

Haptic holography: an early computational plastic

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Abstract

This dissertation introduces *haptic holography*, a combination of computational modeling and multimodal spatial display, as an early *computational plastic*. In this work, we combine various holographic displays with a force feedback device to image free-standing material surfaces with programmatically prescribed behavior.

We present three implementations, *Touch*, *Lathe*, and *Poke*, each named for the primitive functional affordance it offers. In *Touch*, we present static holographic images of simple geometry, reconstructed in front of the hologram plane (in the viewer's space), and precisely co-located with a force model of the same geometry. These images can be visually inspected and haptically explored using a hand-held interface. In *Lathe*, we again display holo-haptic images of simple geometry, this time allowing those images to be reshaped by haptic interaction in a dynamic but constrained manner. Finally in *Poke*, we present a holo-haptic image that permits arbitrary reshaping of its reconstructed surface.

As supporting technology, we offer a new technique for incrementally computing and locally updating interference-modeled holographic fringe patterns. This technique permits electronic holograms to be updated arbitrarily and interactively, marking a long-held goal in display holography. As a broader contribution, we offer a new behavior-based spatial framework, based on both perception and action, for informing the design of spatial interactive systems.

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