Tracking Face Pose and Expression with Range and Brightness Constraints

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The Problem: Real-time head pose and facial expression tracking.

Motivation: We desire a system for robust, real-time tracking of facial pose and expression. It should track a user without any prior model of facial shape. Our system uses observations from real-time stereo range cameras in addition to color image information.

Approach: We use stereo depth measurements in the traditional linear brightness constraint equations, and we introduce a new depth constraint equation. As a result, estimation of certain types of motion, such as translation in depth and rotations out of the image plane, becomes more robust. We derive linear brightness and depth change constraint equations that govern the velocity field in 3-D for both perspective and orthographic camera projection models. These constraints are integrated jointly over image regions according to a rigid-body motion model, yielding a single linear system to robustly track 3D object pose. This approach can be used for tracking the pose of faces in sequences of synthetic and real images, as well as for tracking facial expressions.

Difficulty: This problem is challenging due to the absence of a model of facial shape.

Impact: Tracking facial pose and expression is useful for human-computer interface applications, interactive robotics, performance capture, and virtual avatars.

Future Work: (This project began September 2000.)

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