Active Shape Models (ASM)
• ASM is a statistical model of permissible shape variation and deformation learned from a training set of labeled face images.
  • Once trained, can be used to find and track facial landmarks (e.g., eyes, eyebrows, mouth, nose) on never before seen faces.
  • A Mixture of Experts model allows us to predict the 3D head pose of the subject from the 2D tracked facial landmarks.

Learning Non-Linear Shape Manifold
• Facial shape undergoes drastic non-linear deformation during head rotations.
  • We model non-linear manifold as multiple overlapping subspaces, learning separate ASM models for each one.
  • Dynamically switch models as head rotates using an appropriate distance metric to detect drastic pose changes.
  • Overall model allows real-time tracking.
  • Handles partial occlusions.
  • Can track subjects with glasses.

Projects (1) – American Sign Language
• Grammar in American Sign Language (ASL) is conveyed via facial expressions and gestures (e.g., lowered eyebrows, head shakes, etc.).
• Using spatial and temporal pyramid representations, capture the dynamic deformations of the eye/eyebrow region and the head rotations.
• Tracked features used to recognize wh-questions and negative statements.

Projects (2) – Deception Detection
• Use of ASM face tracker and skin blob tracker to analyze the facial expressions, the hand movements and the gestures of subjects in interview scenarios.
  • Learn subject-specific behavioral thresholds for patterns of relaxation, agitation and over-control.
  • Construct subject-specific models to detect deceptive behavior.

Projects (3) – Face tracking in Space Flight and Perclose
• Perclose (percentage of eyelid closure) – High values are indicators of fatigue.
  • Developed additional tracking technology to analyze eye appearance and measure Perclose.
  • Demonstrated effective face tracking on footage recorded during space flight, despite cluttered background.

Future Milestones
Project (1):
• 3 months: Learn embedded expression manifold to recognize grammatical expressions which are only subtly different.
• 6 months: Use learned models to animate avatars.
• 1 year: Deliver demo application for ASL grammatical facial expressions recognition and avatar animation.

Project (2):
• 3 months: Analyze thermal video data.
• 6 months: Develop models for fusion of existing video data with thermal data.
• 1 year: Deliver face and hand tracker with embedded deception detection module.

Project (3):
• 3 months: Develop learning methods to automatically capture eye appearance templates and to detect eye occlusions.
• 6 months: Deliver demo application for Perclose-based fatigue detection.