Kinesthetic aid for teleoperation

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A recent study was conducted to demonstrate a simple technique for reducing control inaccuracies due to rotational misalignments, such as occur during teleoperations and telerobotics. Such rotational misalignments are often encountered when the remote image sensor, usually a camera, is oriented so that resulting display coordinates are rotated with respect to those in which a user must operate a remote. This is illustrated in Figure 1. Users accordingly must learn to compensate for this misalignment through practice, camera adjustment, or use of multiple camera images. A new compensation technique has been discovered in which the hand not used for control is utilized to provide a kinesthetic cue to the camera orientation. This greatly reduces the difficulty of compensating for control-display misalignment. In essence, the cueing hand, which is positioned to copy the attitude of the viewing camera, provides a kinesthetic reference for the movement of the controlling hand. Users then make their control movements relative to their kinesthetic sense of the orientation of the cueing hand. Experimental testing shows that this technique works and can reduce control inaccuracy associated with some rotational misalignments by 64% without explicit training, as represented in Figure 2. This cueing technique is derived from Y. Guiard's 1987 proposal that the left and right hand working together may be represented by a closed kinematic chain.