SCIRun Haptic Display for Scientific Visualization

Lisa J K Durbeck, Nicholas J Macias, David M Weinstein, Chris R Johnson, John M Hollerbach

Introduction

The overall goal of this research is to enhance scientific visualization by the use of haptic feedback. We have chosen to approach this goal by incorporating a haptic interface into an existing full-featured scientific visualization tool.

People who use scientific visualizations are generally trying to analyze or solve a scientific problem. The visualizations are usually animations or interactive graphics that scientists create for themselves. The visualizations are intermediate representations intended to represent the problem or its solution graphically (1, 2). Ideally these visualizations are accurate, information-rich, interactive, and illustrative of key features of the phenomenon or data set. They should make the problem (or its solution) easier to understand. Toward this goal we augmented existing graphical visualizations with force feedback (3), as well as true 3-D interaction, in ways that highlight key features such as flow lines. The haptic interface we have developed allows the user to form a high-level view of his data more quickly and accurately.

Scientific visualization research has been underway at the University of Utah for much of this decade (4). One outcome of that research is a problem-solving environment for scientific computing called SCIRun (5,6). For this project, we interfaced SCIRun to a haptic device, and we then used SCIRun to create two displays, one graphic and one haptic, which operate together on a common visualization. The work described here uses the system to interact with vector fields, 3-D volumes in which every point in the volume has a vector associated with it. Examples of vectors are gravity, pressure, force, current, and velocity as well as scalar gradients.

Users of our new system can simultaneously see and feel a vector field. Haptic feedback is displayed on a SensAble PHANToM Classic 1.5 (7). The graphics are displayed on an SGI Octane. The user has a haptic display registered to a graphic display. She directs both displays by moving the PHANToM endpoint through the haptic representation of the data volume. The haptic display presents each vector as a force corresponding to the vector's magnitude and direction. The graphic display presents a subset of the vector field as lit directional line segments (8) or as the traditional arrow glyphs.