USC IMSC

A NATIONAL SCIENCE FOUNDATION ENGINEERING RESEARCH CENTER

Human Upper Body Pose Estimation in Static Images

sensory interfaces

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1. Research Goal

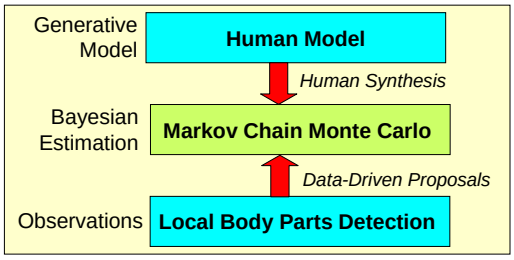
- Human upper body pose estimation in static images

2. Role in IMSC

- Image understanding for human activities recognition
- Image indexing and retrieval, data mining
- Extending to human body tracking for video analysis

3. Research Approach

- Data-driven MCMC (Zhu et al. 2000)

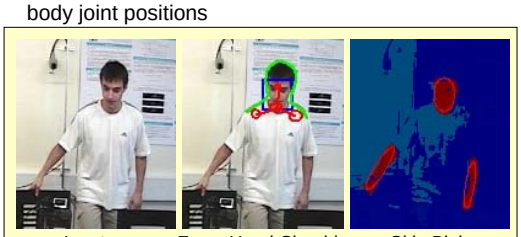


4. Human Model

- Articulated Structure (21D)
- Probabilistic Shape (6D)
- Clothing Sleeve Length (1D)

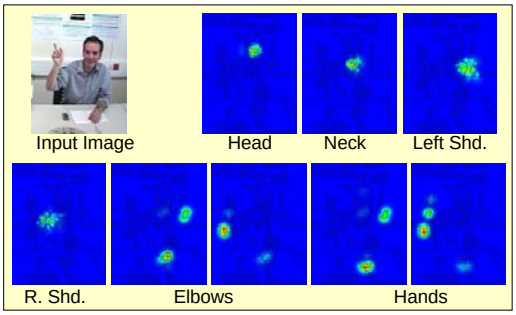
5. Image Observation

- Local observations that generate hypotheses for body joint positions



6. Proposal Maps

- Generated from image observations
- Importance sampling probability distribution approximated by grid-based representation



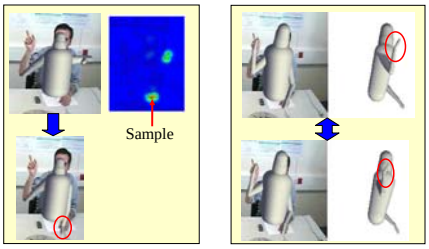
7. MCMC and Proposal Distribution

- Markov chain generates samples of state, $\{\boldsymbol{m}_i\}$, to approximate posterior distribution
- Metropolis-Hastings algorithm: At the t-th iteration, a candidate $\boldsymbol{m}'$ is sampled from $q(\boldsymbol{m}_t|\boldsymbol{m}_{t-1})$ and accepted as the new Markov state with probability

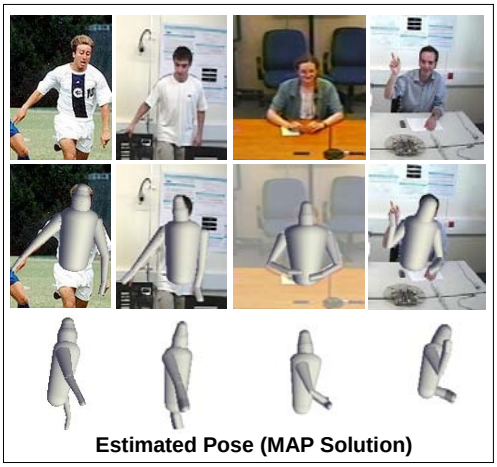
$$p = \min\left\{1, \frac{p(\boldsymbol{m}'|I)q(\boldsymbol{m}_{t-1}|\boldsymbol{m}')}{p(\boldsymbol{m}_{t-1}|I)q(\boldsymbol{m}'|\boldsymbol{m}_{t-1})}\right\}$$

Three types of Markov chain dynamics:

- 1. Random-walk Sampler
- 2. Proposal Jump Dynamic
  - Dynamic involves one joint at a time
  - Sample image position from proposal map
  - Update pose with inverse kinematics
- 3. Flip Dynamic
  - Flip a body part along depth direction



8. Results



9. Accomplishment and Future Work

- Publications
  - European Conference Computer Vision, 2004
  - Computer Vision Pattern Recognition, 2004 (Oral)
- Future Work
  - Estimate more complex, full body pose
  - Initialize human body tracking in video