Multi-scale manipulation in indoor scenes with the world in miniature metaphor

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The World in Miniature Metaphor (WIM) allows users to select, manipulate and navigate efficiently in virtual environments. In addition to the first-person perspective offered by typical VR applications, the WIM offers a second dynamic viewpoint through a hand-held miniature copy of the environment. In this paper we explore different strategies to allow the user to interact with the miniature replica at multiple levels of scale. Unlike competing approaches, we support complex indoor environments by explicitly handling occlusion. We discuss algorithms for selecting the part of the scene to be included in the replica, and for providing a clear view of the region of interest. Key elements of our approach include an algorithm to recompute the active region from a subdivision of the scene into cells, and a view-dependent algorithm to cull-away occluding geometry through a small set of slicing planes roughly oriented along the main occluding surfaces. We present the results of a user-study showing that our technique clearly outperforms competing approaches on spatial tasks performed in densely-occluded scenes.