Perception of 3D structure by spatiotemporal integration of visual and haptic cues

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Previous studies of aperture viewing showed that a moving figure behind a slit can be perceived as integrated but distorted. Here we examined how well a 3D structure can be inferred from a sequence of cross-sectional images. In three experiments, the subject held and moved an imaging transducer over a box and thus got successive slices of a virtual rod that was tilted vertically (pitch) and/or horizontally (yaw). The image was shown at the true location of the rod using an AR display or experimentally displaced away from the haptic manipulation by showing it at a separate LCD display. The subject reported the rod's orientation by rotating a test rod parallel to it. When the rod orientation varied in only one dimension, subjects performed similarly well with both displays. However, when asked to make 2D judgments, errors became substantially greater if the visual and haptic information was displaced, and only in this condition "reversal errors" happened that that the magnitude of the response was approximately correct but its direction was reversed.