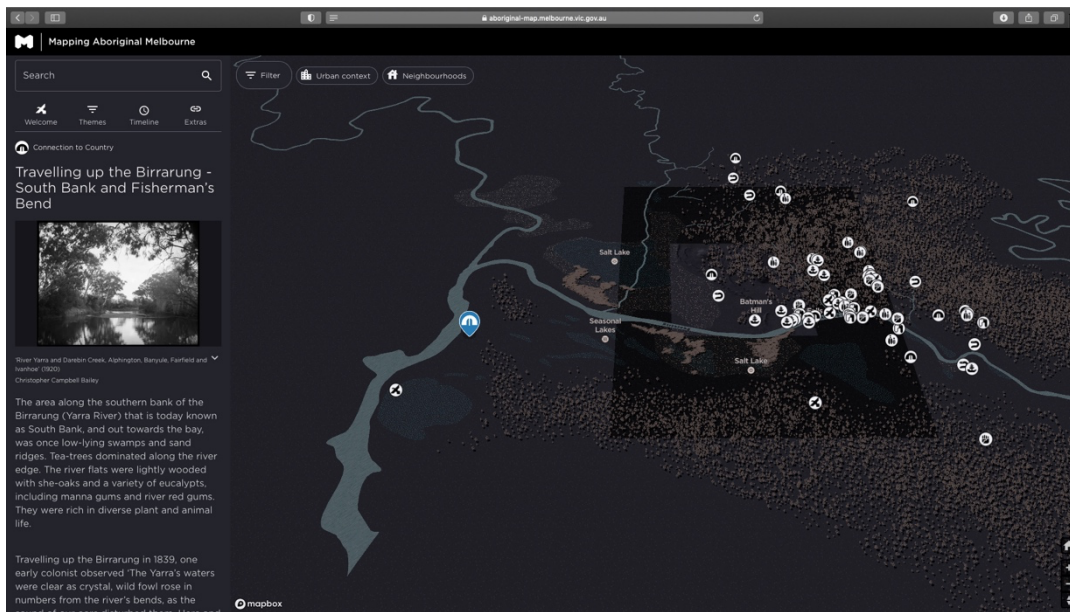

Figure 14: Mapping Aboriginal Melbourne, online map developed by the City of Melbourne. I acknowledge the Wurundjeri Woi-wurrung and Bunurong Boon Wurrung Peoples of the Eastern Kulin as custodians of the knowledge represented in this map. Screenshot taken by the author.

Conclusion

When the unresolved image of Fishermans Bend in the digital twin is untethered from the expectations of coherence that characterise Visuality 1 and Urbanization 1, the vision of buildings cast adrift in an unstable environment is a momentary gap within the standards that produce the digital twin. By revealing an alternative vision, it diffracts our imaginary of the city into a multitude of possible different cities. This momentary irresolution in the visualisation demonstrates that, when enacted by different people, the digital twin can envision different cities. This recognises such moments not as failure but as a refusal that signifies the impossibility of representing all things within one unified visualisation. The digital twin's singular vision, however, means that this kind of after–the–fact work puts the onus on those with different experiences and imaginaries to produce alternative visions and does not address the irresponsibility of knowledge claims based in the vision offered by the digital twin.

Paying attention to how the digital twin visualises the city matters because, as Dunn and Cureton argue "societies shape themselves partly through the images of the future they construct." [19] It also matters because the digital twin, in claiming to be an accurate representation of the city, also claims to be producing and communicating knowledge about the city and, as Karen Barad argues, "Making knowledge is not simply about making facts but about making worlds." [20] That is, the visualisation produced by the digital twin will contribute to the city that is not only imagined and planned but also built. Paying attention to the visions presented within these moments of spatial and temporal irresolution is an effort to recognise what Donna Haraway, citing filmmaker and theorist Trinh Minh-Ha, called "a 'critical difference within'." [21] In the case of Digital Twin Victoria, this means recognising these visions not as steps or mistakes along a path towards a resolved vision of a coherent city but as diffractive visions of difference that can contribute to reconceiving Western conceptions of what the city can be. Such recognition points towards a need for the digital twin, as a technology for the planning of future cities, to be engaged within more expansive representational practices that make space and time for different perspectives to participate in discussions about possible futures.

Acknowledgements

References

[1] https://vic.digitaltwin.terria.io/

[2] Geoffrey C. Bowker and Susan L. Star, *Sorting Things Out: Classification and its Consequences* (Place: The MIT Press, 1999), 13.

[3] Martin Jay, "Scopic Regimes of Modernity," in *Vision and Visuality*, ed. Hal Foster (Seattle: Bay Press, 1988), 3- 23.

[4] Carolyn Briggs et al., "Bridging the Geospatial Gap: Data About Space and Indigenous Knowledge of Place," *Geography Compass* 14, No. 11, (2020), e12542. https://doi.org/https://doi.org/10.1111/gec3.12542.

[5] Brian Massumi, *Politics of* Affect, (Cambridge and Malden: Polity Press, 2015).

[6] Bruno Latour, "From Realpolitik to Dingpolitik: Or How to Make Things Public," in Making Things Public: Atmospheres of Democracy, ed. Bruno Latour and Peter Weibel (Cambridge and Karlsruhe: ZKM, 2005), 14-41.

[7] Cited in Gillian Rose, "Screening Smart Cities: Managing Data, Views, and Vertigo," in *Compact Cinematics: The Moving Image in the Age of Bit-Sized Media*, ed. Pepita Hesselberth and Maria Poulaki (New York: Bloomsbury Academic, 2017), 182.

[8] Allen J. Scott and Michael Storper, "The Nature of Cities: The Scope and Limits of Urban Theory," *International Journal of Urban and Regional Research* 39, (2015), 10.

[9] Ayona Datta, "New Urban Utopias of Postcolonial India: 'Entrepreneurial Urbanization' in Dholera Smart City, Gujarat'," *Dialogues in Human Geography* 5, No. 1, (2015), 3-22; Tariq Jazeel, "Utopian Urbanism and Representational City-Ness: On the Dholera before Dholera Smart City," *Dialogues in Human Geography* 5, No. 1, (2015): 27-30.

[10] Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," *Feminist Studies* 14, No. 3 (1988), 575-99.

[11] Geoffrey C. Bowker and Susan L. Star, *Sorting Things Out: Classification and its Consequences*, 5.

[12] Donna Haraway, "The Promises of Monsters: A Regenerative Politics for Inappropriate/D Others," in *Cybersexualities* (Edinburgh: Edinburgh University Press, 1999), (emphasis in original), 362, note 16.

[13] Nicholas, Mirzoeff, "On Visuality," *Journal of Visual Culture* 5, No. 1, (2006), 53-79; Sylvia, Wynter, "The Ceremony Found: Towards the Autopoetic Turn/Overturn, Its Autonomy of Human Agency and Extraterritoriality of (Self-)Cognition," in *Black Knowledges/Black Struggles: Essays in Critical Epistemology*, ed. Jason R. Ambroise and Sabine Broeck, 184-245 (Liverpool: Liverpool University Press, 2015), 184-245; Dipesh Chakrabarty, *Provincializing Europe: Postcolonial Thought and Historical Difference,* (Princeton:

Princeton University Press, 2000); Kate D. Derickson, "Urban Geography I: Locating Urban Theory in the 'Urban Age," *Progress in Human Geography* 39, No. 5, (2014), 647-657.

[14] Ursula K. Le Guin, "A Non-Euclidean View of California as a Cold Place to Be," in *Dancing at the Edge of the World: Thoughts on Words, Women, Places* (New York: Grove Press, 1982), 80-100.

[15] Arjun Appadurai and Neta Alexander, *Failure* (Cambridge and Medford, Wiley, 2020).

[16] Lauren Berlant, "Intuitionists: History and the Affective Event," *American Literary History* 20, No. 4, (2008), 853.

[17] Ananya Roy, "Who's Afraid of Postcolonial Theory?" *International Journal of Urban and Regional Research* 40, No. 1, (2016), 204.

[18] https://aboriginal-map.melbourne.vic.gov.au/

[19] Nick Dunn and Paul Cureton, *Future Cities: A Visual Guide* (London: Bloomsbury Publishing, 2020), 4.

[20] Karen Barad, *Meeting The Universe Halfway: Quantum Physics and The Entanglement of Matter and Meaning* (Durham: Duke University Press, 2007), 91.

[21] Donna Haraway, "The Promises of Monsters: A Regenerative Politics for Inappropriate/D Others," in *Cybersexualities* (Edinburgh: Edinburgh University Press, 1999), 320.

[22] Image Courtesy STUDIO ORLAN and Ceysson & Bénétière.

Bibliography

Stuart C. Aitken and James Craine, "Into the Image and Beyond: Affective Visual Geographies and GIScience," in *Qualitative GIS: A Mixed Methods Approach*, ed. Meghan Cope and Sarah Elwood (London: SAGE Publications, 2009), , 139-155.

Arjun Appadurai and Neta Alexander, *Failure* (Cambridge and Medford, Wiley, 2020).

Karen Barad, *Meeting The Universe Halfway: Quantum Physics and The Entanglement of Matter and Meaning* (Durham: Duke University Press, 2007).

Lauren Berlant, "Intuitionists: History and the Affective Event," *American Literary History* 20, No. 4, (2008), 845–860.

Geoffrey C. Bowker and Susan L. Star, *Sorting Things Out: Classification and its Consequences* (Place: The MIT Press, 1999).

Monica M. Brannon, "Standardized Spaces: Satellite Imagery in the Age of Big Data," *Configurations* 21(Fall), (2013), 271-299.

Carolyn Briggs, Ingrid Burfurd, Matt Duckham, Olivia Guntarik, Di Kerr, Mark McMillan, and Daisy San Martin Saldias, "Bridging the Geospatial Gap: Data About Space and Indigenous Knowledge of Place," *Geography Compass* 14, No. 11, (2020), e12542. https://doi.org/https://doi.org/10.1111/gec3.12542.

Dipesh Chakrabarty, *Provincializing Europe: Postcolonial Thought and Historical Difference,* (Princeton: Princeton University Press, 2000).

Ayona Datta, "New Urban Utopias of Postcolonial India: 'Entrepreneurial Urbanization' in Dholera Smart City, Gujarat'," *Dialogues in Human Geography* 5, No. 1, (2015), 3-22.

Monica Degen, Caitlin DeSilvey and Gillian Rose, "Experiencing Visualities in Designed Urban Environments: Learning from Milton Keynes," *Environment and Planning A: Economy and Space* 40, No. 8, (2008), 1901-1920.

Kate D. Derickson, "Urban Geography I: Locating Urban Theory in the 'Urban Age," *Progress in Human Geography* 39, No. 5, (2014), 647-657.

Nick Dunn and Paul Cureton, *Future Cities: A Visual Guide* (London: Bloomsbury Publishing, 2020).

Michel Foucault, "Of Other Spaces," trans. Jay Miskowiec, *Diacritics* 16, No. 1, (1986), 22-27.

Alexander R. Galloway, *The Interface Effect,* (Cambridge: Polity, 2012).

Ali Gumillya Baker, "Camping in the Shadow of the Racist Text," *Artlink Indigenous: Kanarn Wangkiny Wanggandi Karlto (Speaking from Inside),* 38, No. 2 (June 2018), 14-21.

Peter Hall, *Cities of Tomorrow: An Intellectual History of Urban Planning and Design since 1880* (Malden and Oxford: Wiley-Blackwell, 2014.

Orit Halpern, *Beautiful Data: A History of Vision and Reason since 1945*, (Durham: Duke University Press, 2014).

Donna Haraway, "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective," *Feminist Studies* 14, No. 3 (1988), 575-99.

Donna Haraway, "The Promises of Monsters: A Regenerative Politics for Inappropriate/D Others," in *Cybersexualities* (Edinburgh: Edinburgh University Press, 1999), 314-366.

N. Katherine Hayles, *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics,* (Chicago: University of Chicago Press, 1999).

Jane M. Jacobs, ""Shake 'Im This Country": The Mapping of the Aboriginal Sacred in Australia - the Case of Coronation Hill," in *Constructions of Race, Place and Nation*, ed. Jan Penrose and Peter Jackson (London: UCL Press Limited, 1993), 100-118.

Martin Jay, "Scopic Regimes of Modernity," in *Vision and Visuality*, ed. Hal Foster (Seattle: Bay Press, 1988), 3- 23.

Tariq Jazeel, "Utopian Urbanism and Representational City-Ness: On the Dholera before Dholera Smart City," *Dialogues in Human Geography* 5, No. 1, (2015): 27-30.

Lampland, Martha and Star, Susan Leigh. *Standards and Ther Stories: How Quantifying, Classifying, and Formalizing Practices Shape Everyday Life.* Cornell University Press, 2008.

Bruno Latour, "From Realpolitik to Dingpolitik: Or How to Make Things Public," in *Making Things Public: Atmospheres of Democracy*, ed. Bruno Latour and Peter Weibel (Cambridge and Karlsruhe: ZKM, 2005), 14-41.

Ursula K. Le Guin, "A Non-Euclidean View of California as a Cold Place to Be," in *Dancing at the Edge of the World: Thoughts on Words, Women, Places* (New York: Grove Press, 1982), 80-100.

Agnieszka Leszczynski, "Speculative Futures: Cities, Data, and Governance Beyond Smart Urbanism," *Environment and Planning A: Economy and Space* 48, No. 9, (2016), 1691-1708.

Karen T. Litfin, "The Gendered Eye in the Sky: A Feminist Perspective on Earth Observation Satellites," *Frontiers: A Journal of Women Studies* 18, No. 2, (1997), 26-47.

Magdalena Maczynska, "This Monstrous City: Urban Visionary Satire in the Fiction of Martin Amis, Will Self, China Miéville, and Maggie Gee," *Contemporary Literature* 51, No. 1, (2010), 58-86.

Brian Massumi, *Politics of* Affect, (Cambridge and Malden: Polity Press, 2015).

Shannon Mattern, "Gaps in the Map: Why We're Mapping Everything, and Why Not Everything Can, or Should, Be Mapped," *Words In Space*, accessed 17 February, 2023, https://wordsinspace.net/2015/09/18/gaps-in-the-map-why-were-mapping-everything-and-why-not-everything-can-or-should-be-mapped/

Katherine McKittrick, *Dear Science and Other Stories,* (Durham: Duke University Press, 2021).

Sarah Mills, "Cultural–Historical Geographies of the Archive: Fragments, Objects and Ghosts," *Geography Compass* 7, No. 10, (2013): 701-713.

Nicholas, Mirzoeff, "On Visuality," *Journal of Visual Culture* 5, No. 1, (2006), 53-79.

Gillian Rose, "Geography as a Science of Observation: The Landscape, the Gaze and Masculinity," in *Human Geography: An Essential Anthology*, ed. John Agnew, David. N. Livingston and Alisdair Rogers (Oxford and Cambridge: Blackwell Publishers, 1996), 341-350.

Gillian Rose, "Screening Smart Cities: Managing Data, Views, and Vertigo," in *Compact Cinematics: The Moving Image in the Age of Bit-Sized Media*, ed.

Pepita Hesselberth and Maria Poulaki (New York: Bloomsbury Academic, 2017), 177-184.

Ananya Roy, "Who's Afraid of Postcolonial Theory?" *International Journal of Urban and Regional Research* 40, No. 1, (2016), 200-209.

Jathan Sadowski and Roy Bendor, "Selling Smartness: Corporate Narratives and the Smart City as a Sociotechnical Imaginary," *Science, Technology, & Human Values* 44, No. 3 (2018), 540-563.

Sara Safransky, "Geographies of Algorithmic Violence: Redlining the Smart City," *International Journal of Urban and Regional Research* 44, No. 2, (2020), 200-218.

Allen J. Scott and Michael Storper, "The Nature of Cities: The Scope and Limits of Urban Theory," *International Journal of Urban and Regional Research* 39, (2015), 1-15.

R. A. Sydie, "The Phallocentric Gaze: Leon Battista Alberti and Visual Art," *Journal of Historical Sociology* 10, No. 3, (1997), 310-41.

Matthew W. Wilson, *New Lines: Critical GIS and the Trouble of the Map* (Minneapolis: University of Minnesota Press, 2017).

Sylvia, Wynter, "The Ceremony Found: Towards the Autopoetic Turn/Overturn, Its Autonomy of Human Agency and Extraterritoriality of (Self-)Cognition," in *Black Knowledges/Black Struggles: Essays in Critical Epistemology*, ed. Jason R. Ambroise and Sabine Broeck, 184-245 (Liverpool: Liverpool University Press, 2015), 184-245.

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