

# Visualising Agent-Based Canoe Journeys in a Real-time Computation Virtual Environment

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## Abstract

This paper explores the use of agent-based machine learning models combined with speculative and critical design methods to investigate potential entanglements between canoes and sea-birds in an imagined Pacific.

## Introduction

*Layered Horizons* (Burrell and Hendery 2019) is a Design Research and Digital Humanities project that brings together disparate data sets from linguistics, anthropology, geography and archaeology—within virtual reality (VR)—to create interactive information visualizations. These visualizations allow a researcher to explore potential connections within data-sets relating to pre-colonial contact between the Pacific and the continent now known as Australia. It brings together computational and non-computational digital methodologies that utilize the affordances offered by each—within the material space of VR. This then enables a unique layering of data, offering new insights to researchers from a wide spectrum of disciplines. This paper explores how using this combination of computational and non-computational methods can achieve a much more flexible and resilient research tool than what could be achieved by relying exclusively on one or the other.

Our process involves speculative and critical design to imagine an alternate Pacific, in virtual space, where the entanglement (Haraway 2016) between canoe and seabirds is centred. Throughout the design and development of *Layered Horizons* we propose a model for Pacific navigation based on “real world” data.

The resulting virtual space encourages a consideration of what “could” be, and more importantly a reconsideration of the framework of investigation.

## The Virtual Environment

We begin by exploring the computational nature of the built virtual environment. One of the key computational methods utilized in creating *Layered Horizons* is the use of data to compute all of the visuals on the fly, as opposed to relying on a pre-set 3D modelled environment. The virtual environment is rendered during the experience based on a broad range of data read at “runtime.” In this way, we can manipulate the environment computationally at the level of the data itself, which becomes vital for the processes we will describe. At the same time this heightened malleability removes an intervening layer of interface and allows for the use of the environment *as* interface, which relies on a user’s embodied understanding of their body in space to comprehend the membrane of interaction.

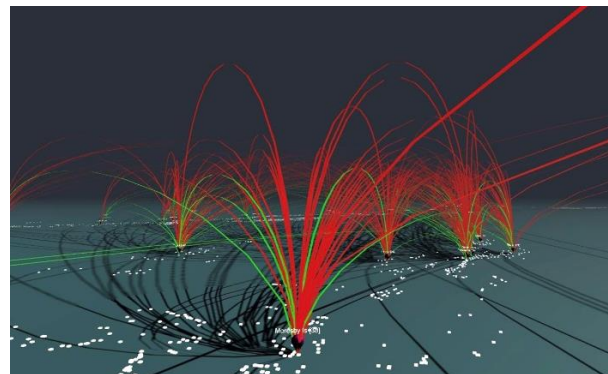


Fig. 1. *Layered Horizons* (Canoe Journeys), 2017-21, Andrew Burrell, Rachel Hendery, Ali Chalmers Braithwaite, VR.

## Computational Canoe Journeys

We will then look at the project's integration of computational and non-computation data sets, using data from Laurent Dousset and Anne Di Piazza's simulated canoe journeys between key locations in the Pacific (Di Piazza, Di Piazza and Pearthree 2007) as an example.

A model of the Pacific that takes into account the space/time relationship of the simulated canoe journeys and the relationships between the location of Pacific islands in the environment can be based on the time it might take to move between islands in canoe time, rather than the physical distance between two places. Using these computational methods allows a researcher to "remap" the Pacific, and then on top of this remapping overlay non-computational data, such as a lexical database, which may either provide new insights into complex relationships within the data or help to confirm pre-existing hypothesis of the same.

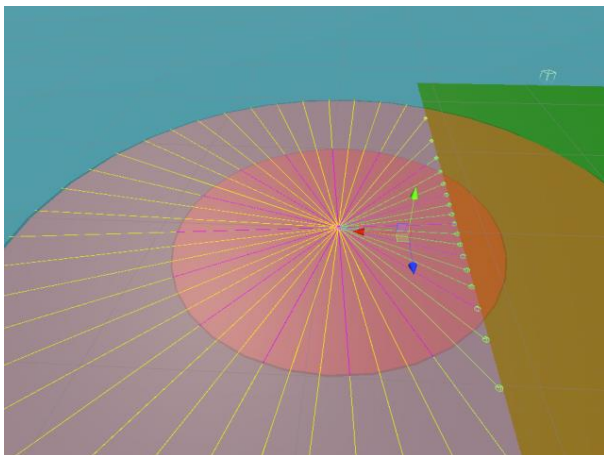


Fig. 2. *Layered Horizons* (agent-based reinforcement learning), 2017-21, Andrew Burrell, Rachel Hendery, Ali Chalmers Braithwaite, virtual environment.

## Agent Based Canoe Journeys

We will then describe a new phase of the *Layered Horizons* project, in which we seek to leverage deep reinforcement learning in the Unity game engine using the MLAGents environment (Juliani et. al. 2018). This extends what we have learnt from working with the simulated canoe journeys to combine non-computational data of sea-bird habits and habitats within the Pacific with known information about the use of sea-birds as a navigation aid, to create a model to run agent-

based computational simulations of possible navigation paths based on this model. This approach is speculative in nature, using hypothetical simulated geographic possibilities to probe current knowledges. This creative simulation is just one method of approach that enriches other forms of historical research.

## Credits

*Layered Horizons* is a Project by Andrew Burrell, Rachel Hendery and Ali Chalmers Braithwaite. It is an outcome of *Waves of Words* funded by the Australian Research Council (DP180100893) We are grateful for the input of the team: Patrick McConvell, Laurent Dousset, Antoinette Schapper, Michael Falk, Billy McConvell, Matthew Spriggs and Tim Denham.

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## Biographies

**Andrew Burrell** is a Lecturer in Visual Communication at the University of Technology Sydney, with a background in media art and design exploring the narrative potential of virtual environments and computational spaces.

**Ali Chalmers Braithwaite** is a PhD candidate in the School of Design at the University of Technology Sydney exploring embodiment and experiential design in virtual environments.