

Motion Gate: A geometric interface for motion-based human-computer interaction

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It is more than a decade that the optical motion capture technology has enabled motion-based interaction with computers without requiring to attach markers or inertial sensors to the body, however the applications that utilize this technology mostly remained in the laboratories. A particular difficulty in developing interactive applications using marker-less motion capture is because of the way the motion data are obtained, through estimating the position of the body joints over the projected image of the body in the camera coordinate. Thus the motion capture does not preserve the information about the acceleration of the joints over their motion path, which tells about how a body moved and the forces involved in a performance. Moreover because of the difference in the body structures, an application would have low accuracy in recognizing a learned motion that performed by different users.

The proposed interface reconstructs a jointed structure between the input joint positions and a learning algorithm to transform the motion of the joints that are captured in the camera coordinate in the performer's body coordinates. The body structure is represented by a tree graph, where each node represents the place of joint in the coordinates of its parent joint by a Euclidean motion, consisting of a rotation followed by a displacement.

The imitation algorithm identifies the displacement between consecutive joints, transforms the displacement to the world coordinate of that base joint that was reconstructed in the previous frame of motion capture and identifies its rotation relative to the world coordinate of the respective joint, and applies the rotation by a rate explained as the mimic rate in the current interface.

The current version of the interface allows to reconstruct different motion captured data obtained by a Microsoft Kinect camera. To activate the mocap input the user press (t) on the keyboard or press its button on the interface. The

mocap joints are visualized by a skeleton and the puppet imitates the mocap input. The slider allows to change the imitation rate between 0-1, where 1 is exact imitation. The user could select a joint to observe the phase portrait of the joint's motion on the right, where the top portrait displays the rotation about the X axis in the joint's coordinate and the bottom one displays the rotation about the Y axis. The lower phase portraits (orange color) displays the X and Y rotation of the respective joint of the mocap input in the world coordinate. However since the mocap data does not preserve the acceleration of the motion, the phase portrait is noisy. To select a joint the user could press the a,s,d,z,x,w buttons on the keyboard or use the interface. The interface allows to overlay the mocap skeleton on the imitating puppet using a (o) key or the respective button.