

# Facial Tracking for Behavior and Gesture Recognition

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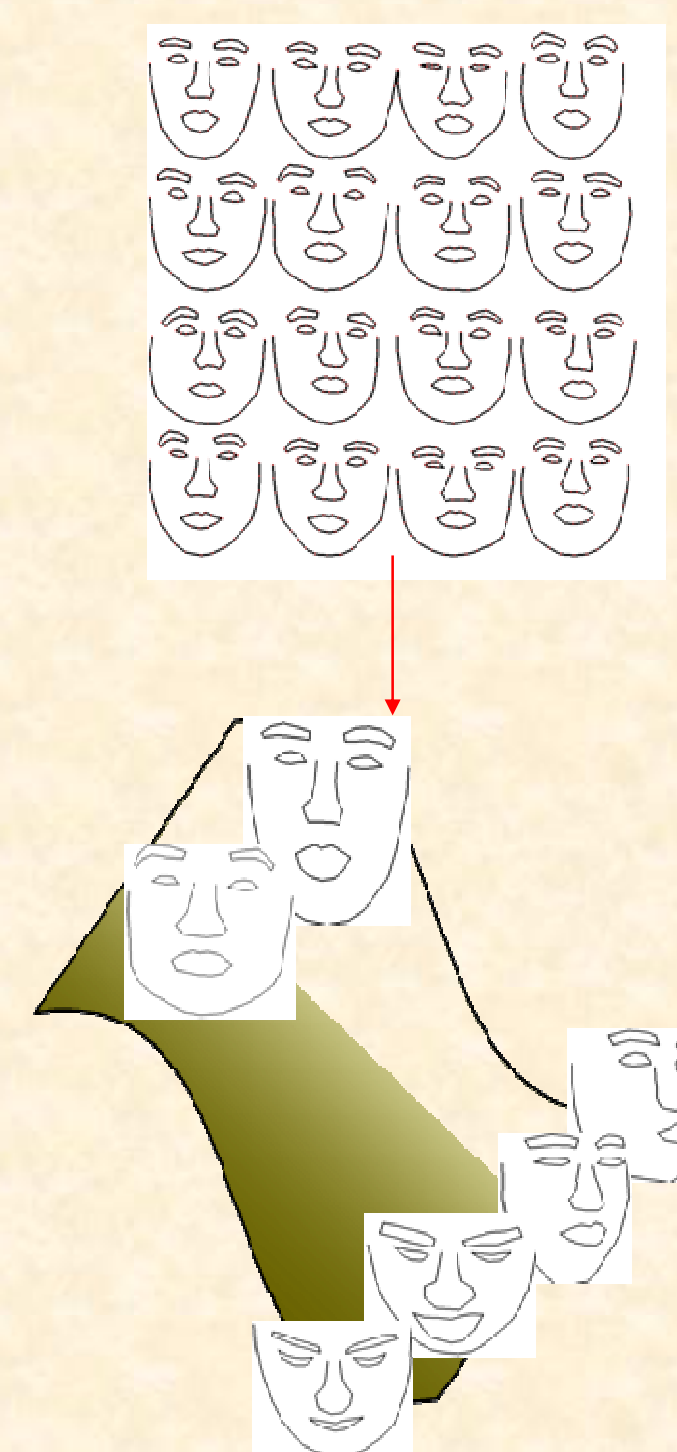
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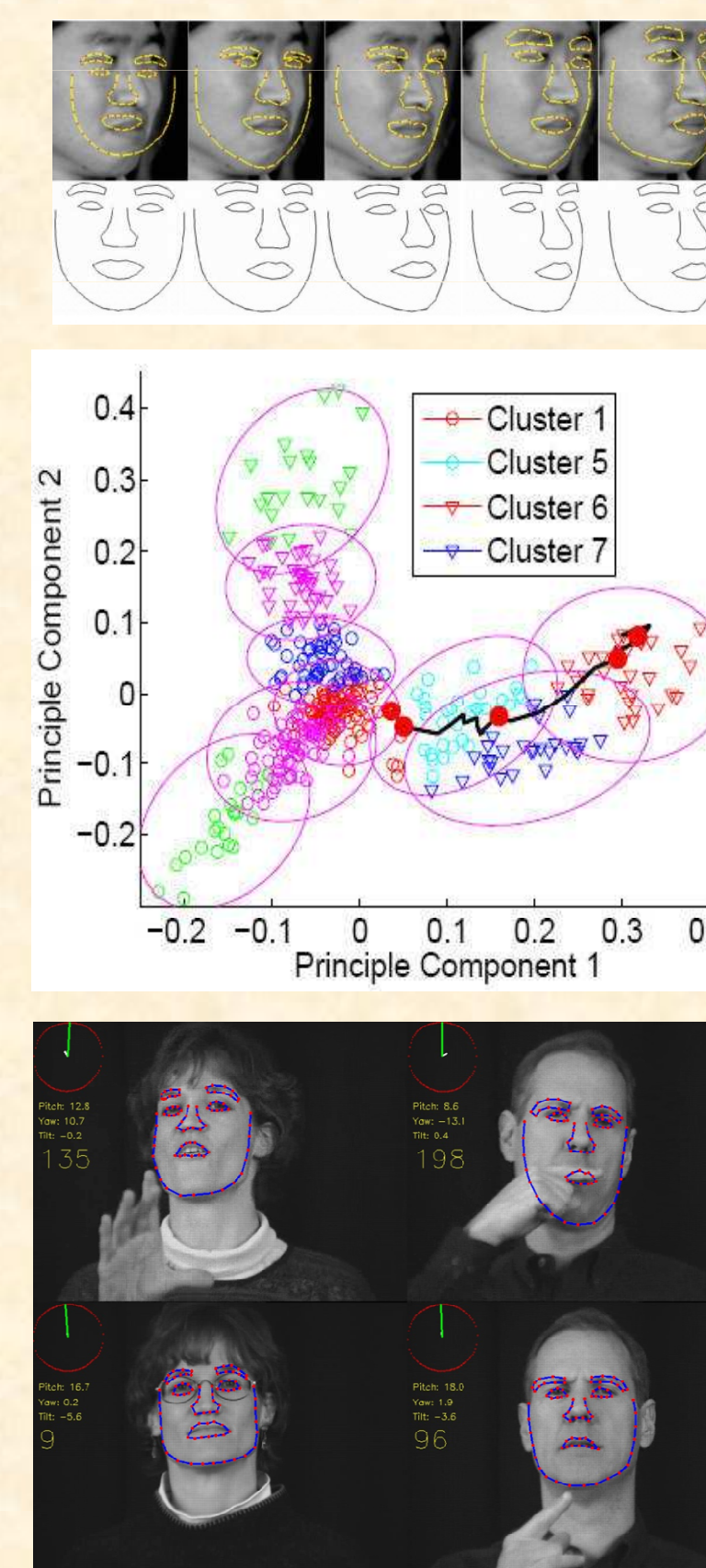
## Active Shape Models (ASM)

- 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



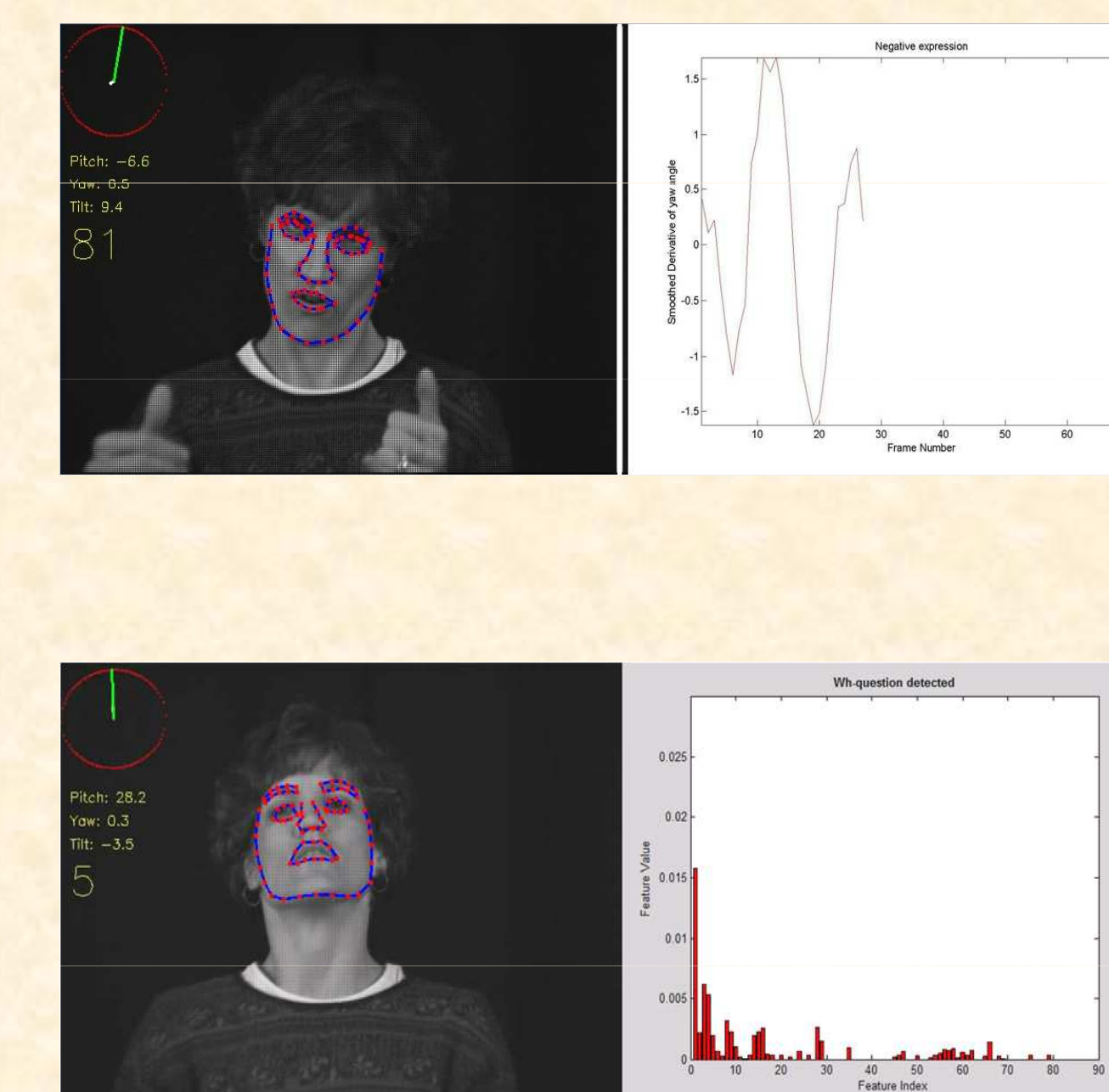
## Learning Non-Linear Shape Manifold

- 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*



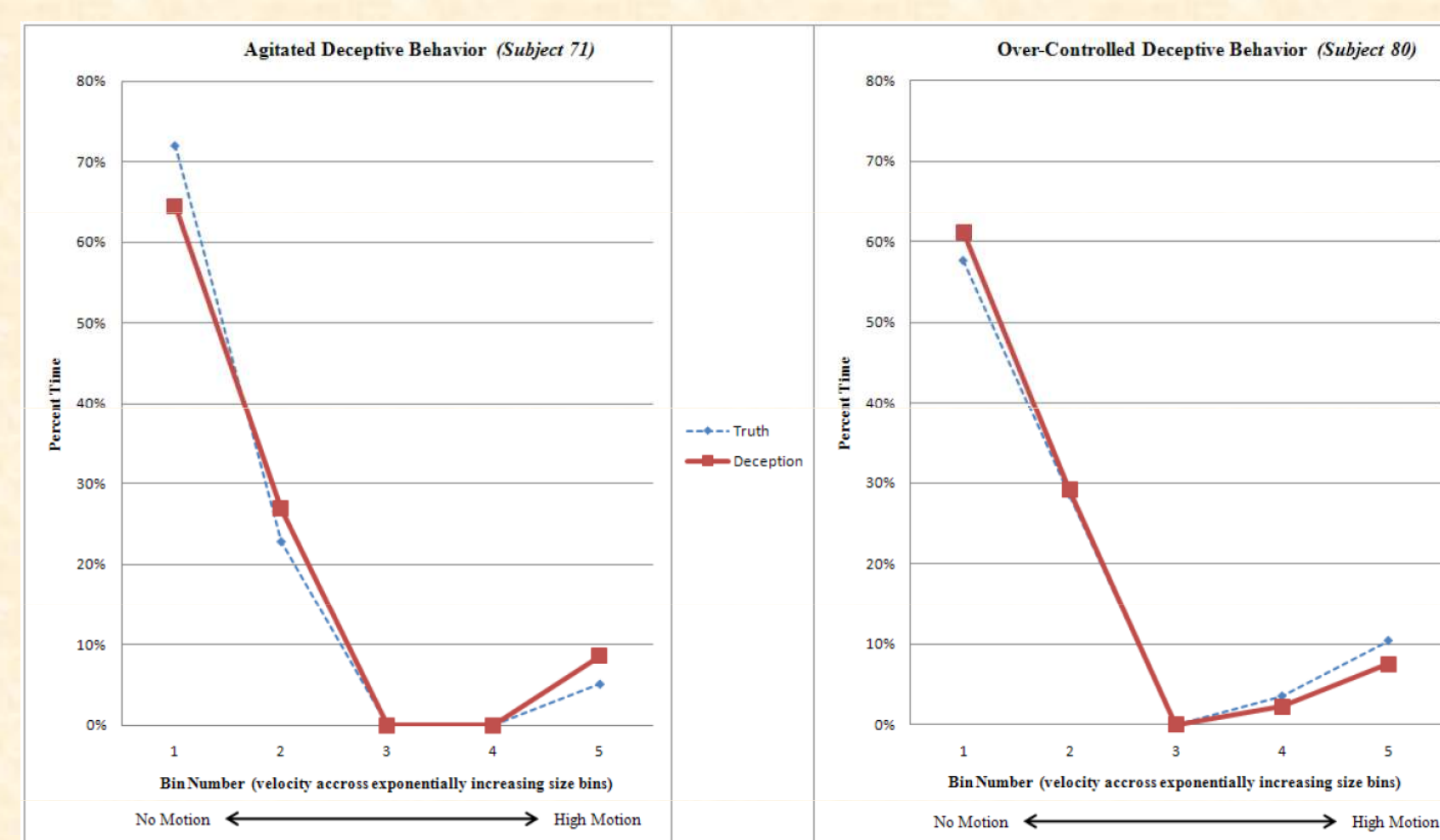
## Projects (1) – American Sign Language

- 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



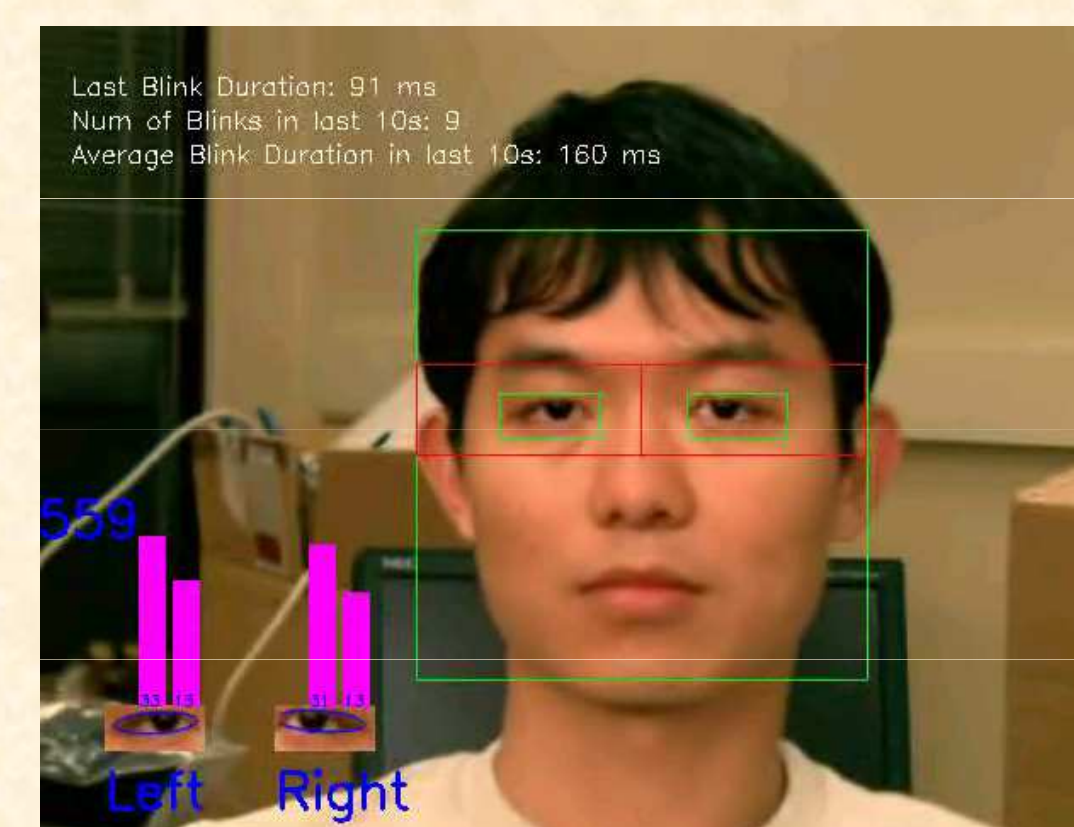
## Projects (2) – Deception Detection

- 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