

A Survey on 3D Virtual Object Manipulation: From the Desktop to Immersive Virtual Environments

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Abstract: Interactions within virtual environments often require manipulating 3D virtual objects. To this end, researchers have endeavoured to find efficient solutions using either traditional input devices or focusing on different input modalities, such as touch and mid-air gestures. Different virtual environments and diverse input modalities present specific issues to control object position, orientation and scaling: traditional mouse input, for example, presents non-trivial challenges because of the need to map between 2D input and 3D actions. While interactive surfaces enable more natural approaches, they still require smart mappings. Mid-air gestures can be exploited to offer natural manipulations mimicking interactions with physical objects. However, these approaches often lack precision and control. All these issues and many others have been addressed in a large body of work. In this article, we survey the state-of-the-art in 3D object manipulation, ranging from traditional desktop approaches to touch and mid-air interfaces, to interact in diverse virtual environments. We propose a new taxonomy to better classify manipulation properties. Using our taxonomy, we discuss the techniques presented in the surveyed literature, highlighting trends, guidelines and open challenges, that can be useful both to future research and to developers of 3D user interfaces.

A Survey of Simple Geometric Primitives Detection Methods for Captured 3D Data

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Abstract: The amount of captured 3D data is continuously increasing, with the democratization of consumer depth cameras, the development of modern multi-view stereo capture setups and the rise of single-view 3D capture based on machine learning. The analysis and representation of this ever growing volume of 3D data, often corrupted with acquisition noise and reconstruction artefacts, is a serious challenge at the frontier between computer graphics and computer vision. To that end, segmentation and optimization are crucial analysis components of the shape abstraction process, which can themselves be greatly simplified when performed on lightened geometric formats. In this survey, we review the algorithms which extract simple geometric primitives from raw dense 3D data. After giving an introduction to these techniques, from the acquisition modality to the underlying theoretical concepts, we propose an application-oriented characterization, designed to help select an appropriate method based on one's application needs and compare recent approaches. We conclude by giving hints for how to evaluate these methods and a set of research challenges to be explored.