

## Using VR in Scientific Investigation: Human-Machine Interface Issues

*Abstract*

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Scientific Visualization has been described as the art of representing data such that it can be perceived directly, capitalizing on the *precognitive* mechanisms of human perception. Virtual Reality has been described as a human-machine interface where there is no interface to design. Although it would appear that VR should be an ideal medium for scientific investigation, it has not yet attained this goal due to the limitations of present-day virtual reality technology and the specific demands of scientific usage.

Current VR implementations are far from ideal. While some aspects, such as viewpoint specification via head position tracking, are highly intuitive and require little or no training, other aspects, such as gestural control, are unable to avoid the learnability and usability problems of traditional interfaces. Furthermore, most VR implementations are encumbering: the user's view of the real environs is occluded, the user is tethered to the computer hardware via numerous cables, the input/output devices require individual adjustment and calibration, often each time they are used, and the "get in/get out" time is significant. There are few VR implementations that can be used by a solitary user unassisted, without risking damage to themselves or the equipment.

Scientific investigation places exceptional demands on a virtual reality system. Difficulty in using a VR system without assistance limits VR's usefulness in a laboratory setting. More fundamentally, scientific visualization systems must provide results which are reproducible and capable of being shared. This poses a challenge for VR, which is more adept at providing a personalized viewpoint.

Perhaps a better definition of virtual reality, or the virtual reality approach to system design, is a system wherein the user is explicitly represented. The amounts of *presence* afforded by various systems form a continuum, with the helmet-and-glove inclusive VR being only one of many means of achieving a high degree of presence. Presence is precisely what is most desirable about VR to scientific visualization. From quantum physics to social psychology, the role of the observer in a scientific experiment can no longer be overlooked. Virtual reality, as it approaches the ideal, will indeed become an efficacious medium for scientific investigation.