

## Research Goal

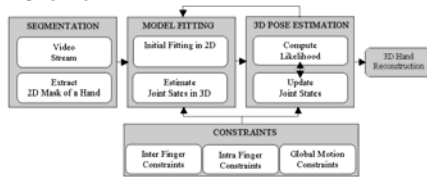
- Recognize hand motion and gestures for multimodal interactions
- Understand human hand motion
  - ▣ Reconstruct 3D hand shape
  - ▣ Infer accurate natural articulation and occlusion in real time

## Role in IMSC

- User-state assessment from multimodal data
- Enabling technology for multimodal interactions
- Augmenting the capabilities of a multimodal system
  - ▣ Provide functionalities relying on natural hands motion
  - ▣ Understand natural body language

## Research Approach

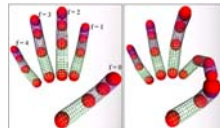
### ■ Overview



Overview of the proposed approach

### ■ 3D hand model and constraints

- ▣ Articulated hand model for constraining the physical structure of the hand and its movement.



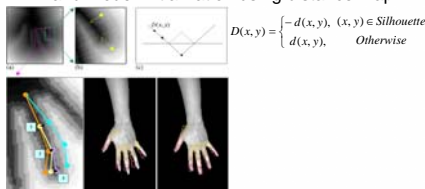
The articulated hand model consists of 15 joints and 20 DOF

- ▣ Three types of constraints are defined :

- ◆ Intra-Finger Constraints.
- ◆ Inter-Finger Constraints.
- ◆ Global Motion Constraints.

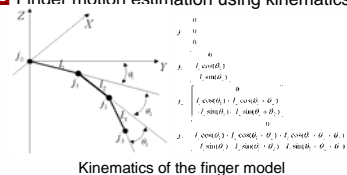
### ■ 3D Pose Estimation from a 2D Image

- ▣ Hand model initialization using distance map



**Model initialization.** (a) Distance map. (b), (c) Approaching median axis (minimum distance) along the gradient of distance map. (d) Joint position refinement. (e) Coarse 2D model with ellipsoid fitting. (f) An example after refinement.

- ▣ Finner motion estimation using kinematics



Kinematics of the finger model

### ■ Articulated motion tracking

- ▣ 3D model fitting onto detected shape using hand model and motion constraints

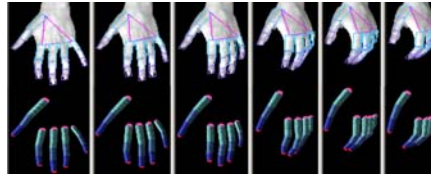
## Uniqueness & Related Work

### ■ Related work

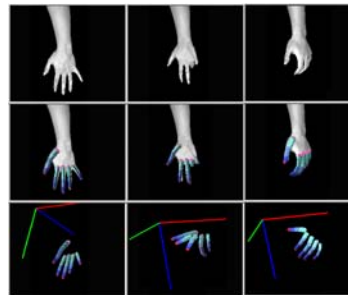
- ▣ Model based approaches: require a search in high dimensional space (more than 20 DOF)
- ▣ Appearance based approaches: require a large amount of training data set

### ■ Our approach

- ▣ Using inter-finger constraints and global motion constraints, a hand motion can be divided into global pose and individual finger motion.



1<sup>st</sup> row show the result of the global pose estimation with palm-triangle. re-projected hand model 2<sup>nd</sup> row shows the reconstructed 3D hand model.



1<sup>st</sup> Row shows the original hand pose. 2<sup>nd</sup> row represents the reconstructed pose. 3<sup>rd</sup> row is different angle view.

## Accomplishments

- Sung UK Lee and Isaac Cohen, "3D hands and fingers reconstruction from a monocular view", ICPR04, UK.

## 5 Year Plan

- Articulated model fitting and tracking.
- Efficient tracking technique for real time performance.
- Gesture recognition from the inferred articulated model.
- Computer interaction using basic hand gestures
- Multimodal interaction using hand motion