Procedural Modeling for the VR-Based Analysis of Human Spatial Behavior

Jan Oliver Wallgrün[1], Alexander Klippel[1], Mark Simpson[1], Kai-Florian Richter[2], Mahda Bagger[1] & Qingyu Ma[1]

[1]ChoroPhronesis Lab, Penn State University, USA

[2]Department of Geography, University of Zurich, Switzerland

It is commonly accepted that human understandings of space are not accurate representations of the space encountered. Internal representations, or mental maps, cannot themselves be analyzed directly, so their relationship with spatial aspects of the environment must be inferred through recorded behavioral responses - such as performance in a wayfinding task. Relationships have been found between movement patterns of cognitive agents, the cognition of space (e.g., how easy it is to create a mental representation of an environment), and spatial structures identifiable through formal spatial measures. Current research at the ChoroPhronesis lab, Pennsylvania State University, aims at investigating the application of such formal spatial measures based on results from space syntax research and research on salience of landmarks to explain spatial behavior in VR experiments designed in Unity and conducted using different VR devices (Oculus Rift, HTC Vive). Running such experiments will require the generation of virtual indoor and outdoor environments in which the layout and appearance are systematically varied to investigate the correlations between human spatial behavior and formal spatial measures. In our current work, we are therefore developing the methods and workflows to produce such systematically varied environments using procedural modeling techniques. In our current workflow, procedural rules in ESRI's CityEngine software are used to generate 3D environmental models from 2D layouts of cities or indoor environments. The 3D models are then imported into the Unity game engine and different spatial measures are applied. Future experiments will use these environments to measure human performance (distance traveled, time needed to complete the task, and how optimized their routes were) in different wayfinding tasks and analyze the correlation with the spatial measures.