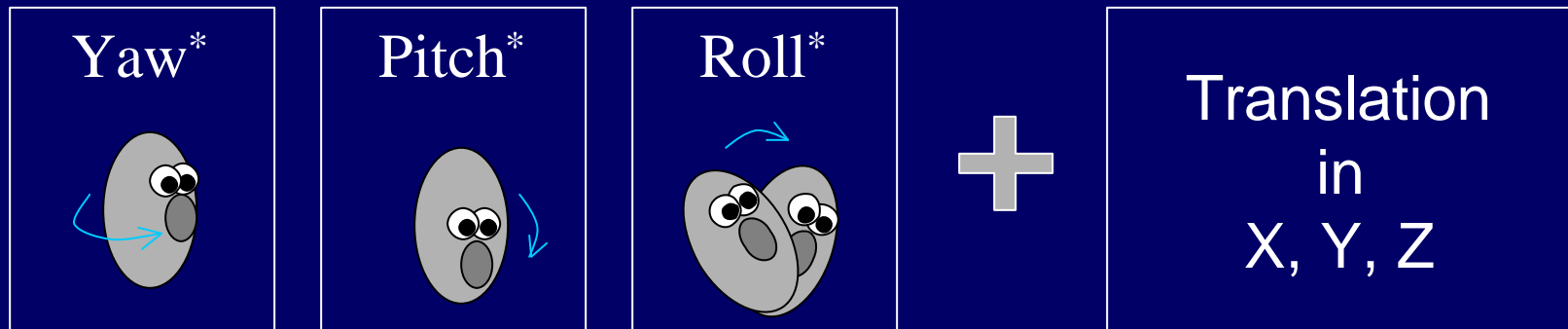


Head pose estimation without manual initialization

Paul Fitzpatrick

Life without manual initialization



* Nomenclature varies

- Manual initialization gives mapping from relative pose to absolute pose
 - Initial orientation
 - Shape parameters
- If automated, replacement is likely to be weakest link
 - Otherwise, it would be a complete pose estimation system in itself
- So initialization drives design



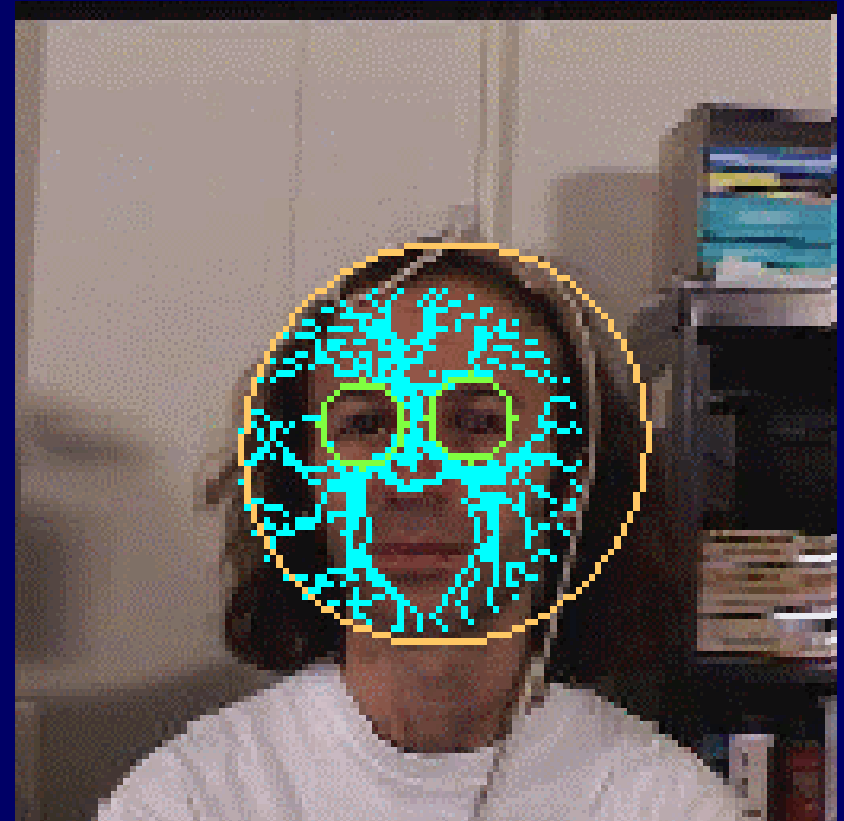
Opportunistic initialization

- Use frontal view as reference pose
- Eyes, nose are well-defined, stable, symmetric
- Head outline is less well-defined, but always present and relatively easy to find
- Use outline to guide search for eye region



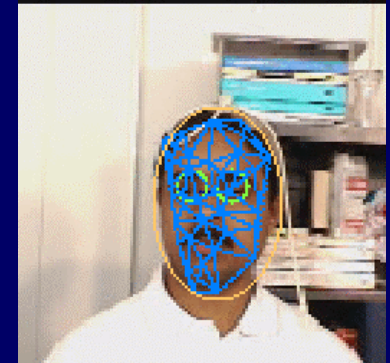
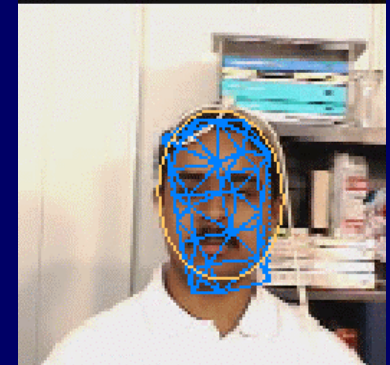
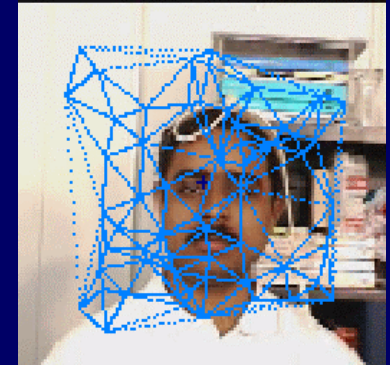
Head outline and eye location

- Track head using :-
 - Color histogram
 - Grouped motion
- Match against ellipse model
 - “ellipse-specific direct least-square fitting” (M. Pilu et al)
- Histogram initialized from grouped motion of ellipse
- Eyes located using a blob detector
 - Trade off detection rate for low false positives
 - Only search for eyes where orientation can be determined



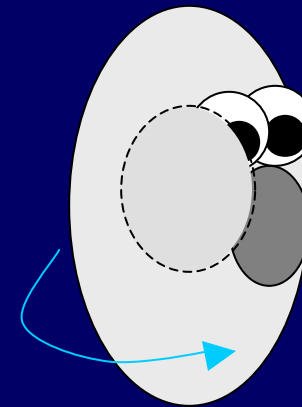
Tracking pose changes

- Establish a mesh of trackers on the face
- Prune mesh by head outline, comparative motion
- As head rotates, occluded trackers are destroyed and new ones created
- Tracking mesh gives 2D translation, in-plane rotation, and relative scale
- When eyes are detected, establish a coordinate system on nearby trackers
- Purpose of mesh is to allow eye location to be maintained across large excursions in yaw and pitch

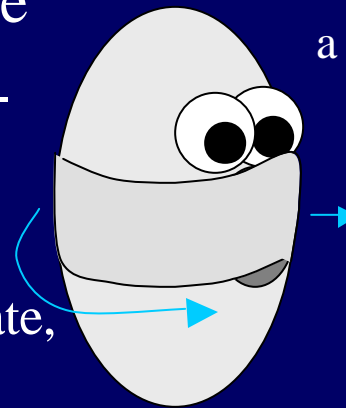


Mesh coordinate system

- Mesh coordinate system is that of “flattened head” surface
- Ideally interacts with image coordinates only where surface is parallel to image plane
- Represents the remaining 2 dimensions
- Must lead to inconsistencies, especially without good knowledge of head size
- Still, useful in two important cases :-
 - When part of mesh remains visible throughout, serving as landmark
 - When movement is somewhat degenerate, e.g. look away, then look back



Point of interaction shifts when head rotates in depth



If movement lies within a 2D strip, Euclidean geometry survives

Video

