SPATIAL COGNITION IN TANGIBLE COMPUTING

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ABSTRACT:

Complex spatial forms like topography can be challenging to understand, much less intentionally shape, given the heavy cognitive load of visualizing and manipulating 3D form. This cognitive work can be offloaded onto computers through 3D geospatial modeling, analysis, and simulation. Interacting with computers, however, can also be challenging requiring training and highly abstract thinking that adds a new cognitive burden. Tangible computing – an emerging paradigm of human-computer interaction in which data is physically manifested so that users can feel it and directly manipulate it – aims to offload this added cognitive work onto the body. We have designed Tangible Landscape, a tangible interface powered by an open source geographic information system (GRASS GIS), so that users can naturally shape topography and interact with simulated processes with their hands in order to make observations, generate and test hypotheses, and make inferences about scientific phenomena in a rapid, iterative process. Conceptually Tangible Landscape couples a malleable physical model with a digital model of a landscape through an continuous cycle of 3D scanning, geospatial modeling, and projection. We ran a terrain modeling experiment with 39 participants to test whether tangible interfaces like this can effectively enhance spatial performance by offloading cognitive processes onto computers and our bodies. We used topographic and morphometric parameters, differencing, hydrological simulation, and spatial statistics to quantitatively assess spatial performance. We found that Tangible Landscape generally enhanced 3D spatial performance, but future work is need to understand the role of cognition, affect, motivation, and metacognition in tangible computing.

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