

Recalibration of visual cue combination by correlation with haptics

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How do observers judge material properties such as roughness? We describe a series of experiments demonstrating that observers do not display roughness constancy. That is, perceived roughness of an object varies with changes in the position of the illuminant or in the observer's viewpoint. We find that observers integrate several cues to perform this task including binocular disparity as well as contrast, proportion of the image in shadow, etc. Although these latter cues are correlated with roughness for a fixed set of viewing conditions, they vary with changes in viewing conditions, resulting in the failure of constancy. We call these latter measurements "pseudo-cues" to emphasize this dependence on viewing conditions. We describe experiments in which reliable cues (binocular disparity) or pseudo-cues (e.g., proportion of the image in cast shadow) are artificially correlated with simulated bumpiness in training sessions in a virtual haptic environment. By measuring cue weights before and after training, we learn whether the hand can effectively train the eye to reweight the visual cues to surface material.