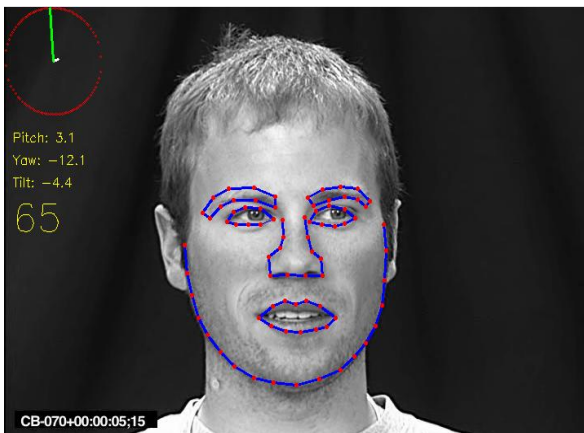


# Tracking and Recognition of 3D Human Motion

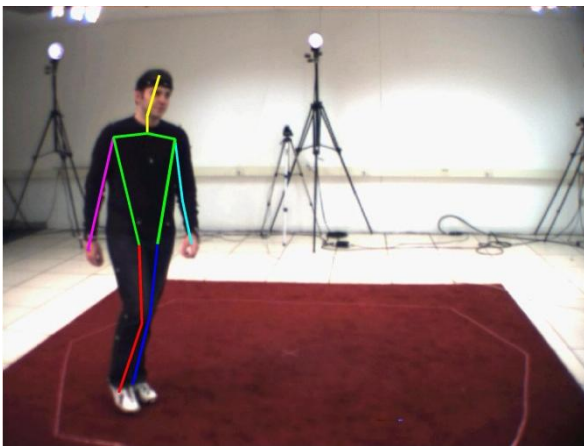
Mark Dilsizian

Department of Computer Science  
Rutgers University

# Tracking and Recognition of 3D Human Motion



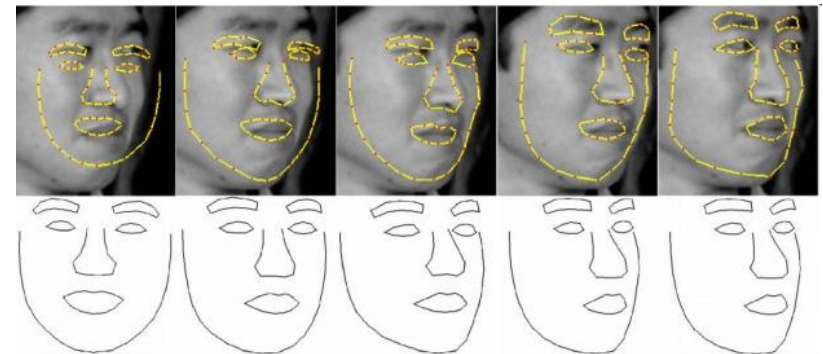
- Face Tracking
  - Tracking facial features in real-time using a single camera
  - Event/Gesture Recognition
  - Expression Analysis



- Body Tracking
  - Full body 3D-pose reconstruction
  - Gait Analysis
  - Behavior Recognition

# Facial Tracking using an Active Shape Model

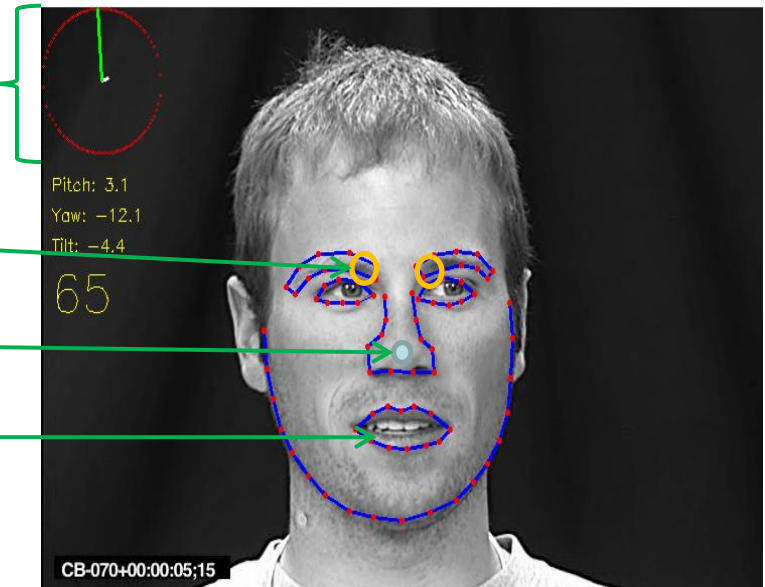
- Form a statistical model of permissible facial shapes and deformation
- Utilize a point tracker to monitor landmarks from frame to frame constraining using an ASM model
- Learn non-linear shape manifold as separate ASM models for each major pose and dynamically switching models as the head rotates

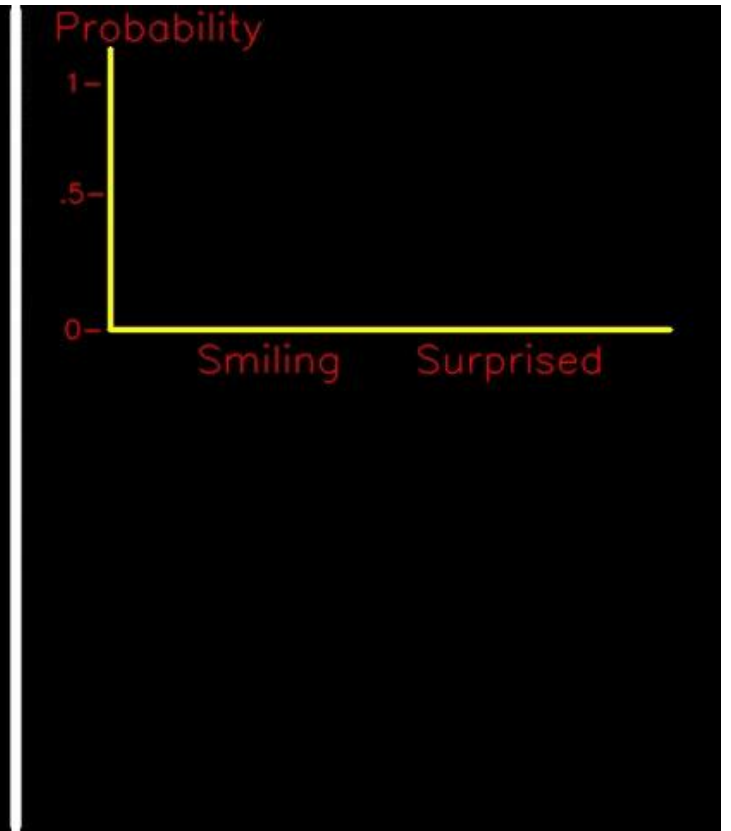




# Facial Expressions/Gestures

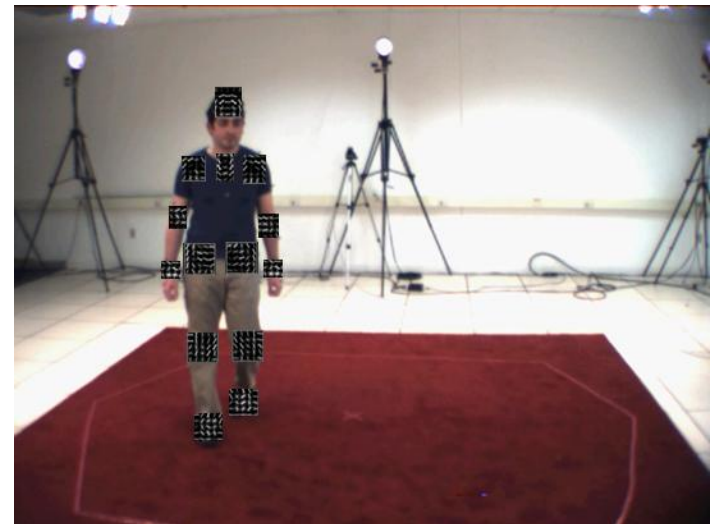
- Extract
  - 3D head pose
  - Eyebrow displacement
  - Nose movement (for nod and shake detection)
  - Mouth deformation (e.g., mouth area)
- Expression/Emotion Recognition
- Blink Rates and Alertness measures
- Sign language
- Deception detection





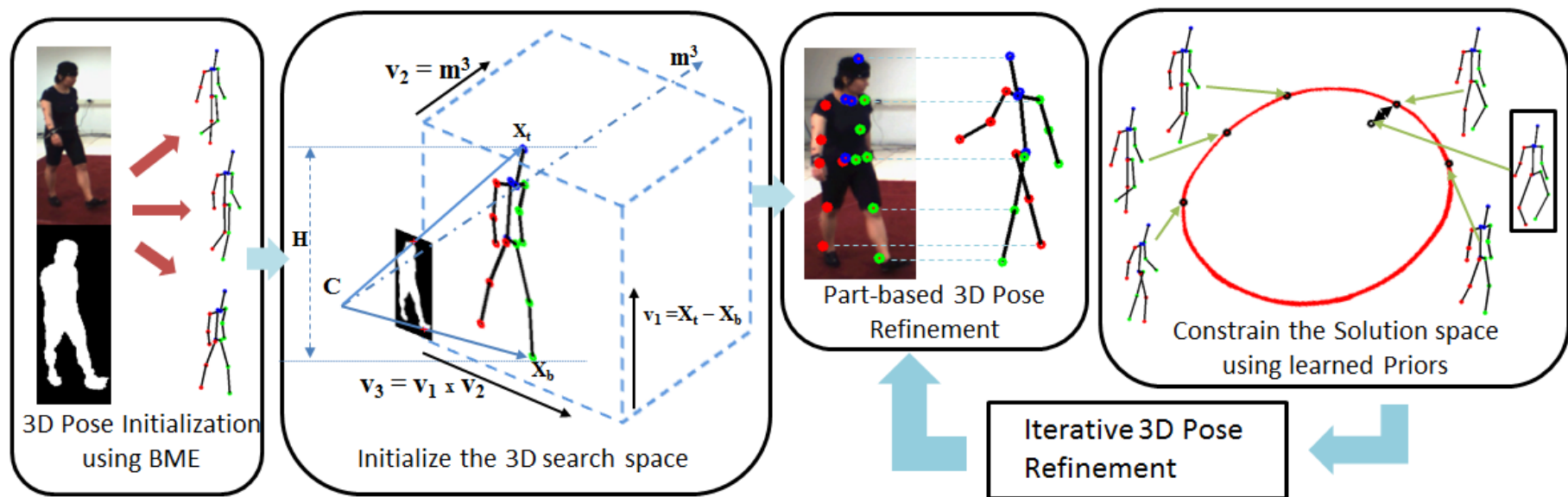
# 3D Pose Reconstruction from Monocular images

- 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

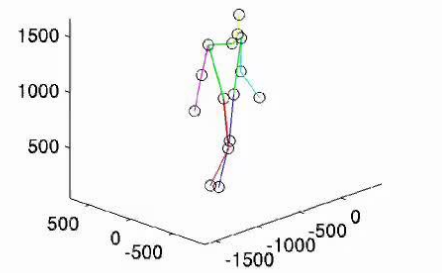
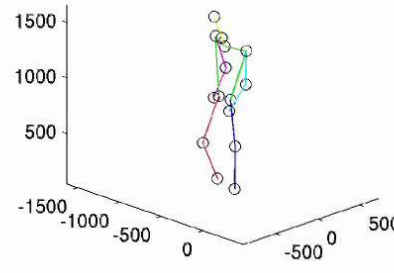
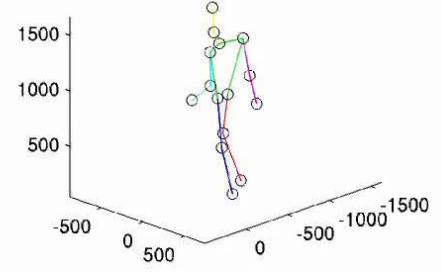
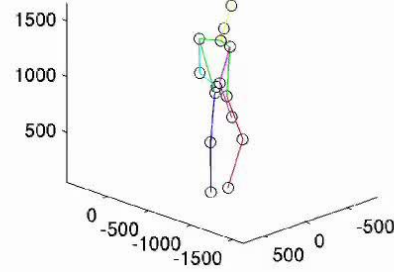
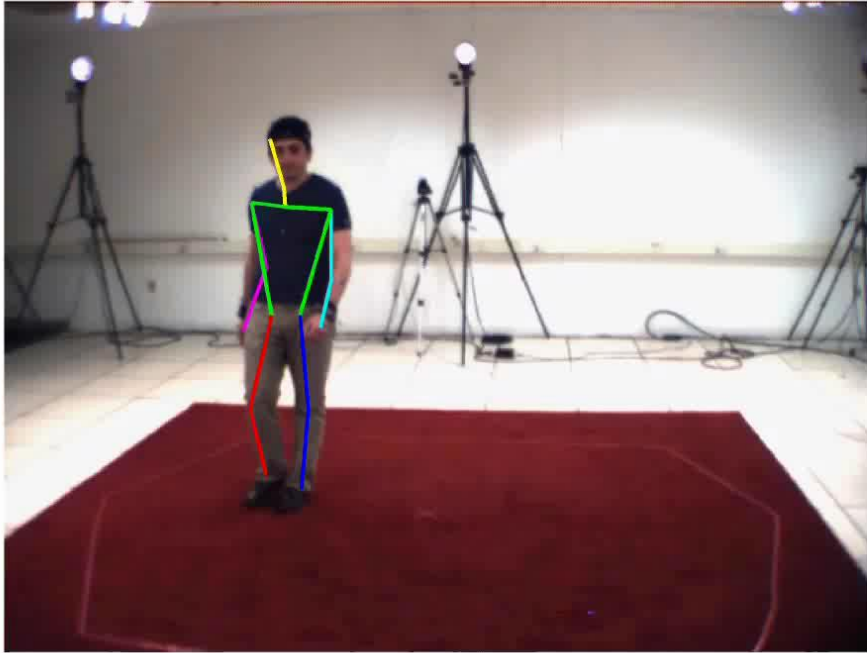


# Part-based Hierarchical Skeleton Model

- 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

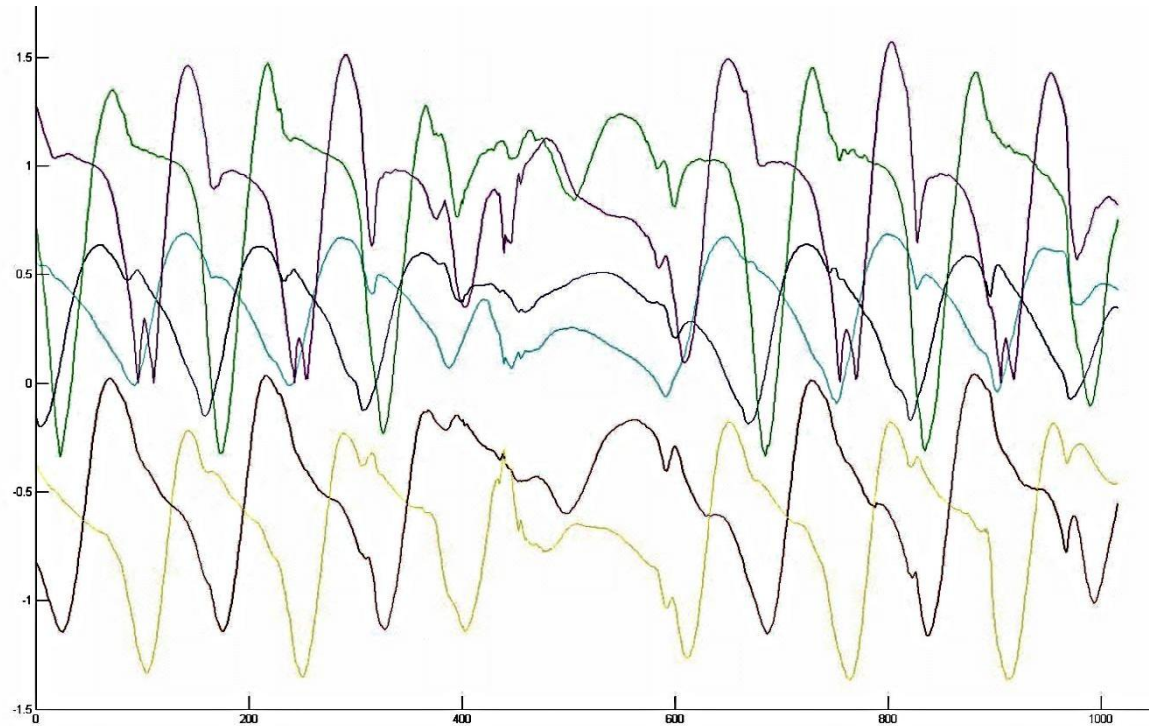






## Applications

- 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