Towards a Low Cost Multi-Camera Marker Based Human Motion Capture System

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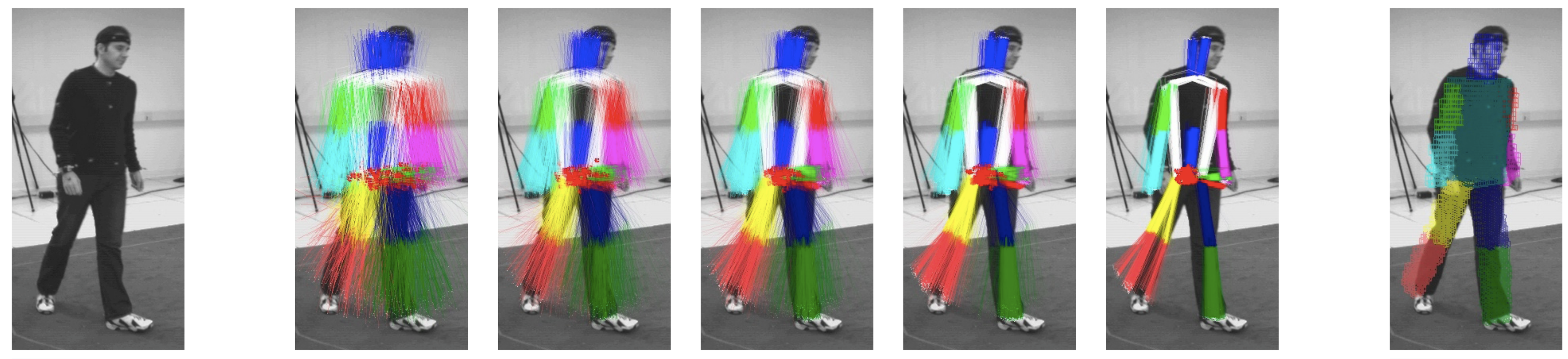
1. Objectives

- Construct a Human Motion Capture system aided by markers placed on the body of the performer able to perform with off-the-shelve computers
- Use the proposed system as an alterantive to commercial motion capture systems that require a dedicaded and expensive hardware
- Test the performance of the proposed system using a standard dataset and some real life sequences

2. Tracking proposal

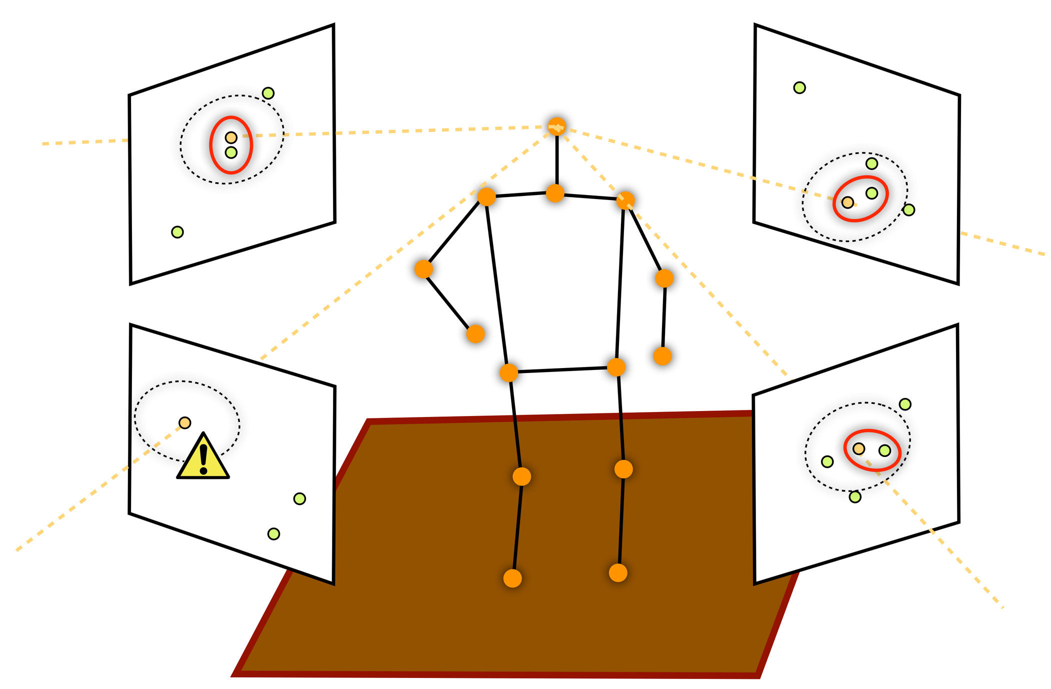
- **Tracking scenario:** high dimensional state space and multimodal likelihood function.
- **Proposal:** Annealed Particle Filter (APF) to efficiently explore the state space through a set of progressively smoothed versions of the likelihood function to make particles converge to the main mode of it.



Original Image — Annealing layers — Result

Likelihood Evaluation

- How to combine a set of 2D measurements against the 3D model encoded in every particle?



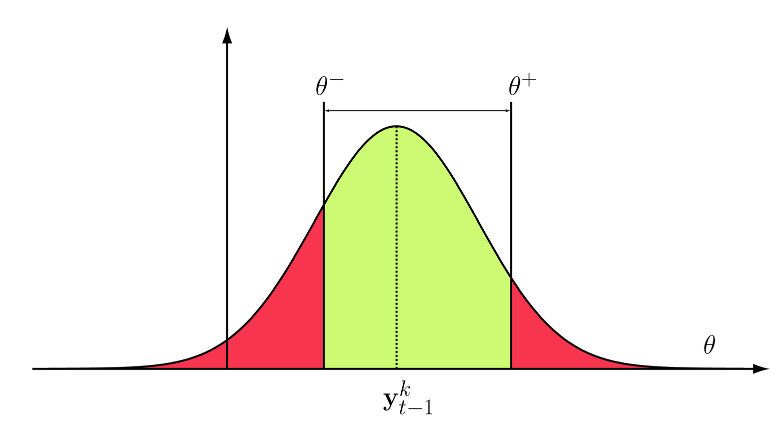
- Compute the 3D position of all landmarks of the HBM
- Detect markers in all available views
- Project every landmark on all views
- Find the closest measurement within a radius
- Compute the generalized Symmetric Epipolar Distance (SED) over the detected points
- Cost function: average the SED for all HBM landmarks
- Conform the weight of the particle

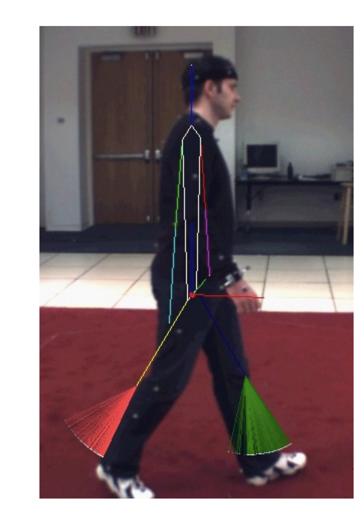
Particle state

- To better capture the dynamics of the human body, an articulated body model is selected to be the particle state (angles+position+global rotation)
- The state space adds up to 27 DoF

Particle propagation

- Take into account angular legal ranges and embed them into the propagation of the particle state





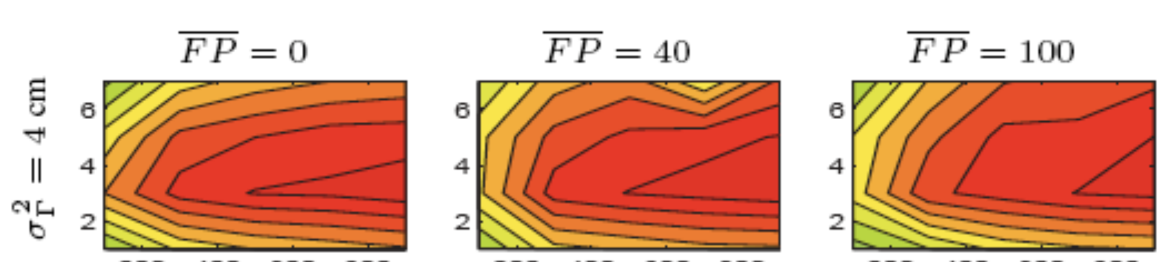
- Propagate particles from a truncated Gaussian function centered in the particle's previous state and bounded within the allowed angle span

3. Results (quantitative)

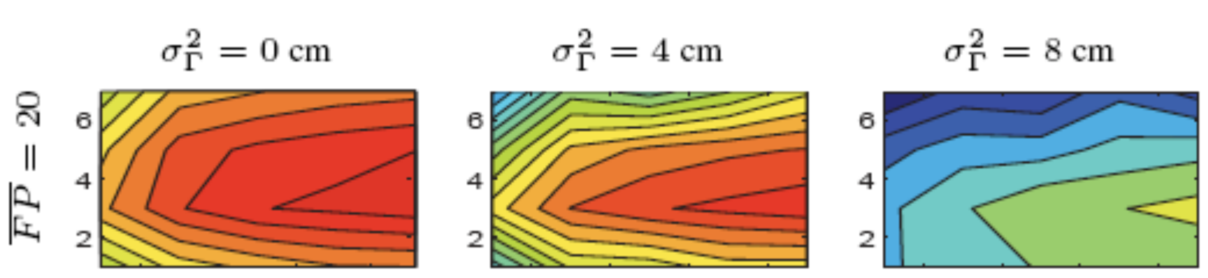
- HumanEva-I data set has been employed to test the presented algorithm
- Synthetic 2D measurements have been generated using a realistic false measurement, detection ratio and measurement error
- Quantitative results:

	Marker based APF			
	μ	σ	*MMTP*	*MMTA*
Walking	56.01	14.46	45.81	96.15
Jog	62.51	18.71	47.77	90.12
Throw/Catch	58.31	18.64	47.13	91.72
Gesture	44.70	4.31	42.42	97.46
Box	77.89	30.64	46.12	87.03
Average	**59.88**	**17.35**	**45.85**	**95.32**

- The algorithm is robust against false measurements since they are rarely hold a 3D consistency



- However, the algorithm is sensitive to the amount of measurement noise



- Real-time performance (25 fps) in a 3GHz computer

4. Results (qualitative)

- This algorithm has been tested in a realistic scenario where a dancer with some markers is performing:

5. Conclusions

- A viable alternative for marker-based multi-camera human motion capture is presented requiring a low computational load
- Future research within this topic involves capturing multiple people in the analysis scenario and the usage of scalable human body models to render the algorithm robust in the case where there are few cameras