Tracking and Recognition of 3D Human Motion

Mark Dilsizian
Department of Computer Science
Rutgers University
Tracking and Recognition of 3D Human Motion

- **Face Tracking**
  - Tracking facial features in real-time using a single camera
  - Event/Gesture Recognition
  - Expression Analysis

- **Body Tracking**
  - Full body 3D-pose reconstruction
  - Gait Analysis
  - Behavior Recognition
Facial Tracking using an Active Shape Model

• Form a statistical model of permissible facial shapes and deformation

• Utilize a point tracker to monitor landmarks from frame to frame constraining using an ASM model

• Learn non-linear shape manifold as separate ASM models for each major pose and dynamically switching models as the head rotates
Pitch: 1.62951
Yaw: -0.439886
Tilt: -1.93096
Facial Expressions/Gestures

- Extract
  - 3D head pose
  - Eyebrow displacement
  - Nose movement (for nod and shake detection)
  - Mouth deformation (e.g., mouth area)

- Expression/Emotion Recognition

- Blink Rates and Alertness measures

- Sign language

- Deception detection
3D Pose Reconstruction from Monocular images

- Currently Motion Capture systems are used to capture 3D body pose data
  - Animation
  - Biometrics

- Our method: 3D Pose from a single camera
  - Animation
  - Biometrics
  - Gesture recognition
  - Activity Recognition
Part-based Hierarchical Skeleton Model

- Uses a statistical model to initialize a 3D search space of plausible poses
- Optimize a physics-based model over each body part in the 3D search space using limb length and joint angle constraints
Applications

• Animation from single camera video sequences

• Behavior/Activity Recognition

• Gait cycles can be extracted from joint angles
  • Identify gait cycle irregularities
  • Person recognition
  • Biometrics
Future Work

• Tracking/Theoretical Work
  – 3D pose reconstruction for hands (3 months)
  – Optimize the full body reconstruction to work in real-time (9 months)
  – Unified model (face, model, hands) that uses physical constraints of an object when projecting from 2D features to a 3D model (9 months)

• Applications
  – Activity recognition based on gait cycles (4 months)
  – Sign language recognition (face and hands) (~6-9 months)
  – Suspicious gait detection (~ 9 months)
  – Other projects in the pipeline
    • Deception detection
    • Sports biometrics
    • Elderly monitoring