

Human Motion Tracking

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Tópicos em Visualização e Imagens

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Human motion tracking: Contents

Applications

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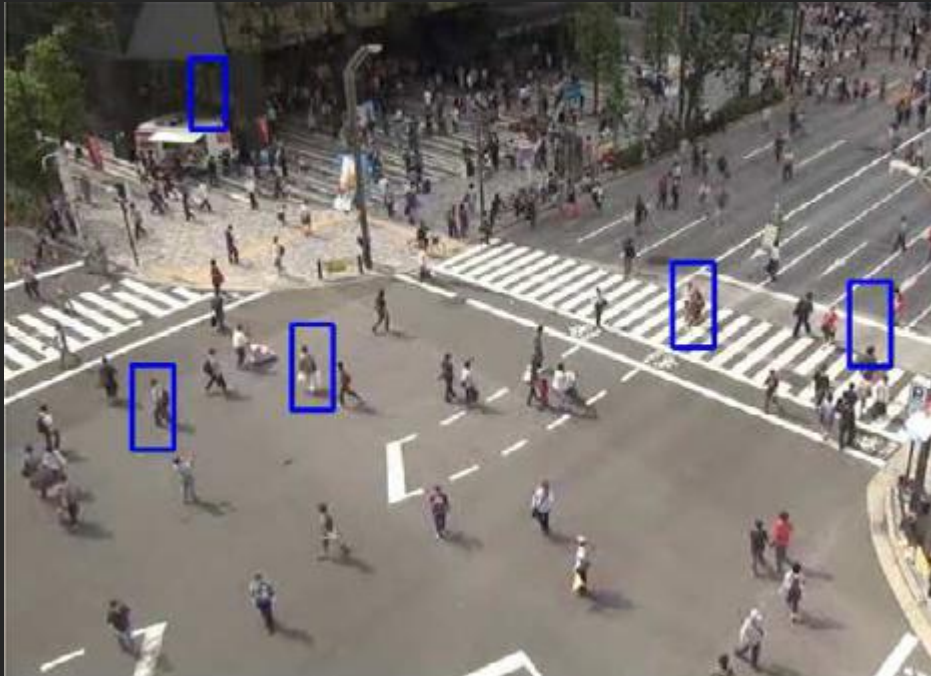
Paper:

3D Human motion tracking by exemplar-based
conditional particle filter

Liu, J., Liu, D., Dauwels, J., & Seah, H. S. (2015). Signal Processing

Human motion tracking: Applications

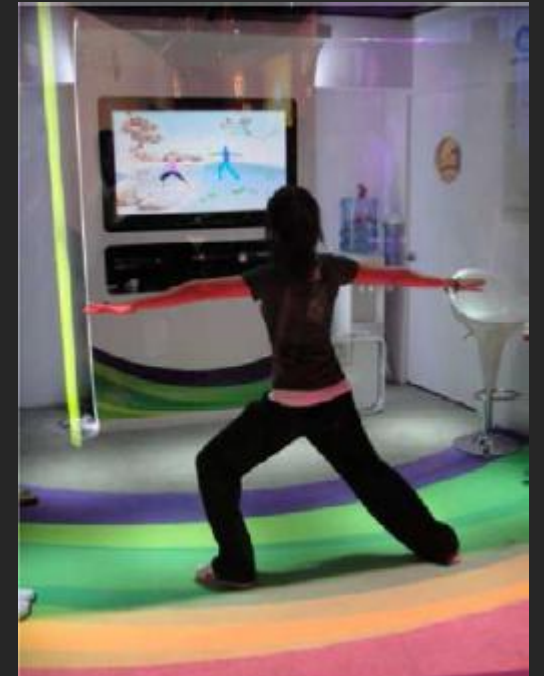
Surveillance



Sports



Gaming



Sarafianos et al. 3D Human pose estimation: A review of the literature and analysis of covariates. 2016

Human motion tracking

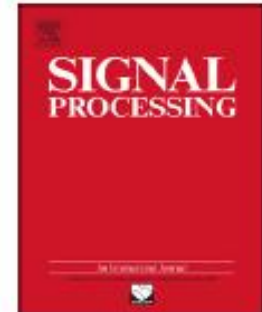
Signal Processing 110 (2015) 164–177



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journal homepage: www.elsevier.com/locate/sigpro



3D Human motion tracking by exemplar-based conditional particle filter



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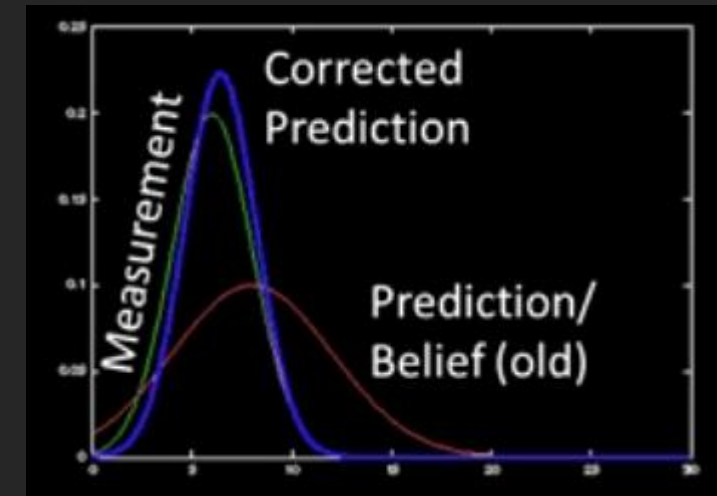
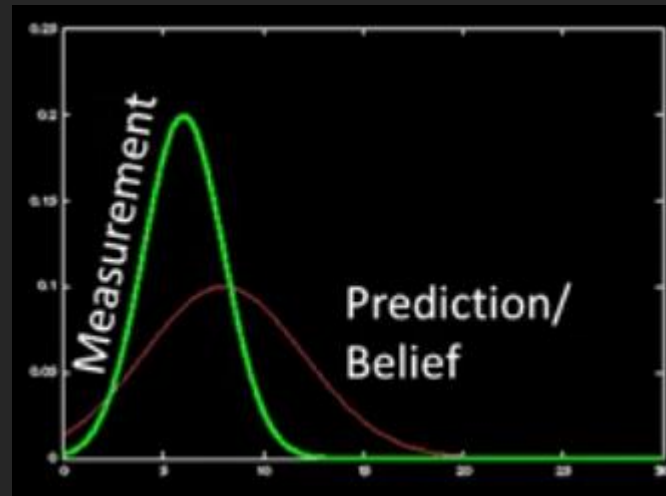
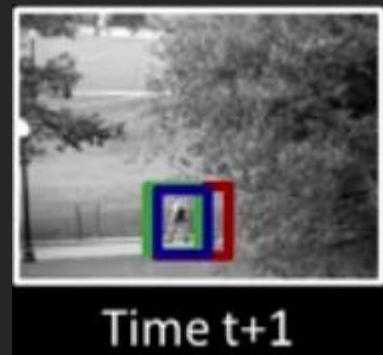
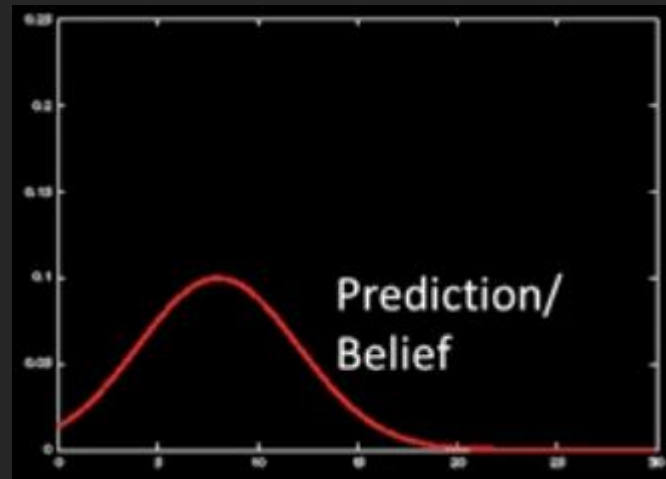
^b Singapore Polytechnic, Singapore

^c School of Electrical & Electronic Engineering, Nanyang Technological University, Singapore

Challenges in tracking

- High degree of freedom in motion
- Can be large displacements between one frame and the next
- Errors could accumulate
- Occlusions, blocking

Tracking as Inference

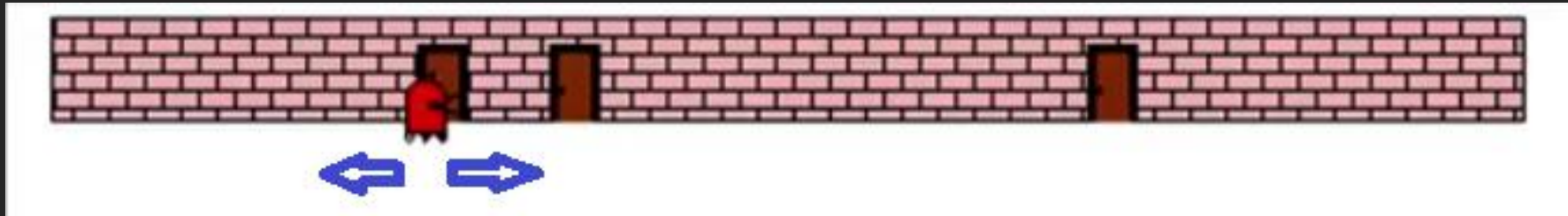


Tracking: Dynamics

Dynamics: model of expected motion. How things change

Given a **model of expected motion** predict where objects will be in next frame, before seeing the image.

- Restrict the search space



Tracking as Inference

Tracking: We **predict** the new location of an object in the next frame using **estimated dynamics**. Then we **update** based on measurements.

Parameters:

X: state

Z: observations

State changes from X_{t-1} to X_t and we get a new observation Z_t

Tracking as Inference

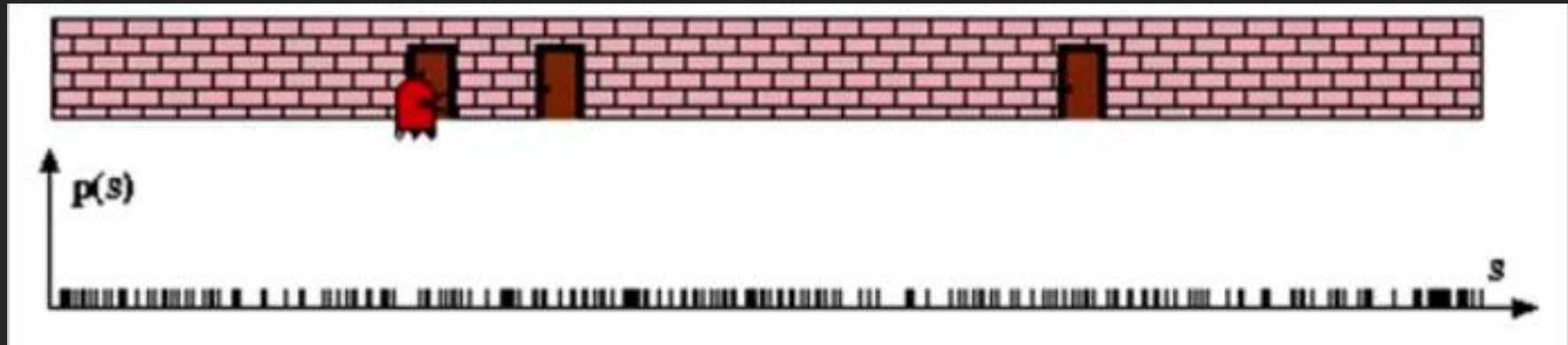
Prediction: What is the next state of the object given all the previous measurements?

Correction: Compute an updated estimate of the state from prediction and measurements

Tracking: The process of propagating this posterior distribution of state across time

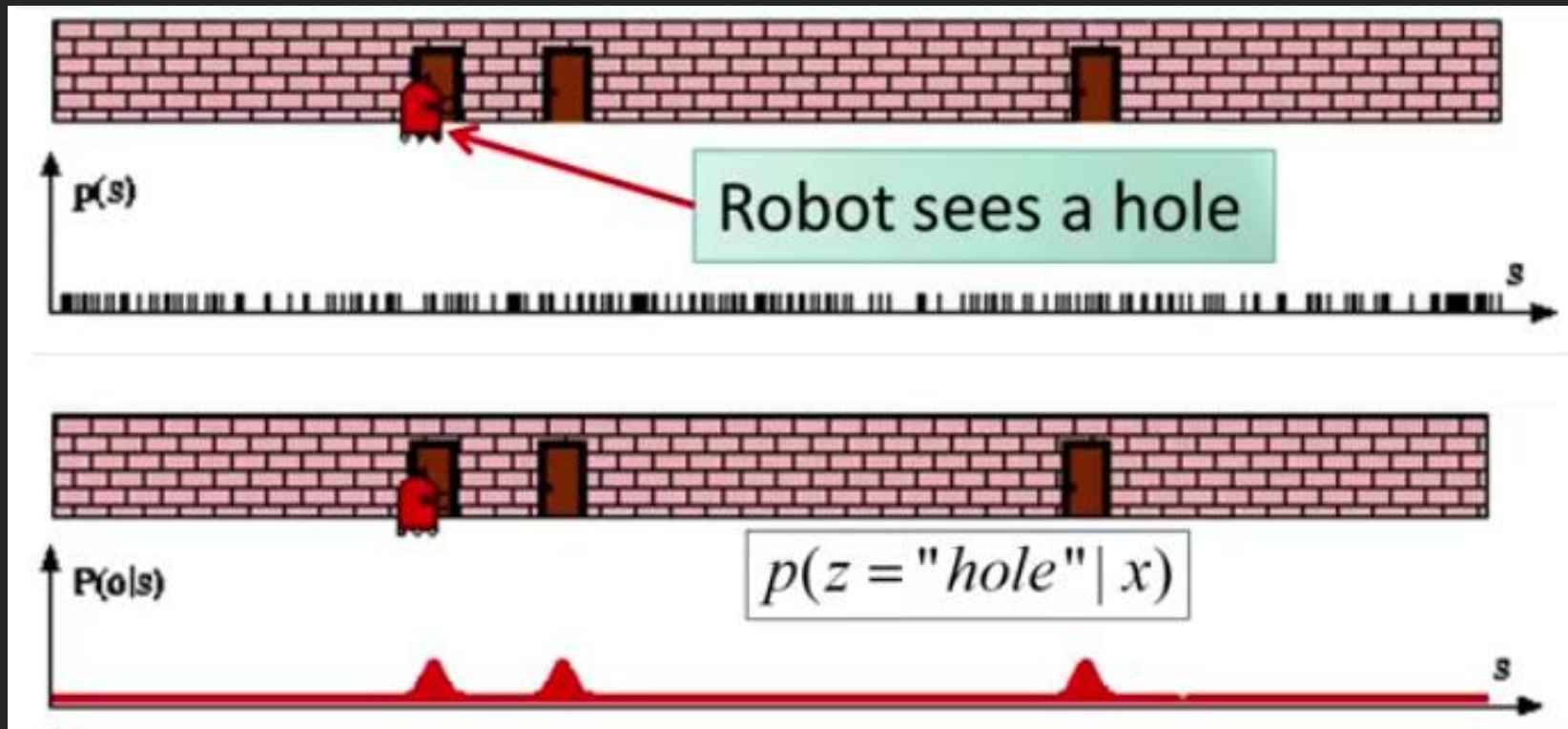
Particle Filter

Prior belief: uniform random distribution



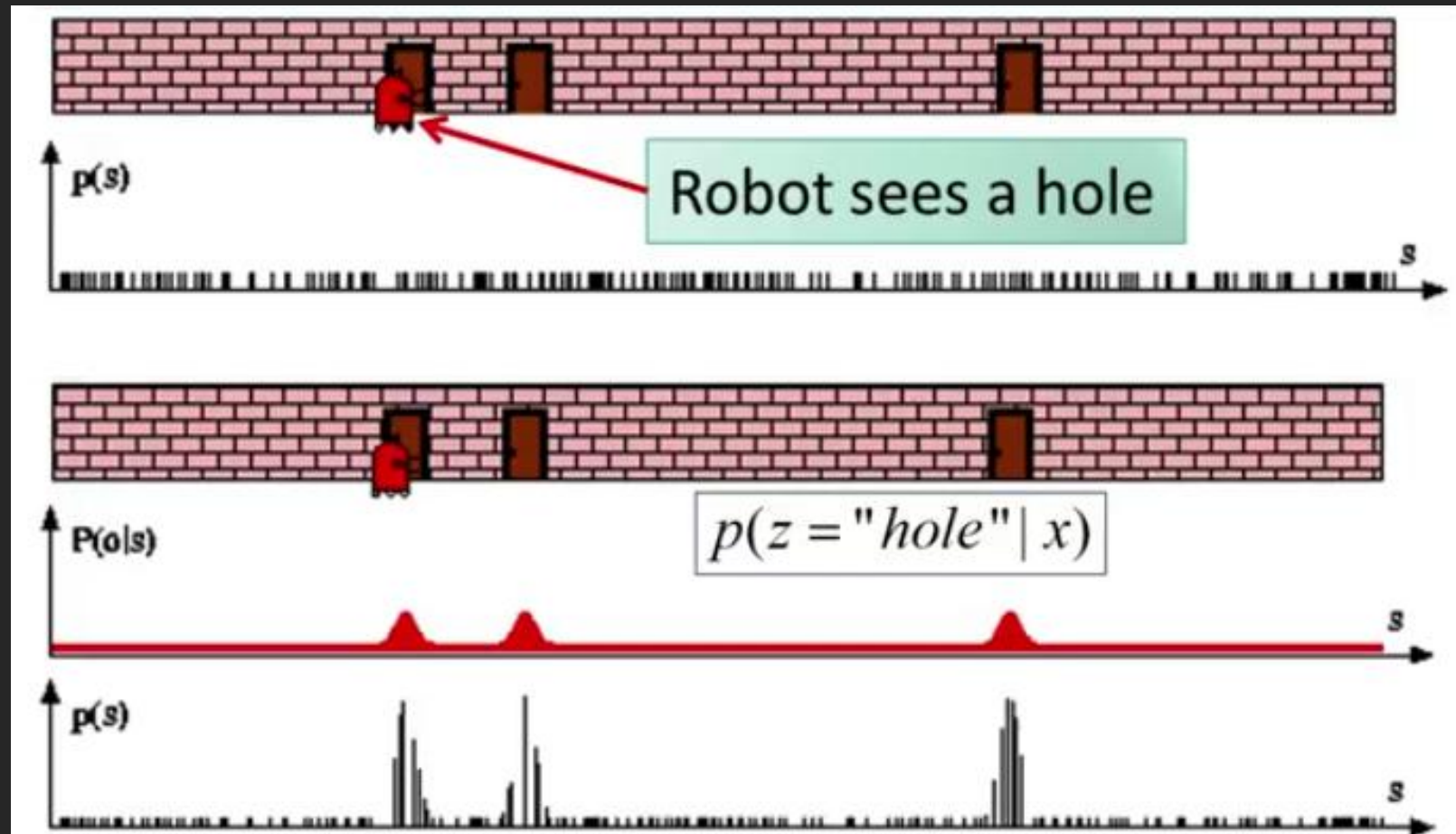
Particle Filter

What is the probability that the robot would see a hole if it is at this location



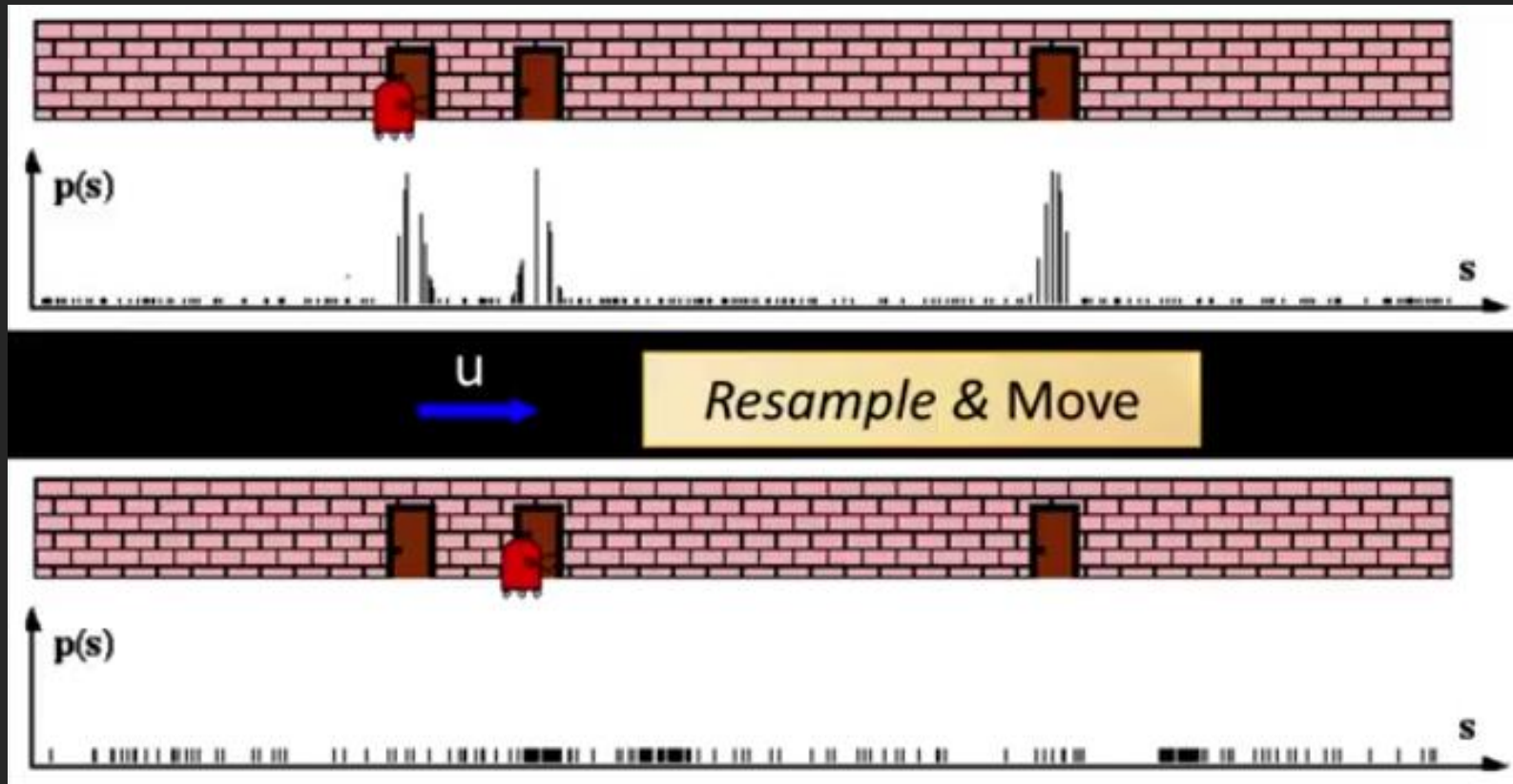
Particle Filter

Posterior: Prior times the likelihood



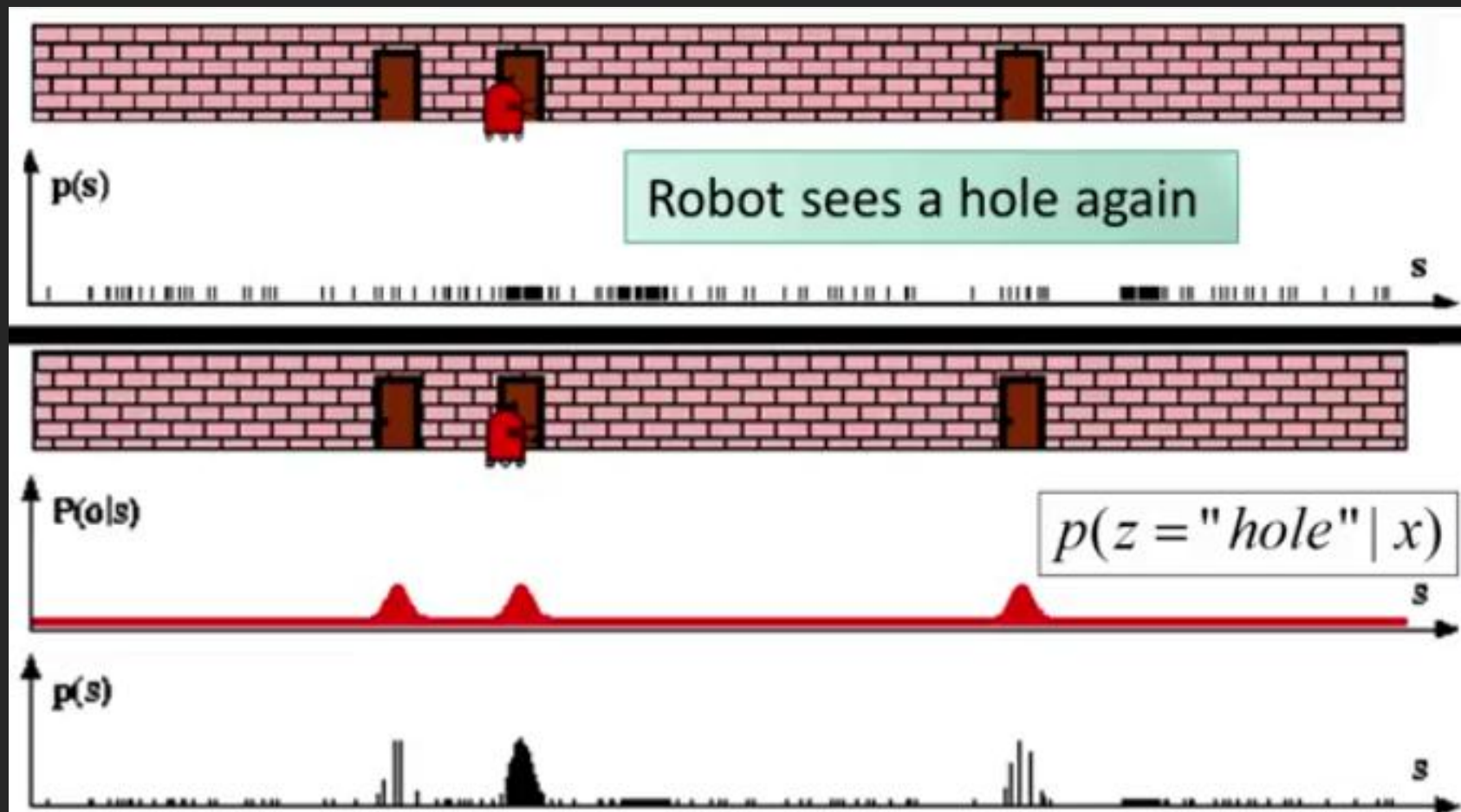
Particle Filter

Resample and move



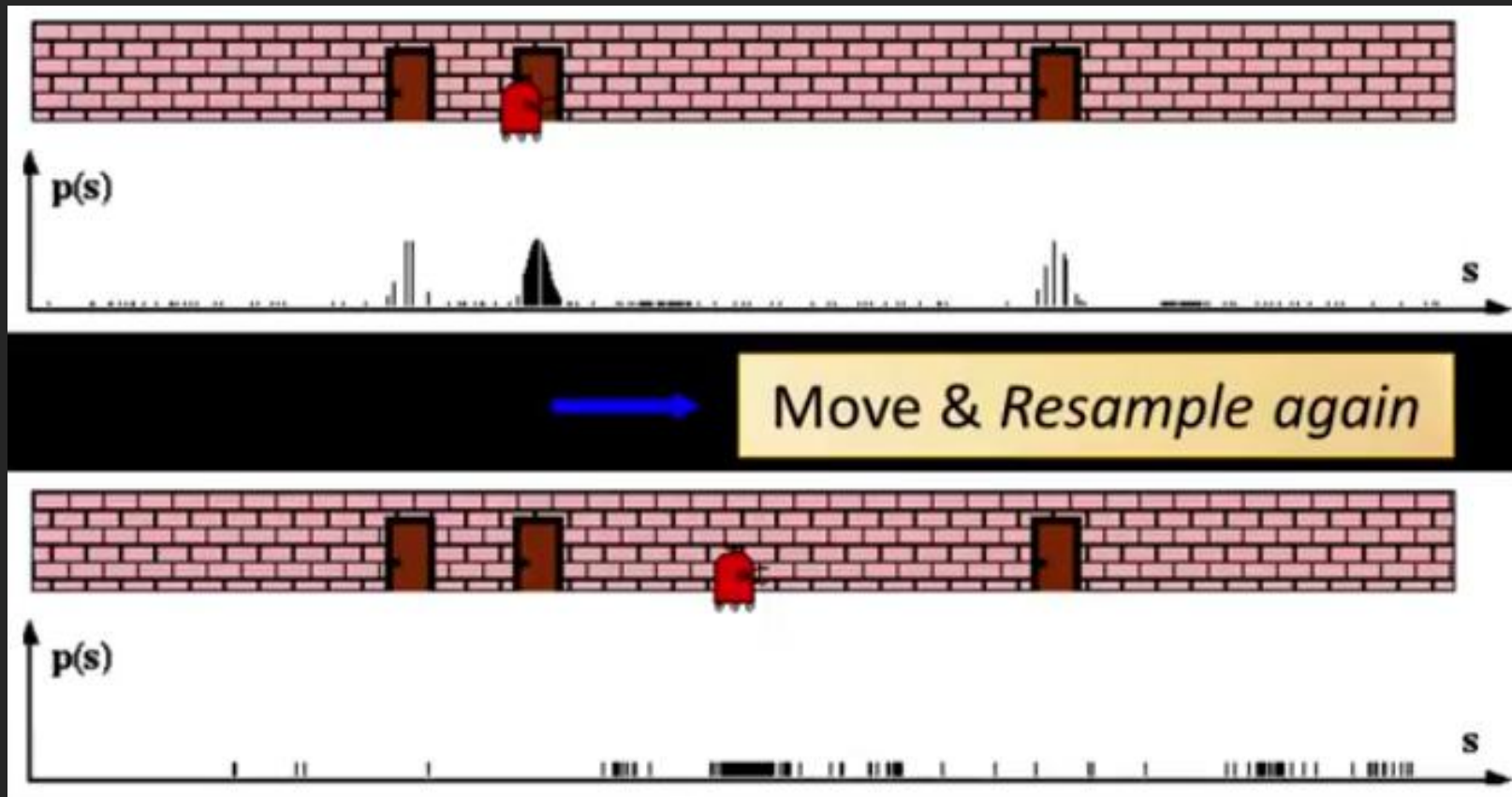
Particle Filter

Posterior

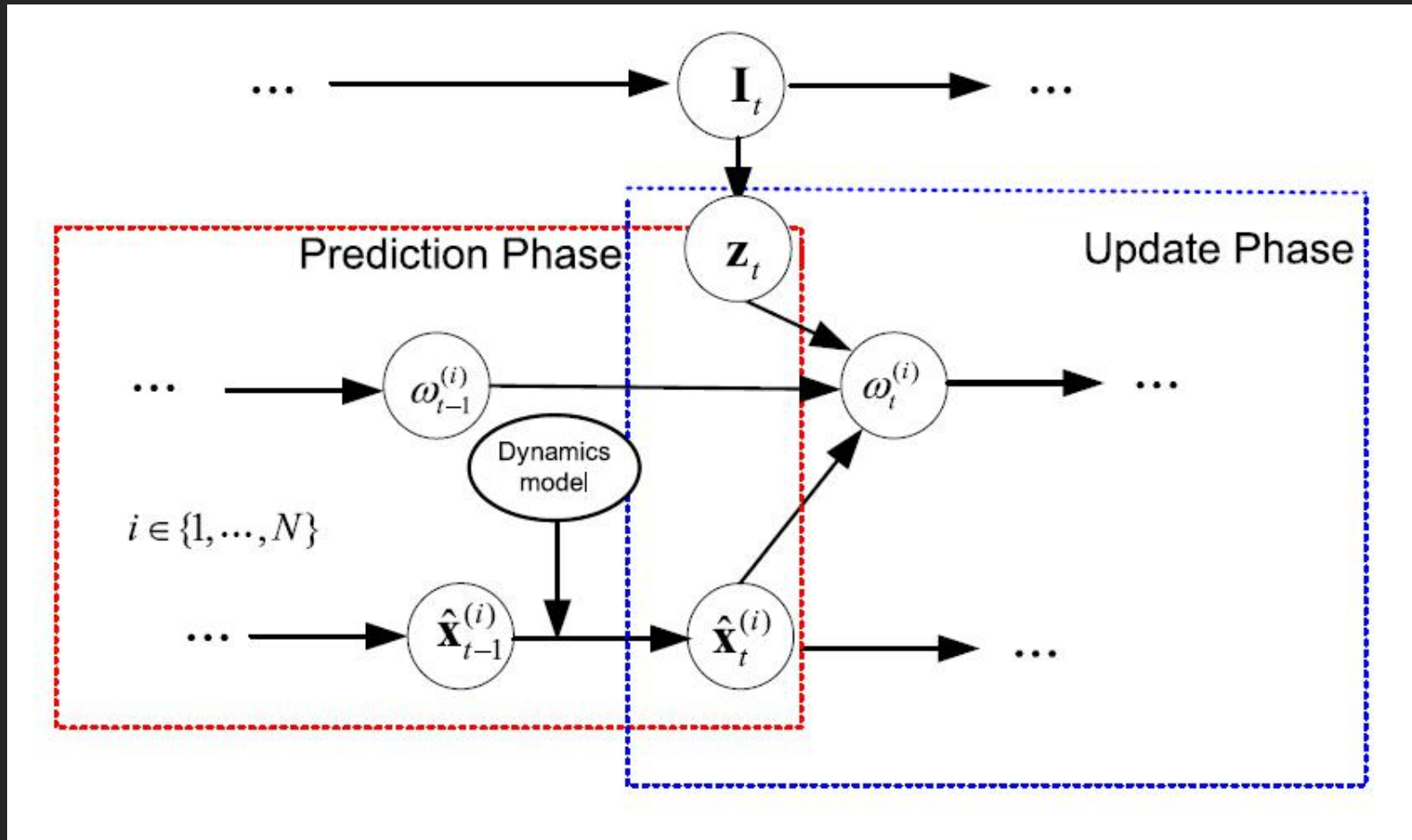


Particle Filter

Resample and remove

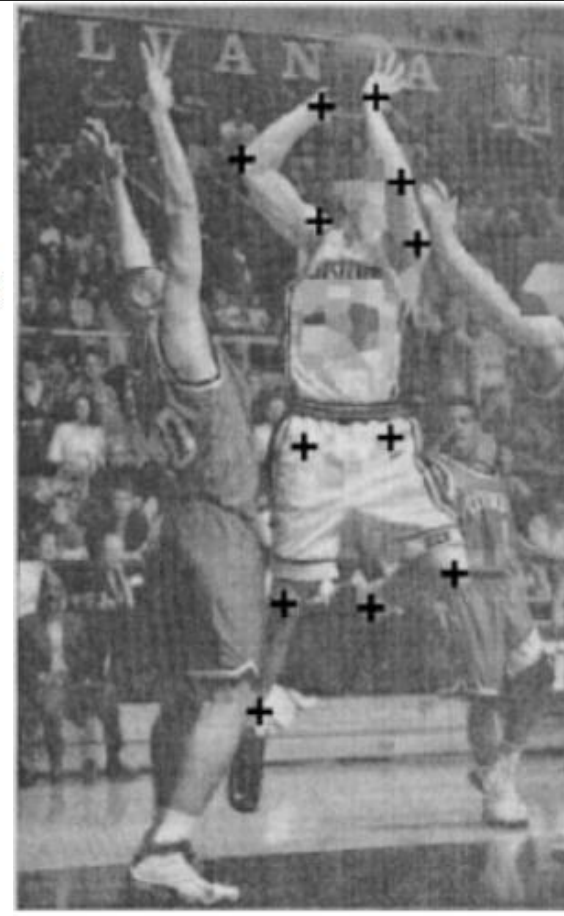
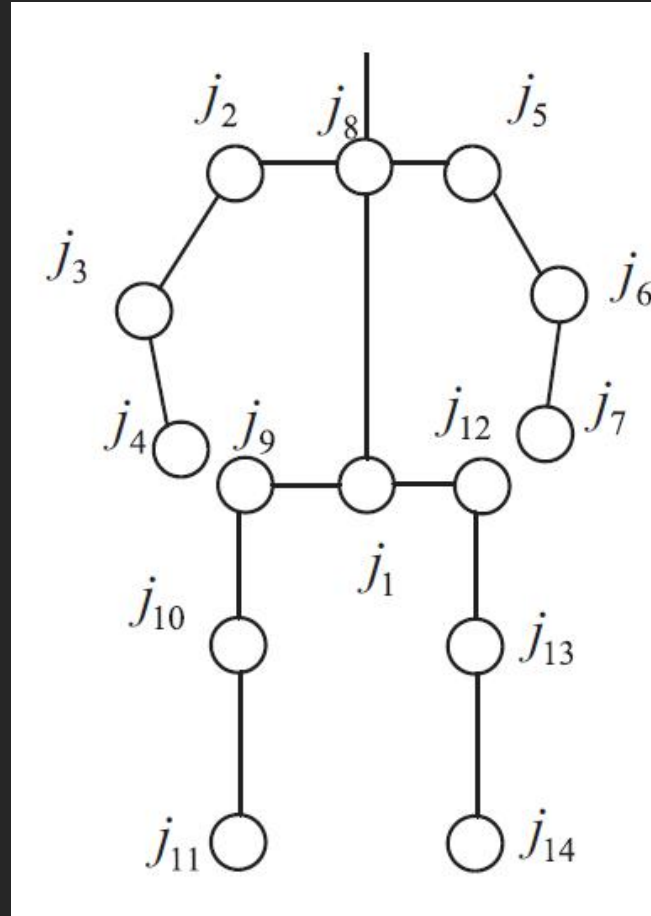
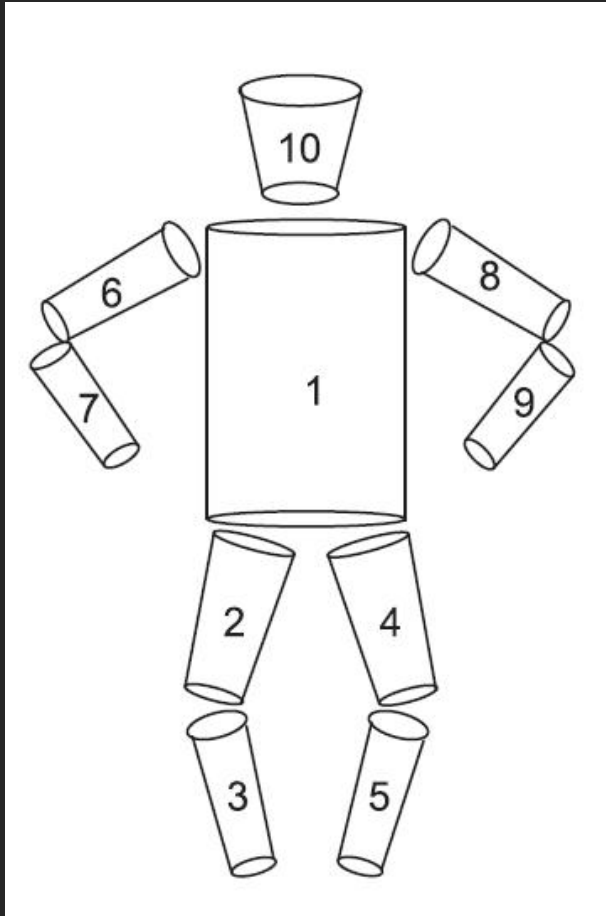


Particle filters

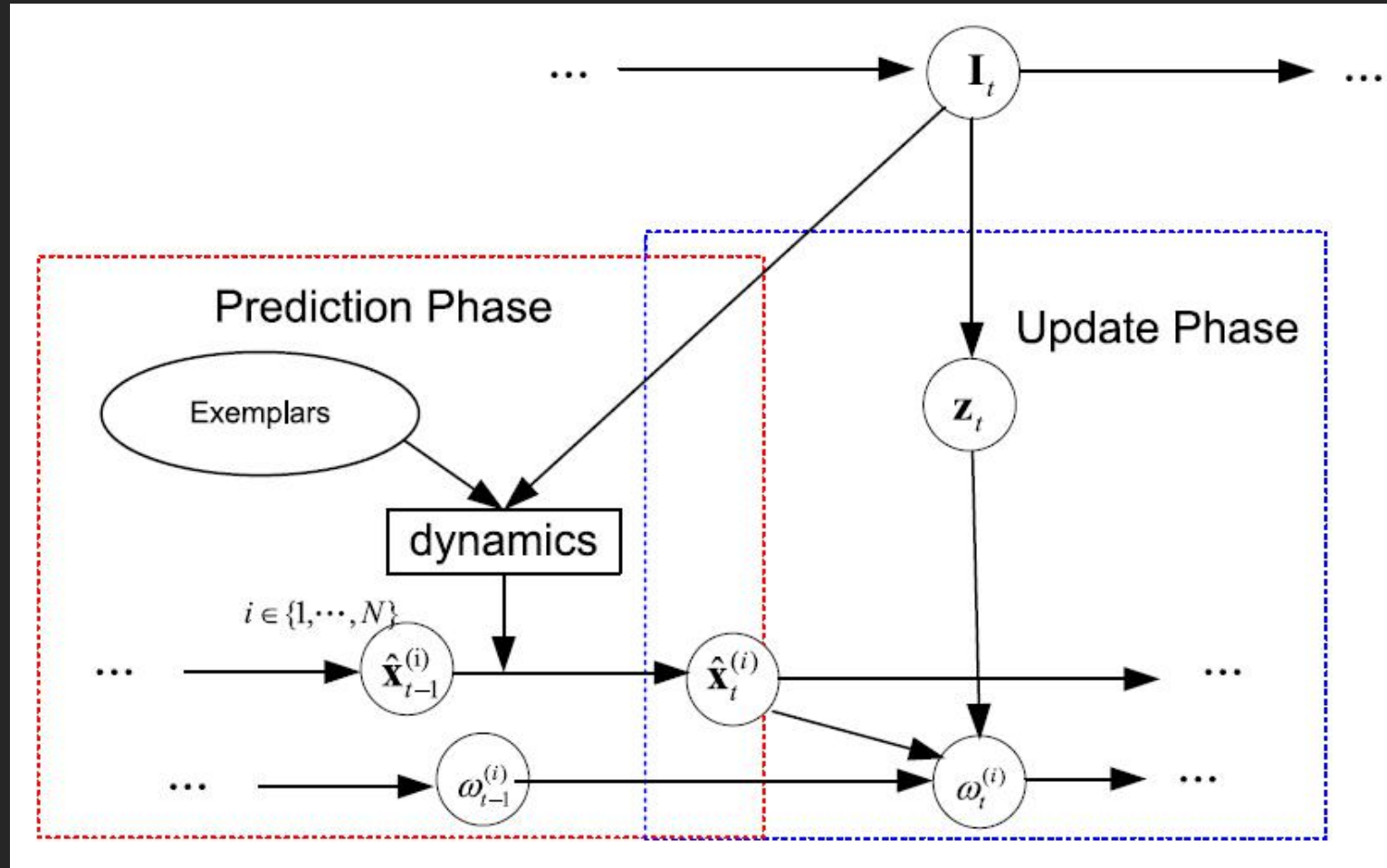


3D Human motion tracking by exemplar-based conditional particle filter

Exemplars: 3D human body model. Kinematic chain



Exemplar based Particle Filters



HumanEva Dataset

Videos with persons performing predefined actions

Multi-view video sequences at 60Hz

Synchronized with 3D body poses

HumanEva-II

<http://humaneva.is.tue.mpg.de/>

**HUMANEVA: Synchronized Video and Motion Capture Dataset
and Baseline Algorithm for Evaluation of Articulated
Human Motion**

Leonid Sigal • Alexandru O. Balan • Michael J. Black

Experiment: Sudden change

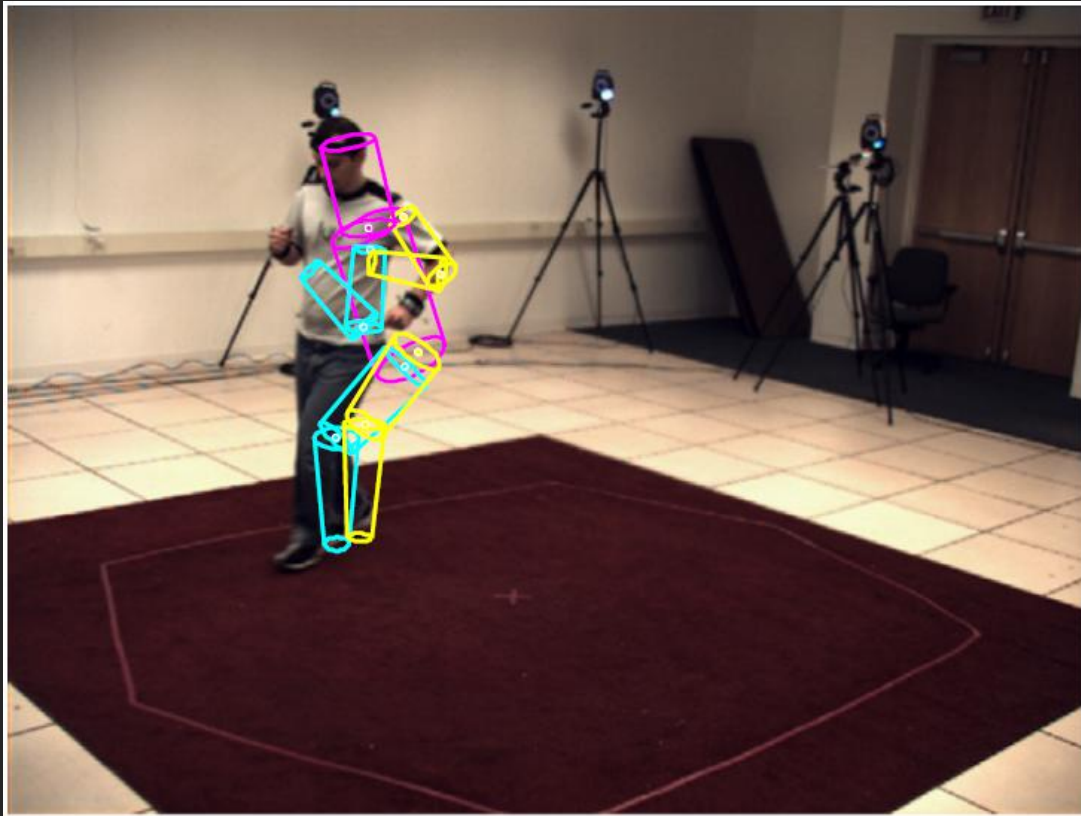
Frames 450 - 680 used

Frames 460 - 480 omitted to simulate sudden change

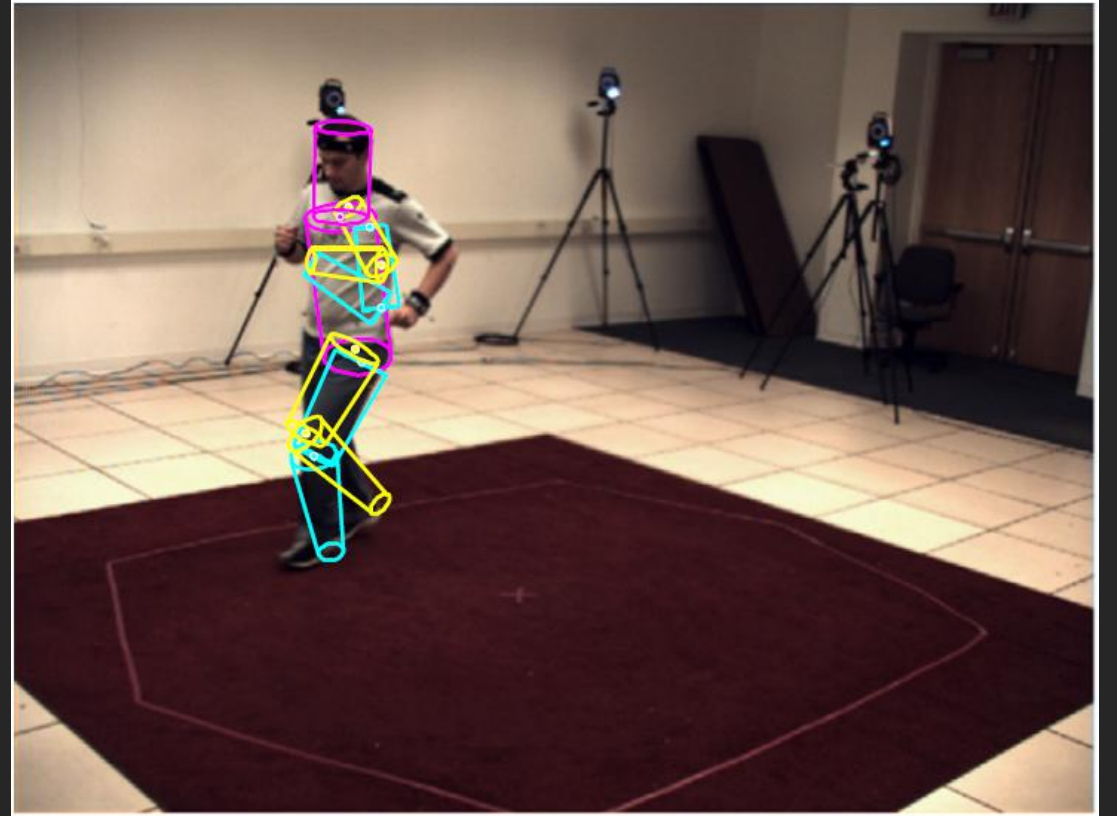
Baseline algorithm

Exemplar-based conditional particle filter

Experiment: Sudden change. Frame 485

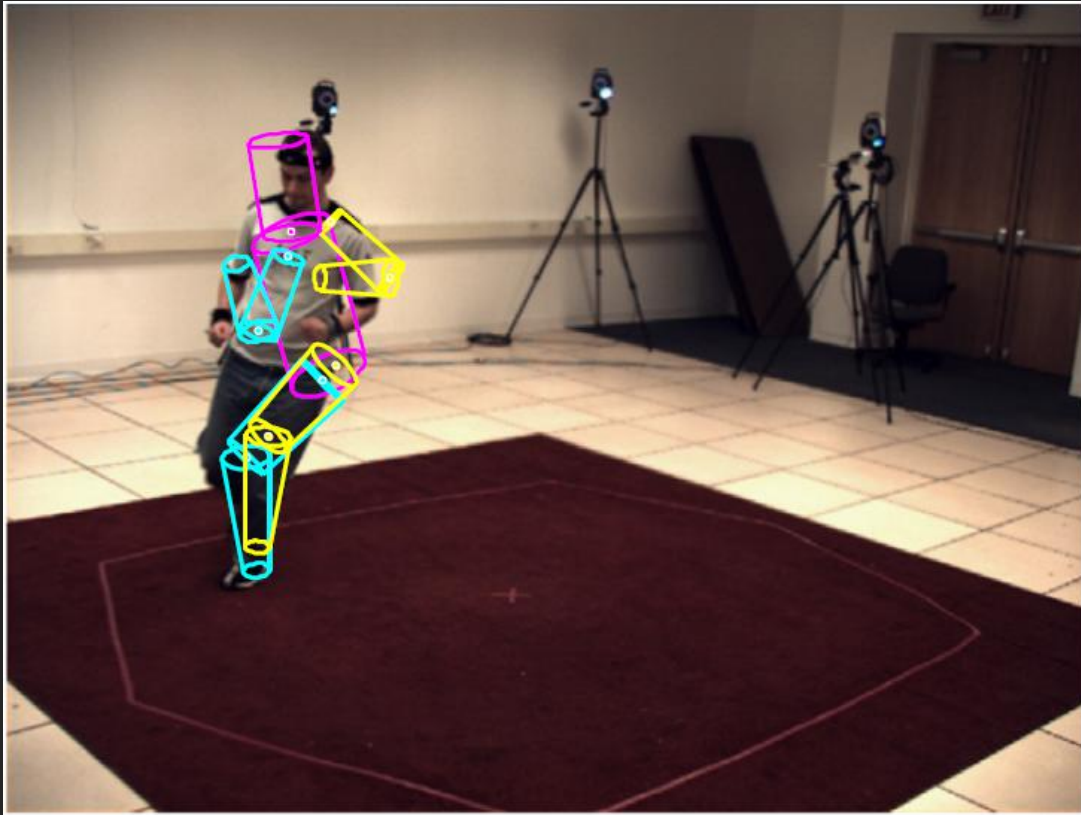


Baseline

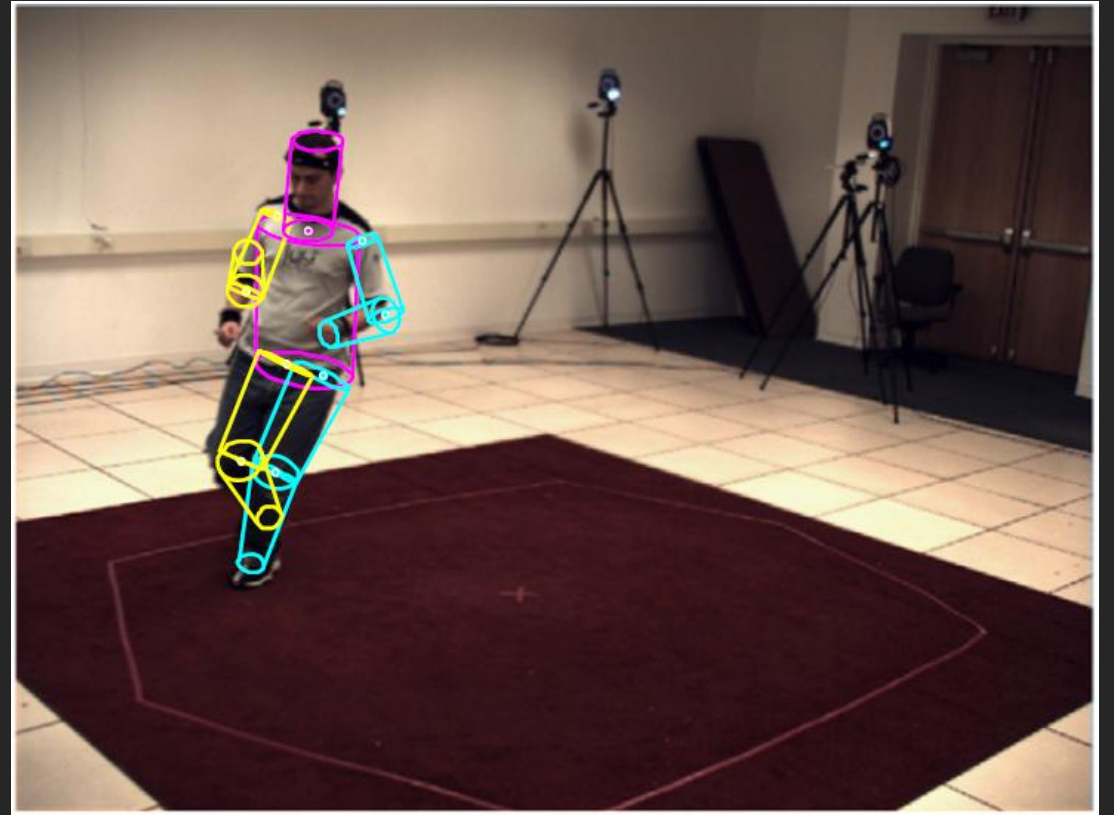


Exemplar-based conditional particle filter

Experiment: Sudden change. Frame 500

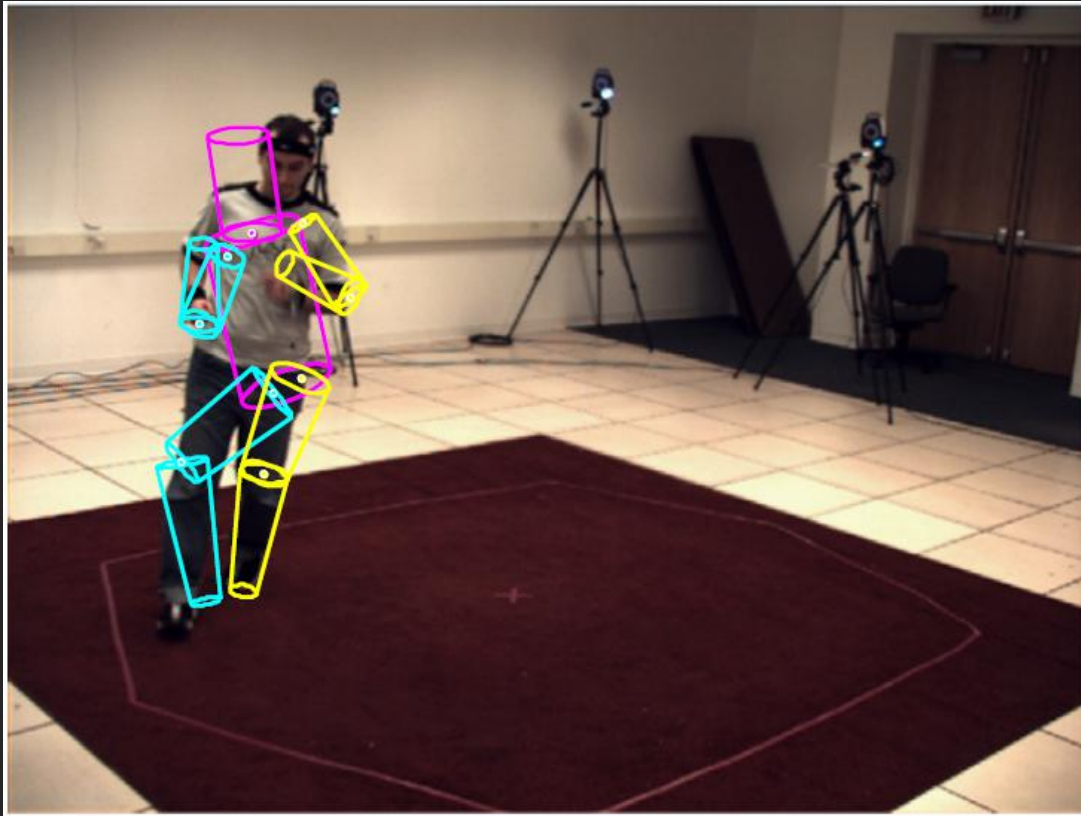


Baseline

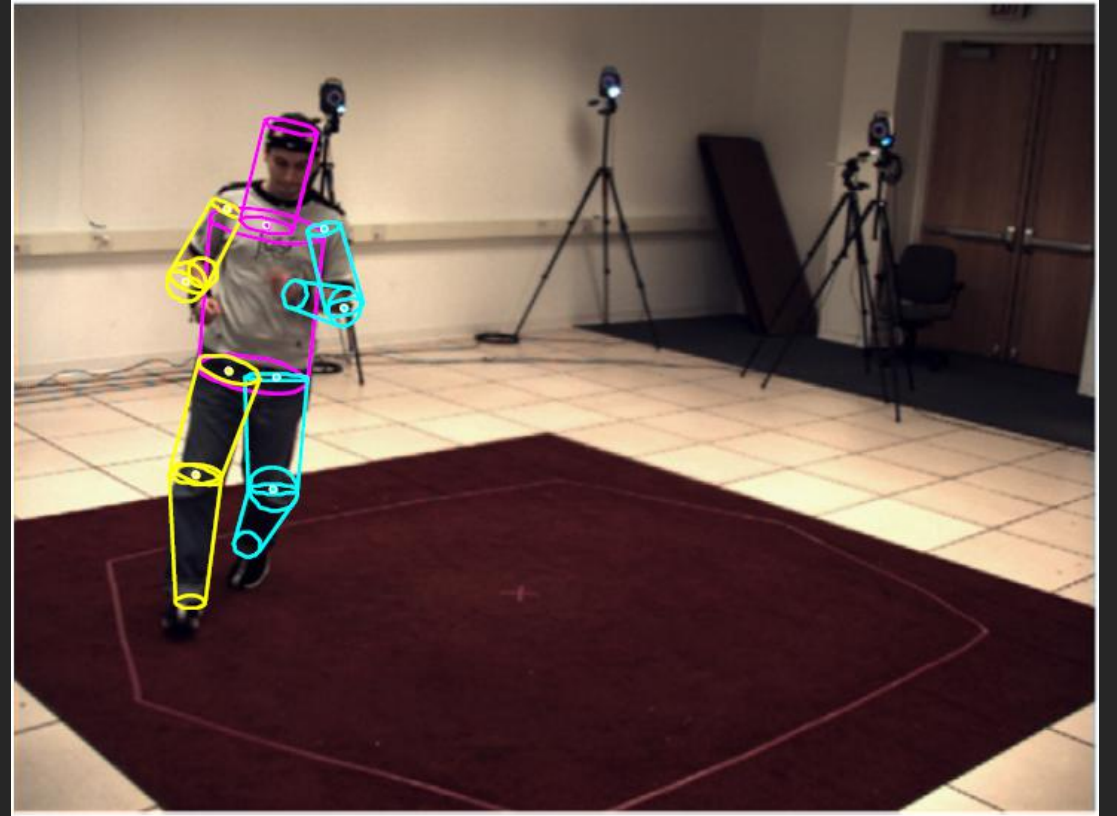


Exemplar-based conditional particle filter

Experiment: Sudden change. Frame 515

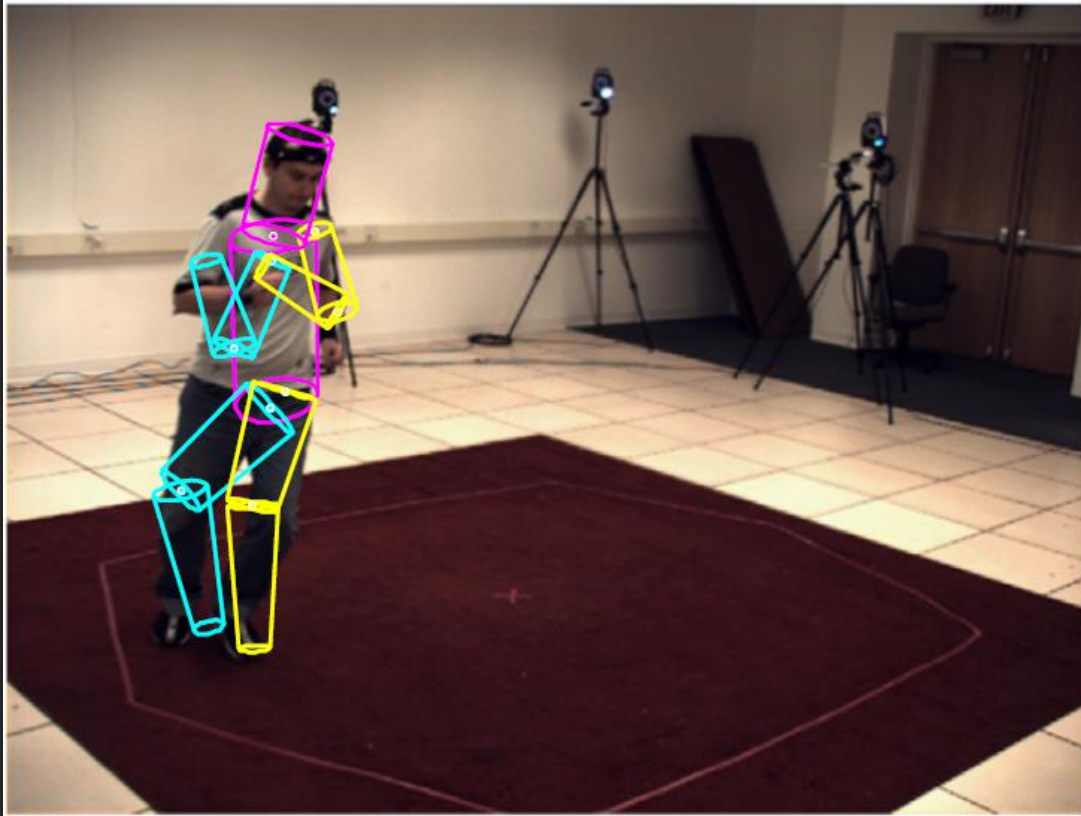


Baseline

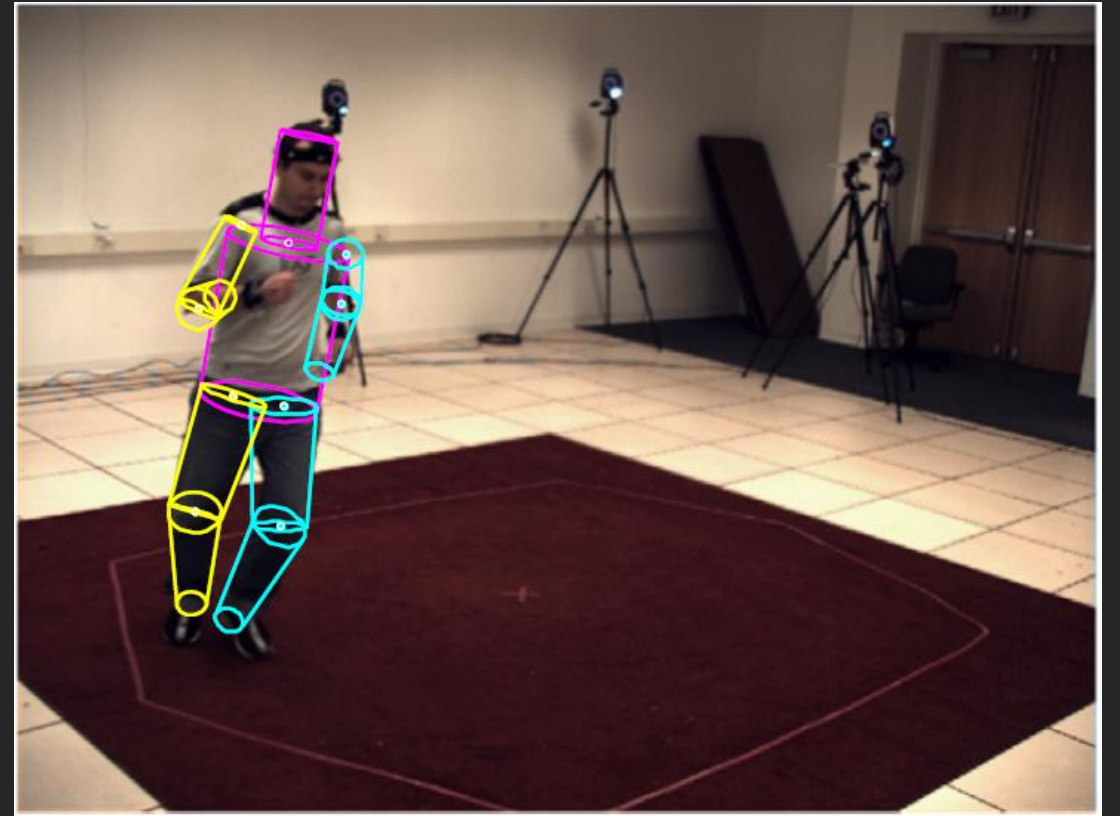


Exemplar-based conditional particle filter

Experiment: Sudden change. Frame 530

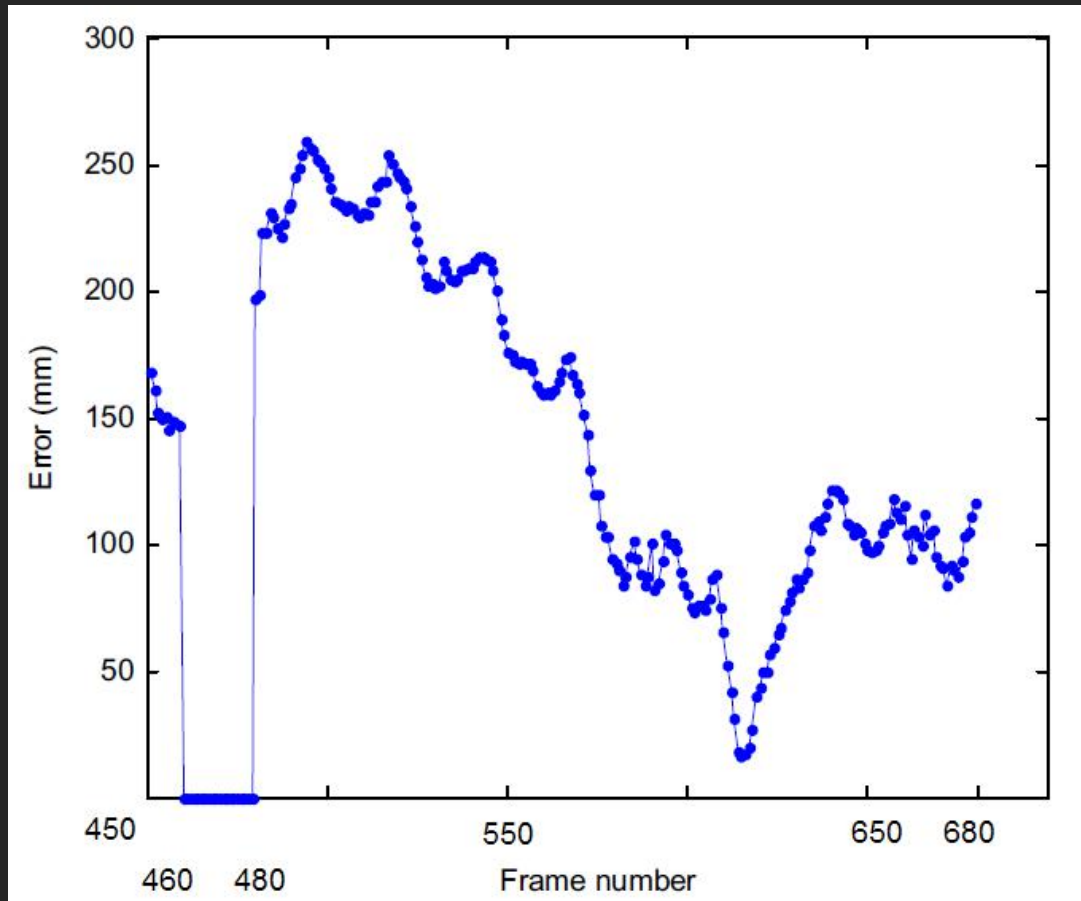


Baseline

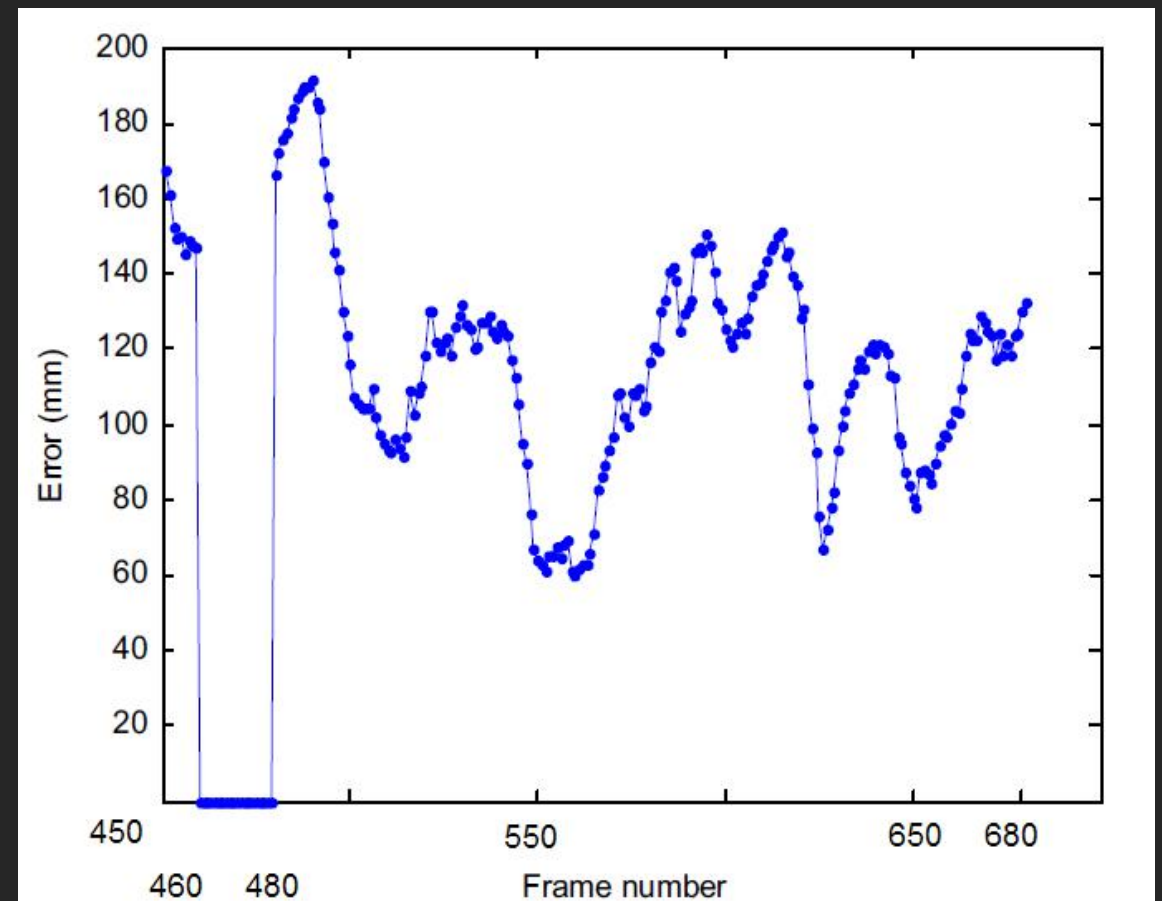


Exemplar-based conditional particle filter

Experiment: Sudden change. Tracking error



Baseline



Exemplar-based conditional particle filter

Experiment: Low-frame rate camera

HumanEva-II

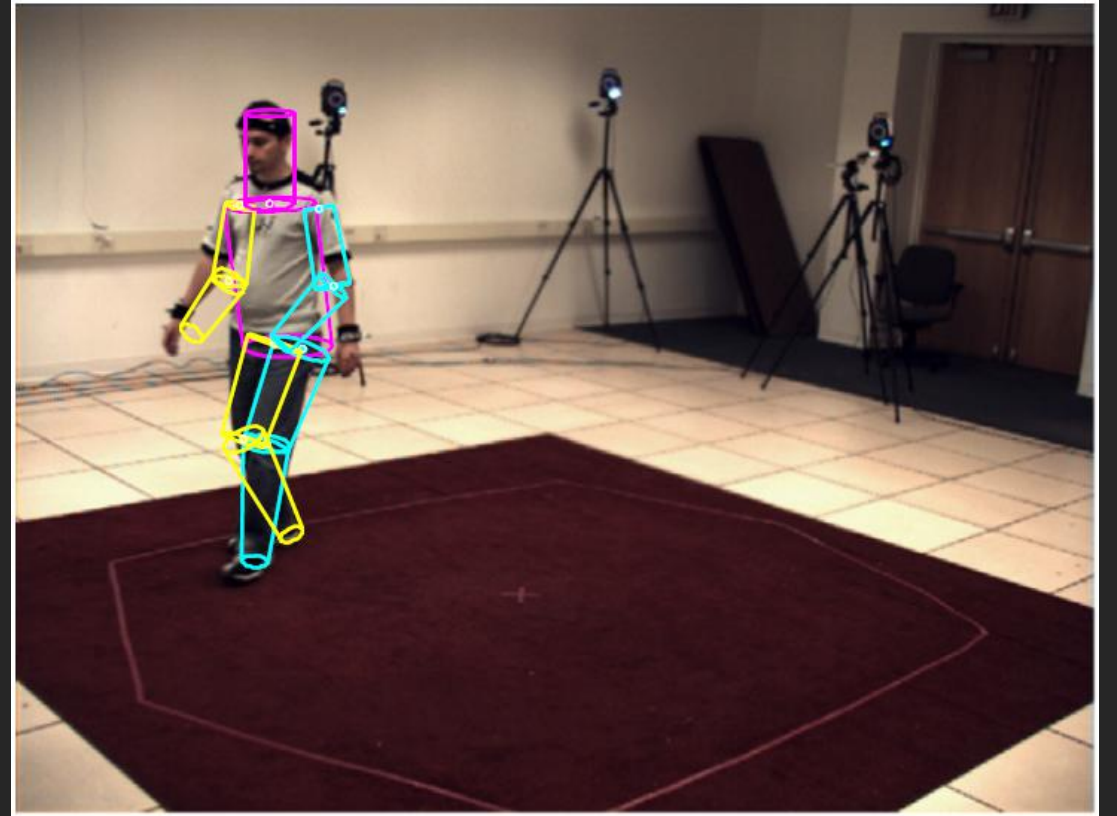
Original frames at 60Hz

Frames resampled every 4 frames, new frames at 15Hz

Experiment: Low-frame rate camera. Frame 485

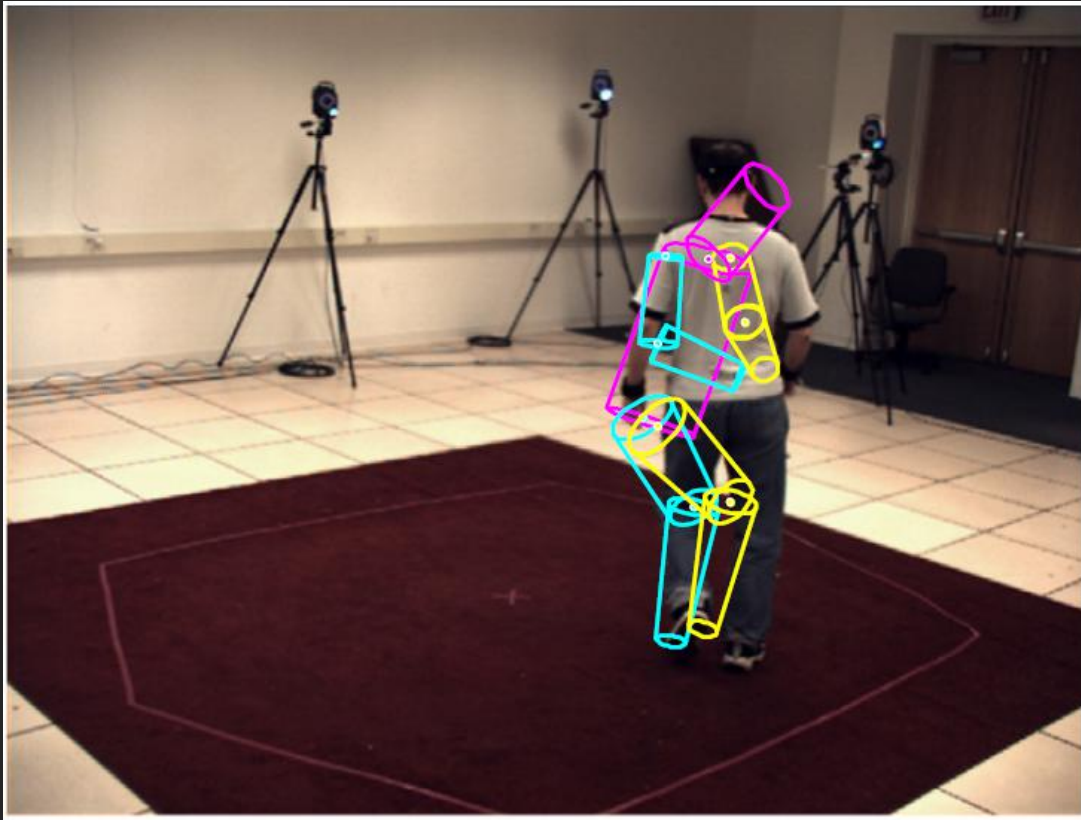


Baseline

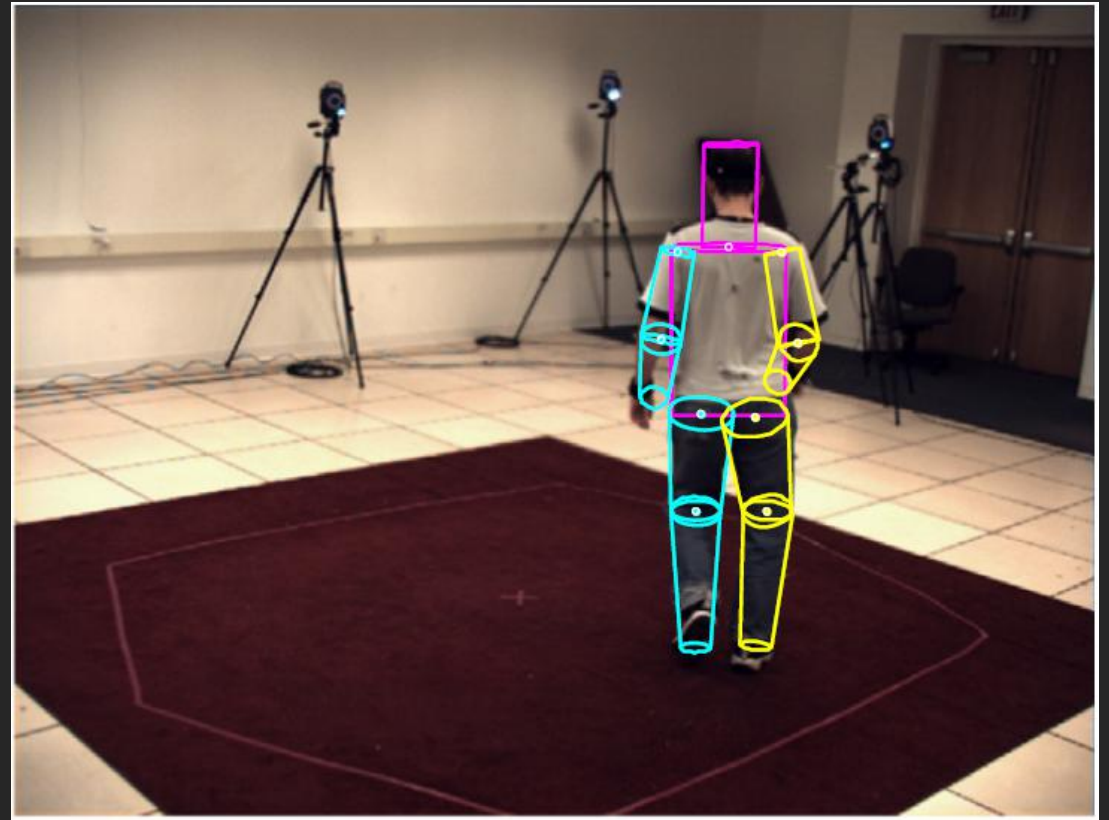


Exemplar-based conditional particle filter

Experiment: Low-frame rate camera. Frame 500

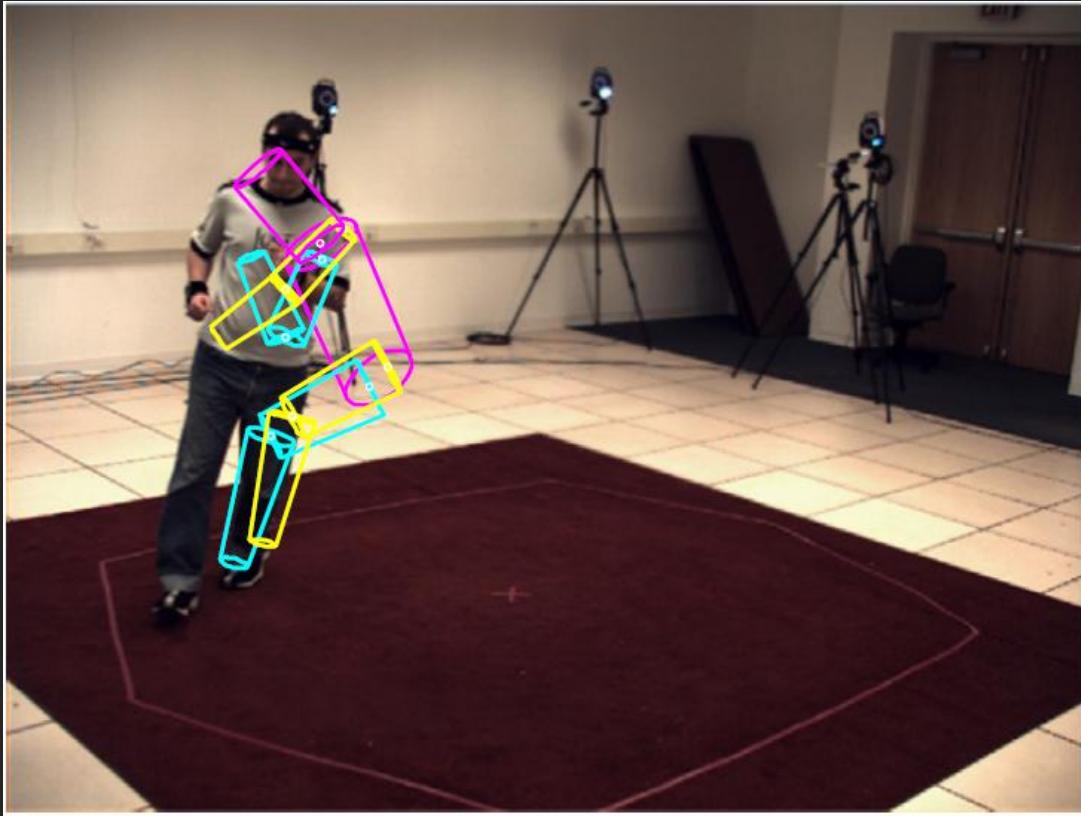


Baseline

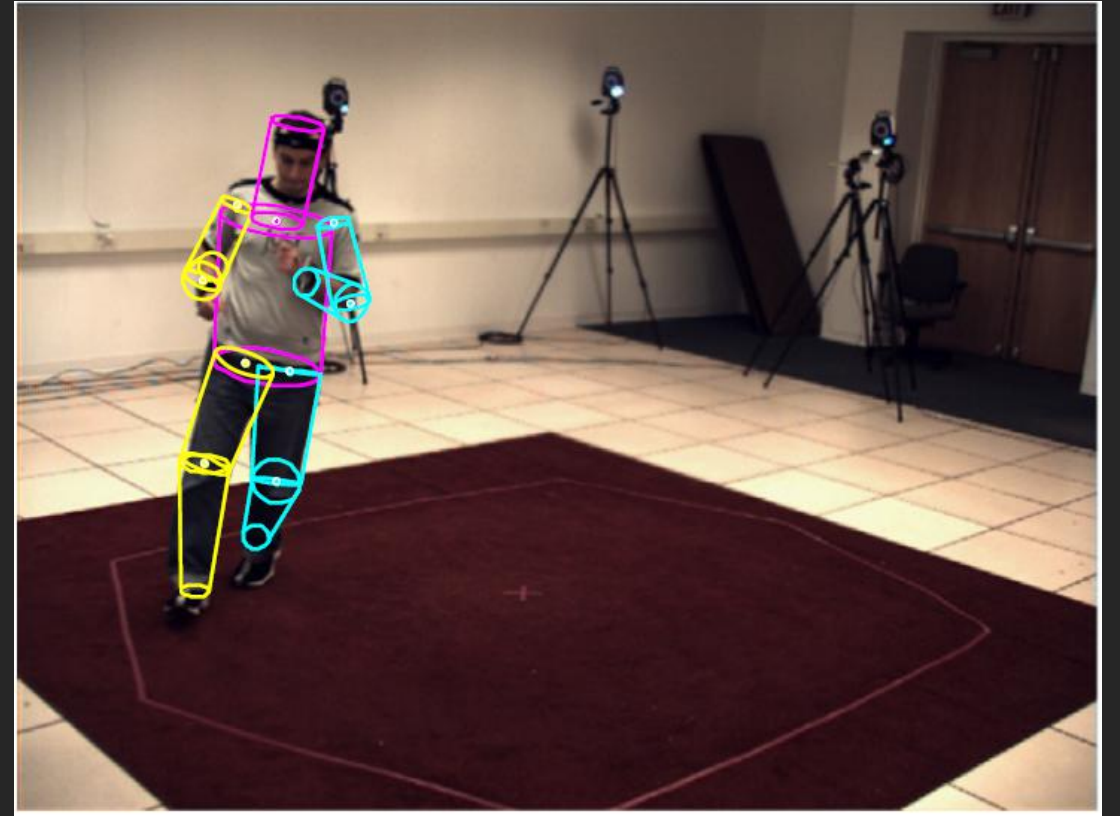


Exemplar-based conditional particle filter

Experiment: Low-frame rate camera. Frame 515

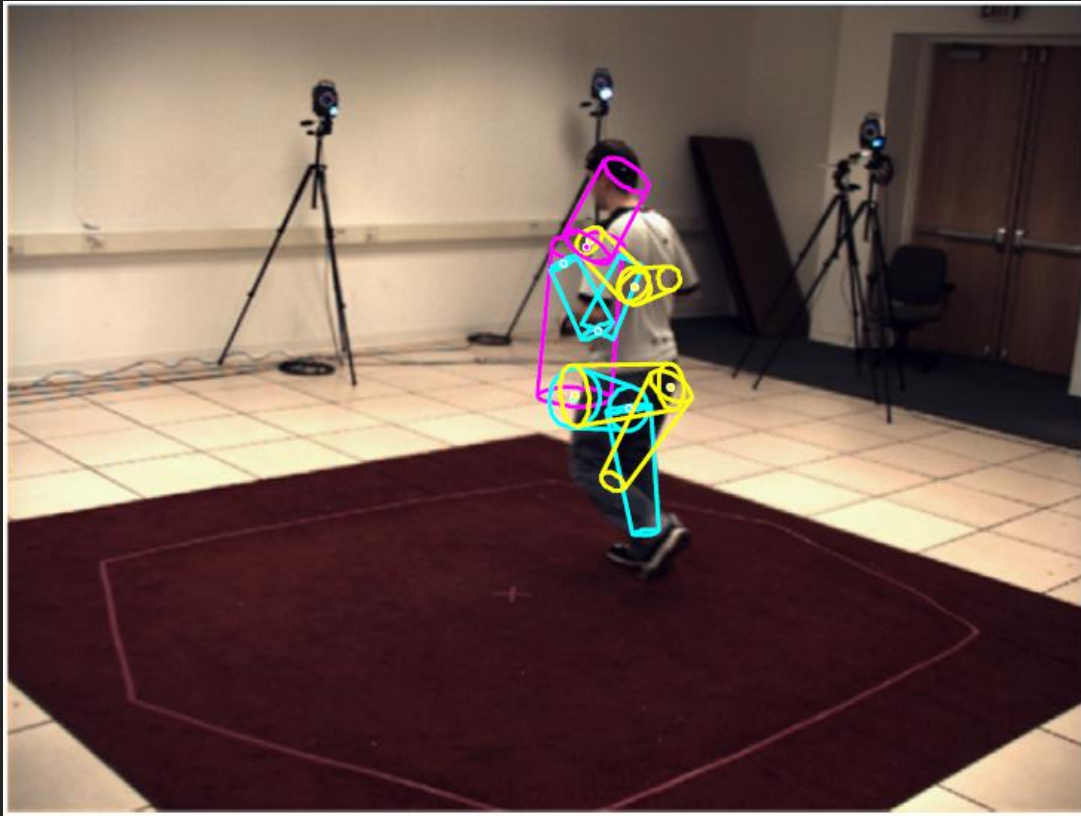


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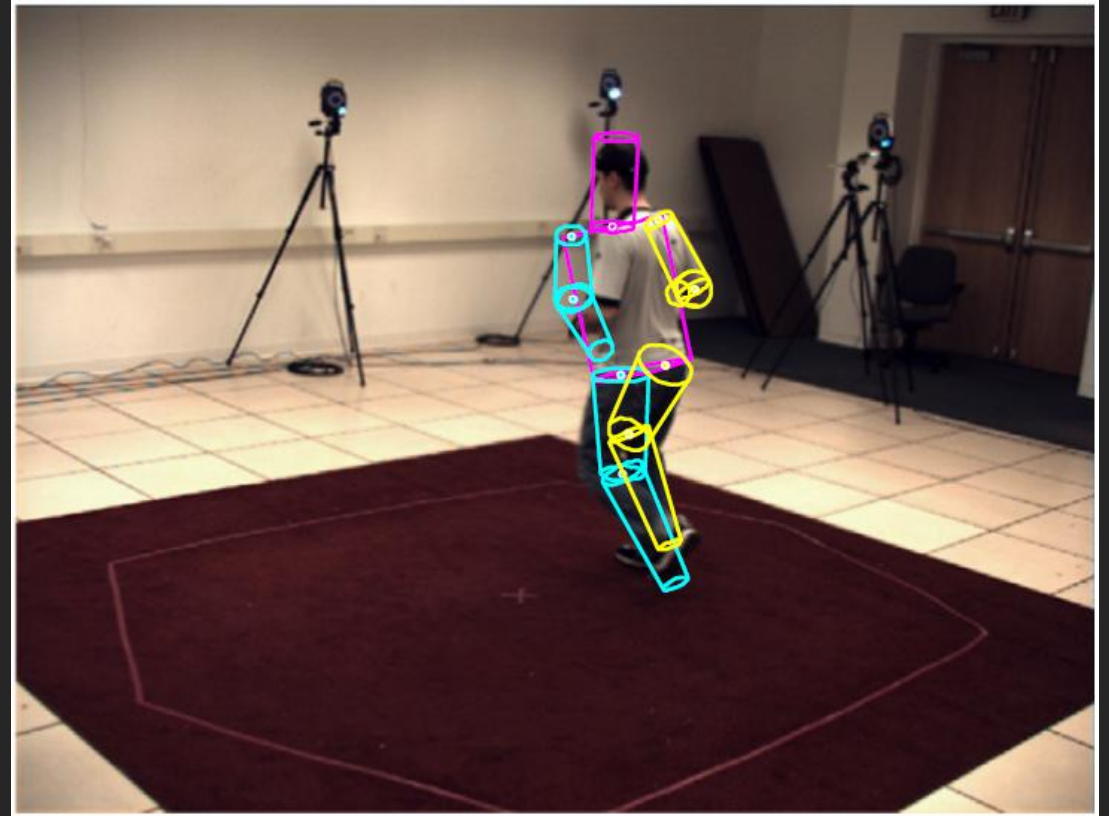


Exemplar-based conditional particle filter

Experiment: Low-frame rate camera. Frame 530

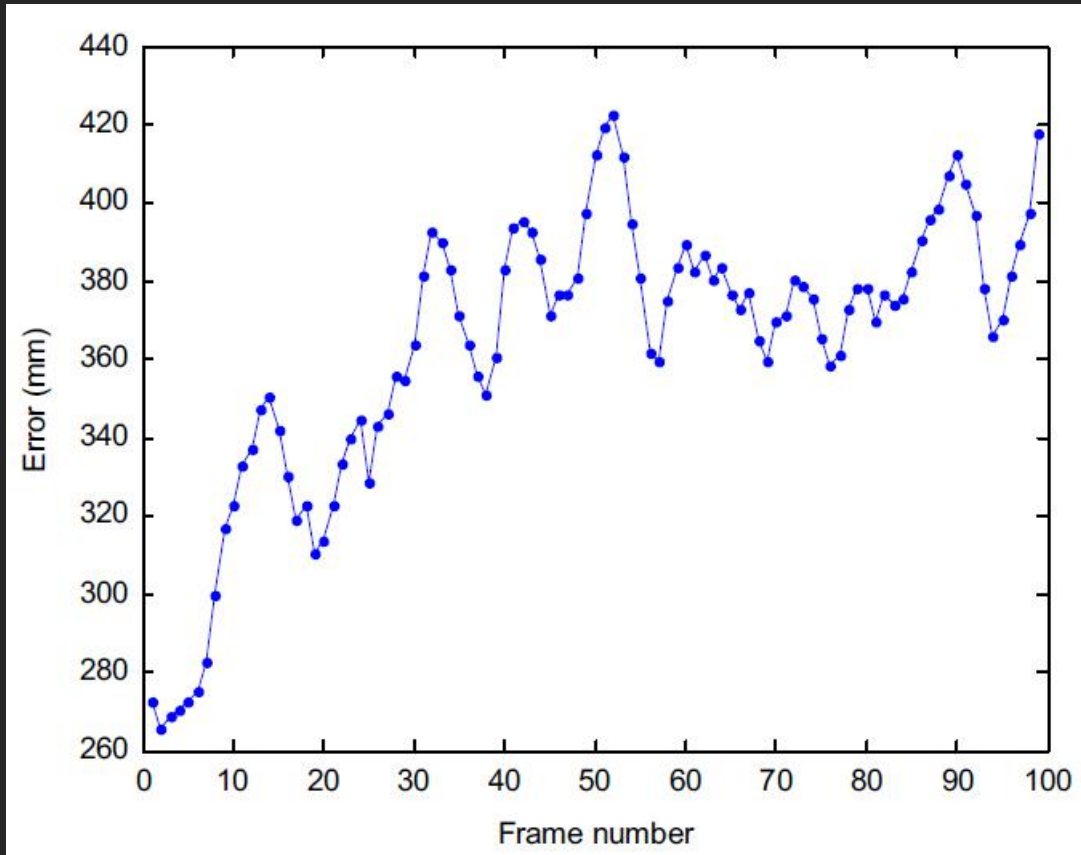


Baseline

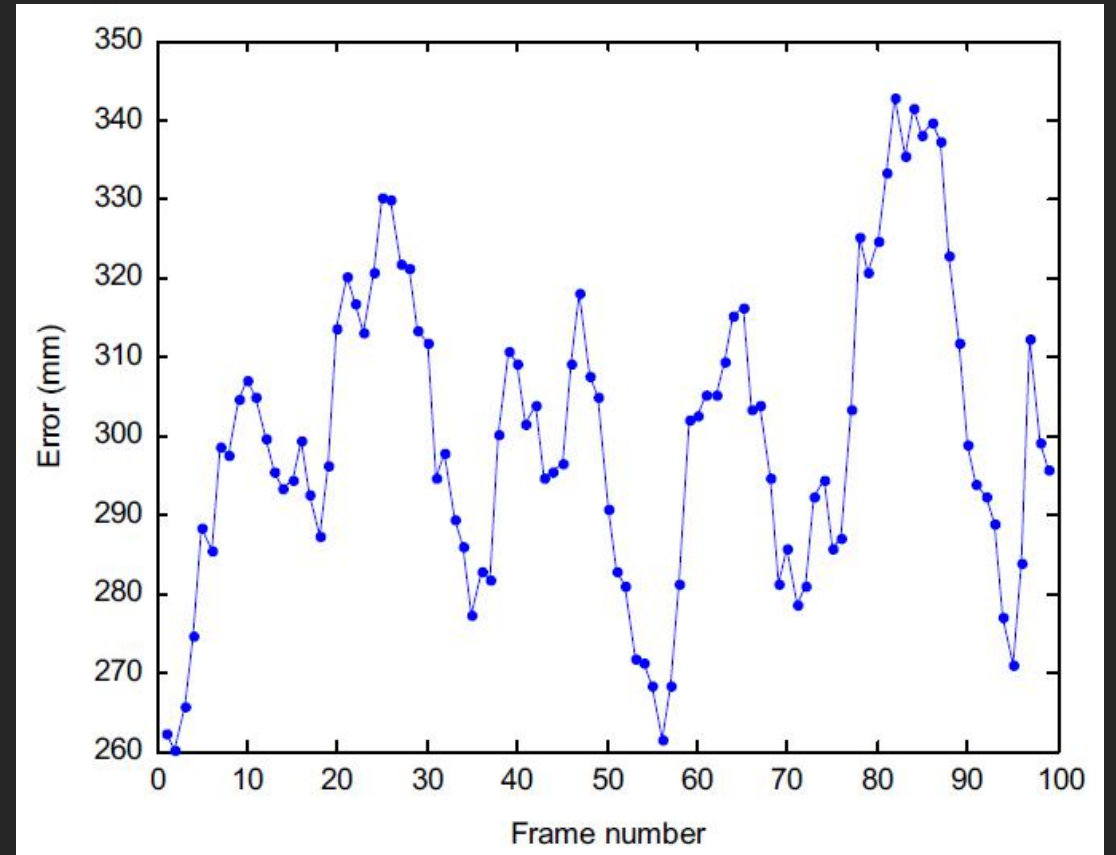


Exemplar-based conditional particle filter

Experiment: Low-frame rate camera. Tracking error



Baseline



Exemplar-based conditional particle filter

Experiment: Brown Dataset

Evaluate and compare human tracking algorithms

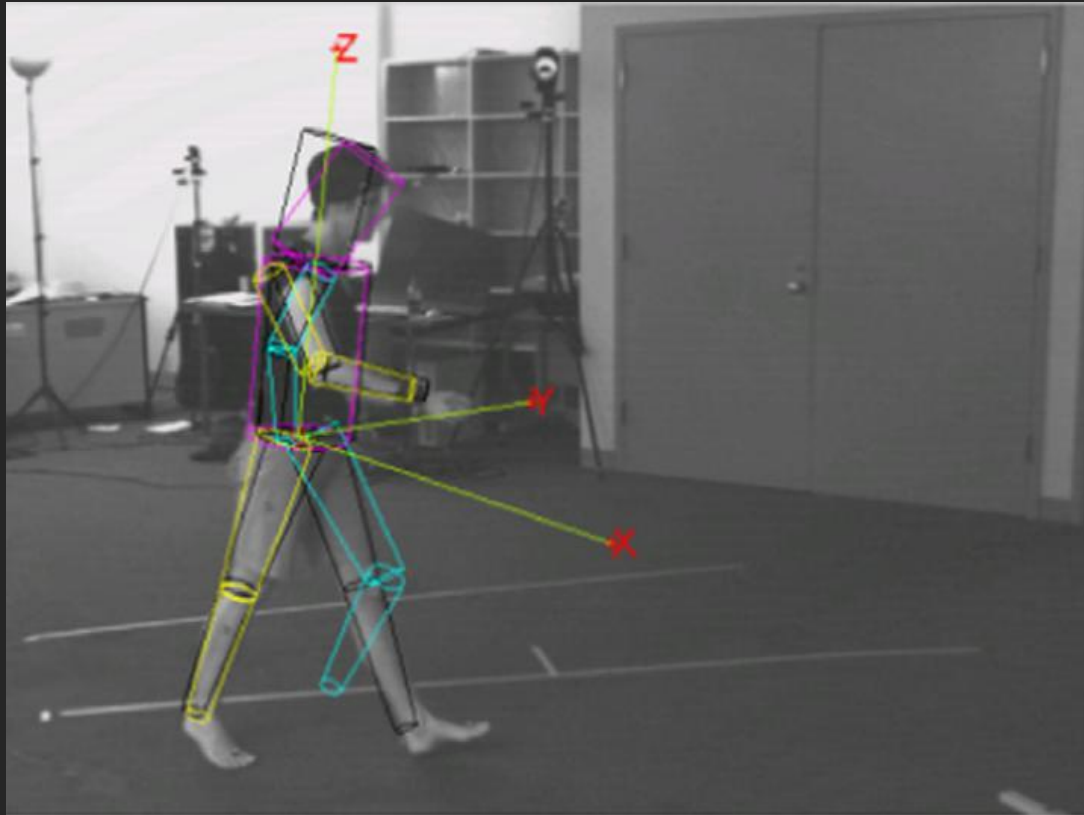
Training and testing data

Ground truth body poses

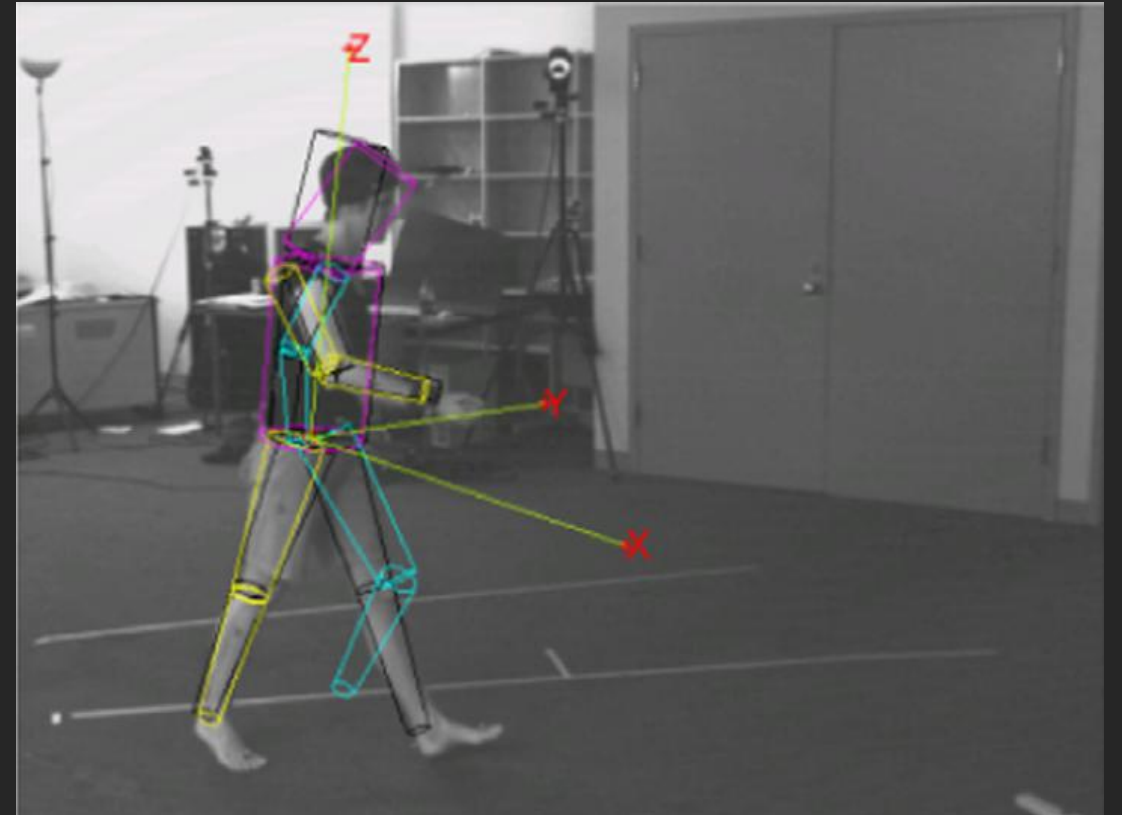
4 synchronized cameras at 60Hz

A. Balan, L. Sigal and M. Black, "A Quantitative Evaluation of Video-based 3D Person Tracking," 2005

Experiment: Sudden change. Frame 153

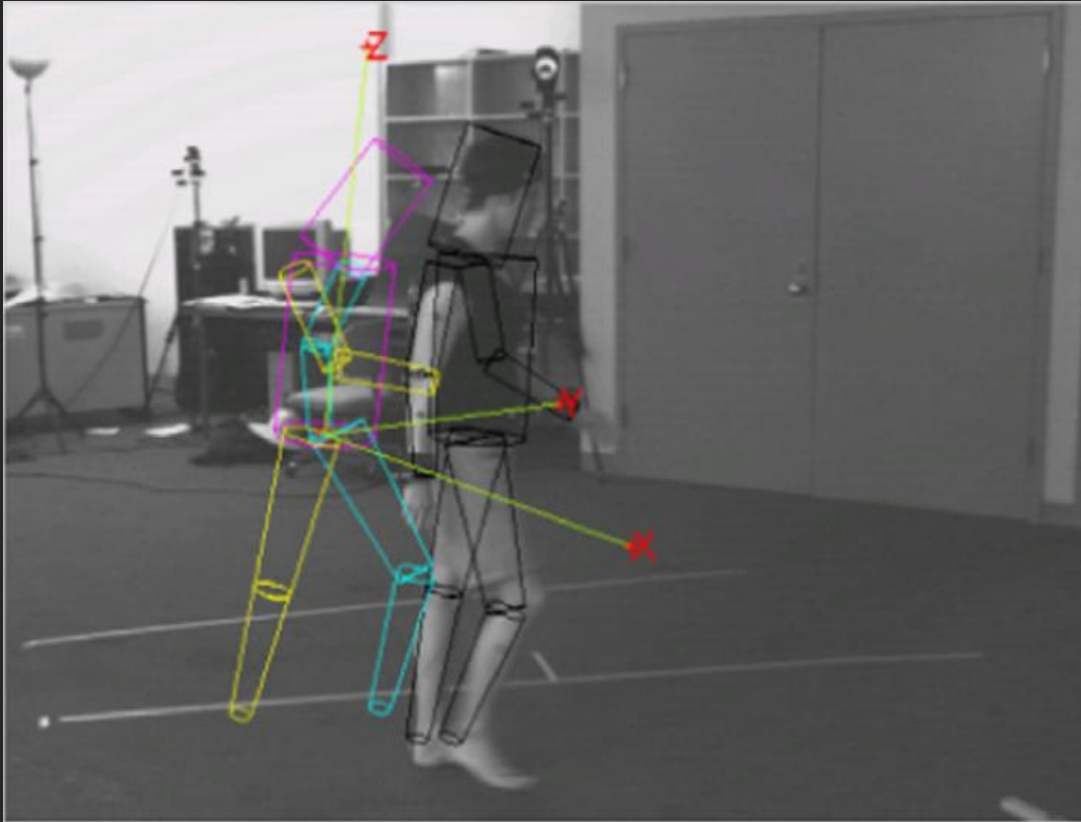


Annealed Particle

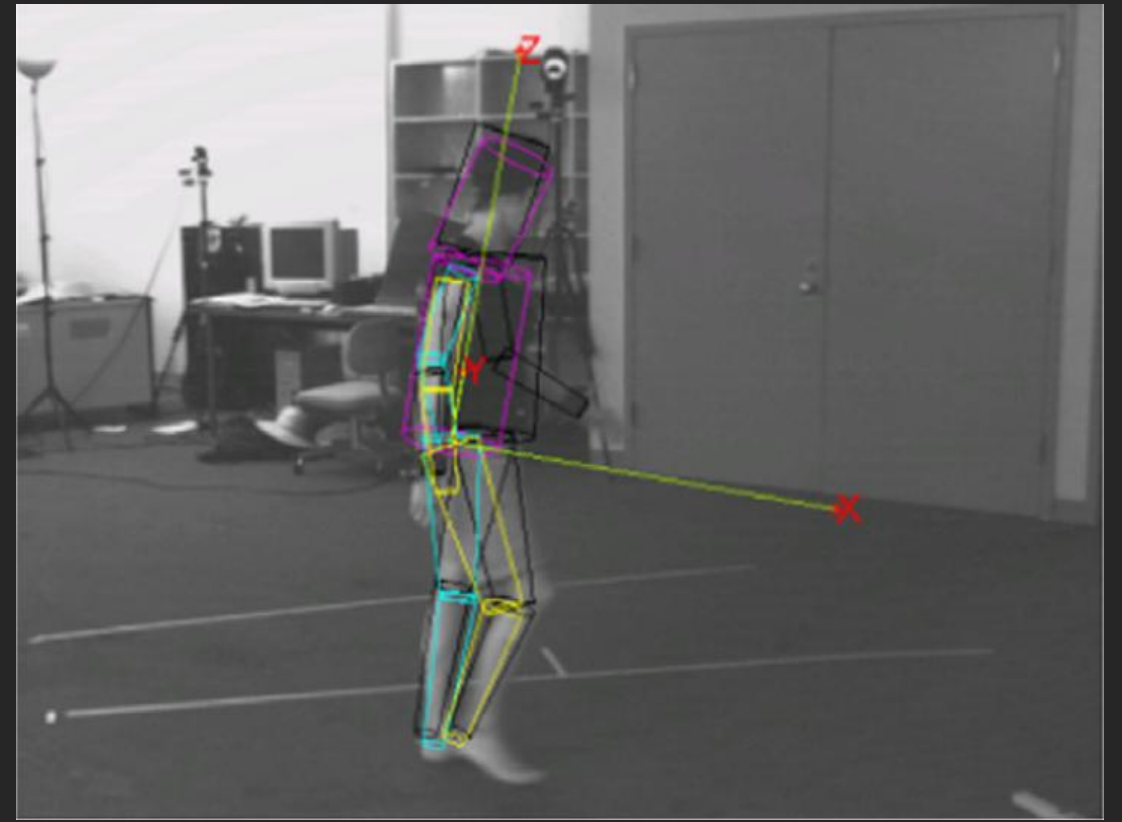


Exemplar-based conditional particle filter

Experiment: Sudden change. Frame 179

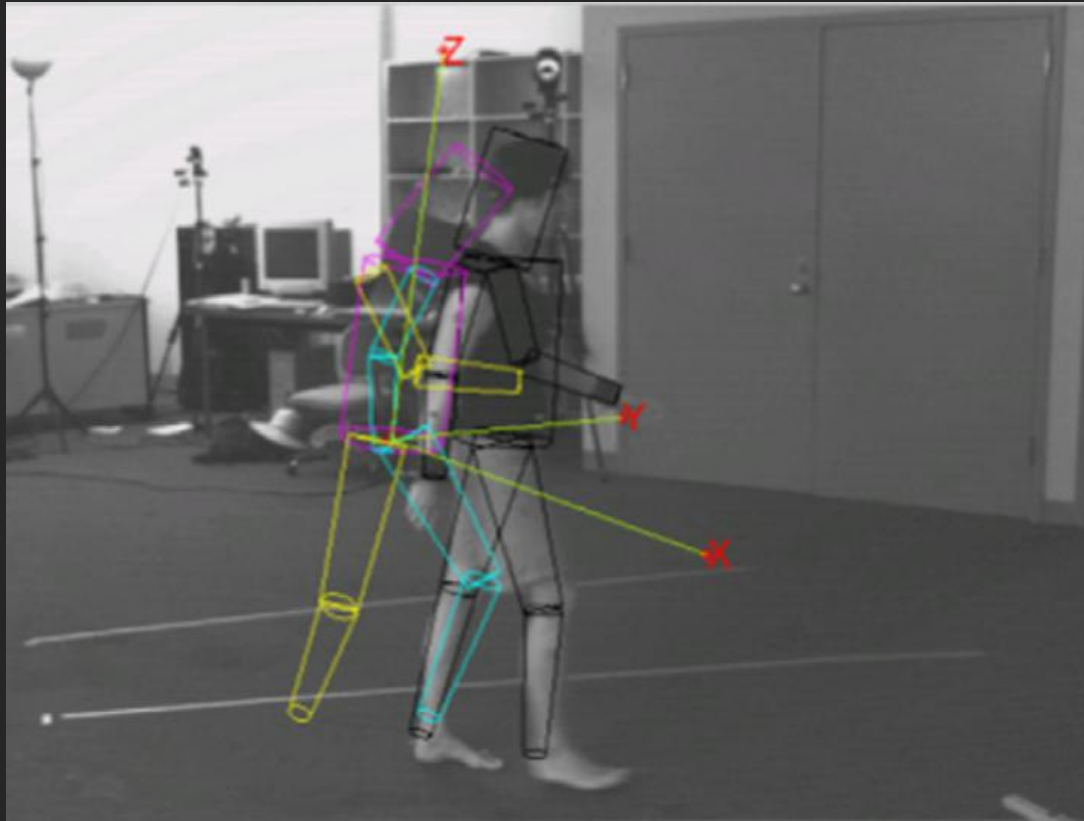


Annealed Particle

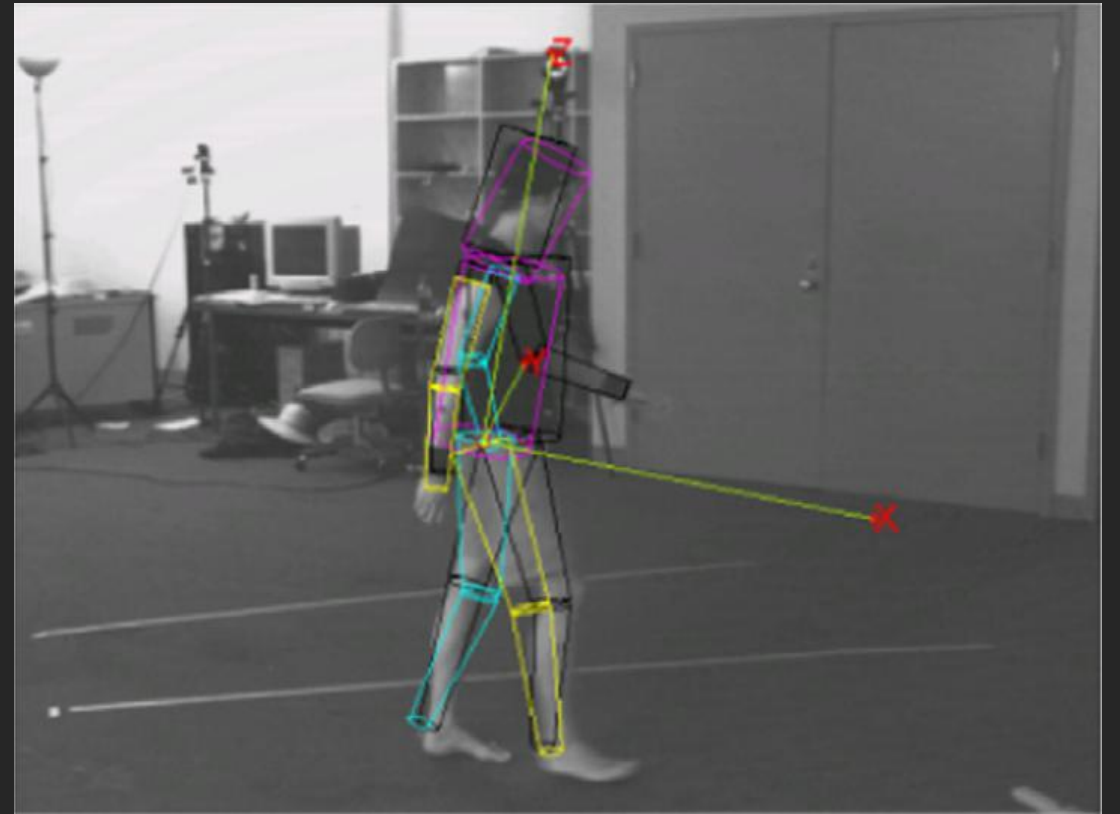


Exemplar-based conditional particle filter

Experiment: Sudden change. Frame 183

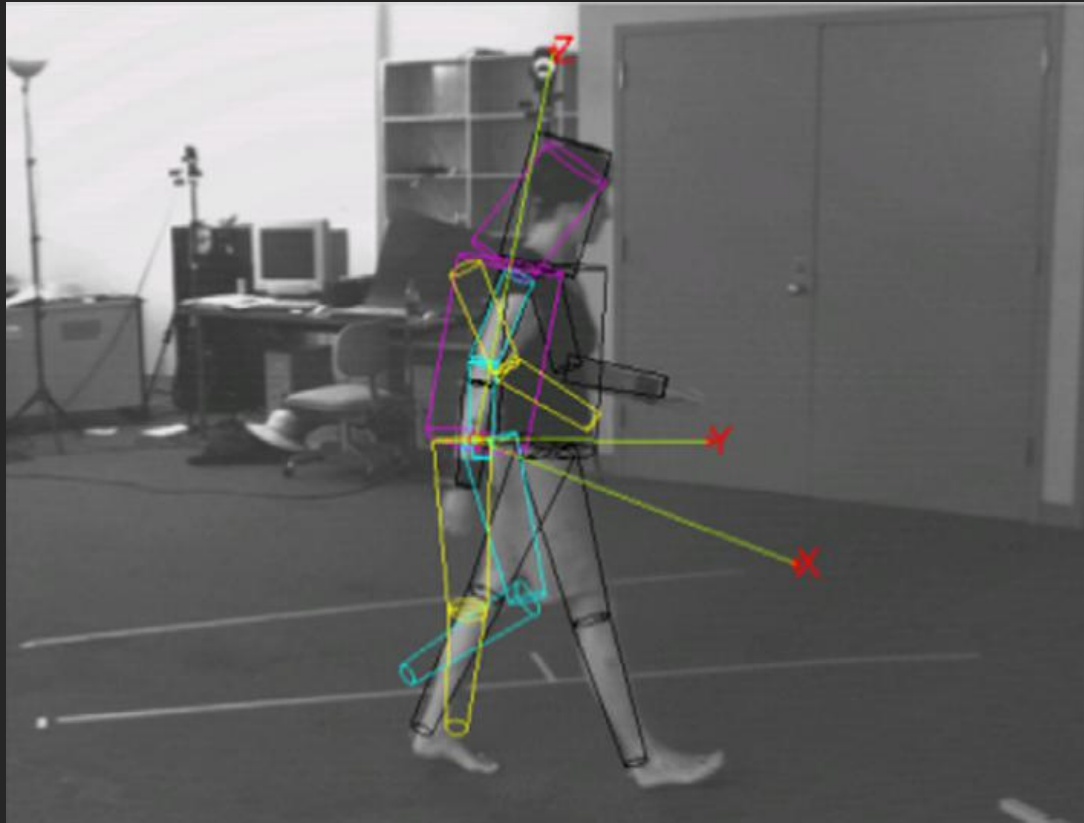


Annealed Particle

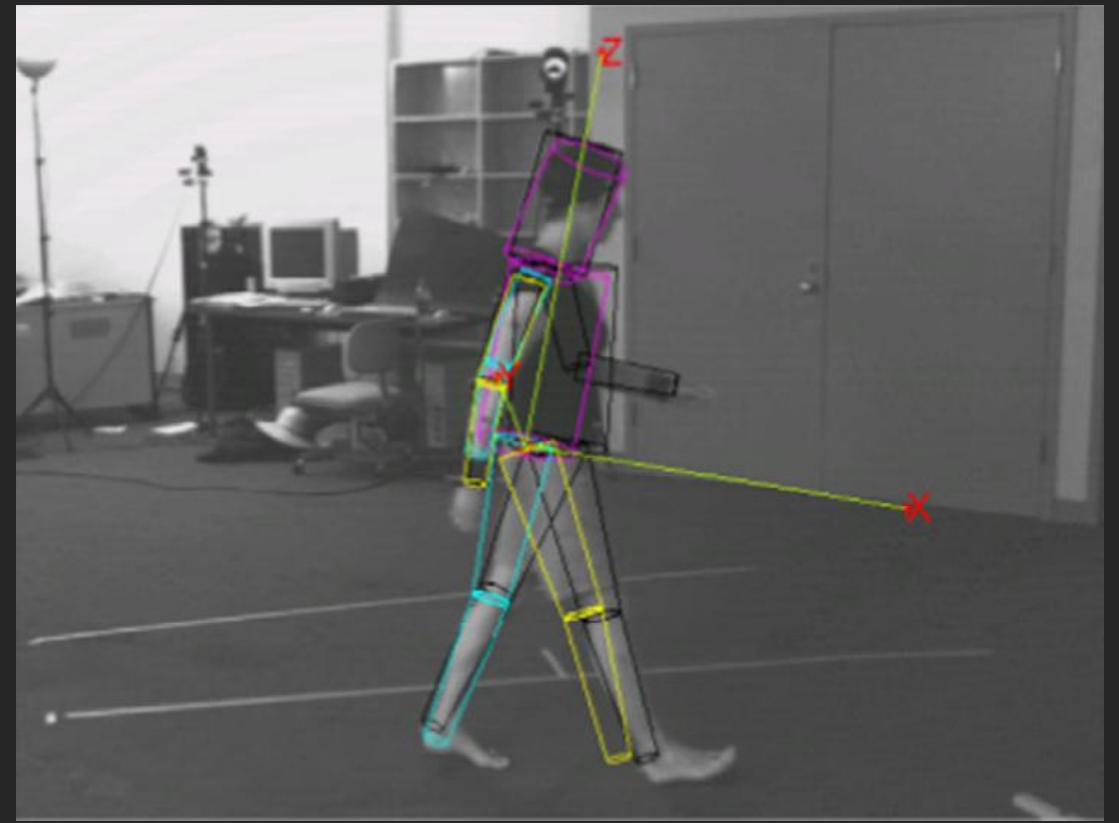


Exemplar-based conditional particle filter

Experiment: Sudden change. Frame 190

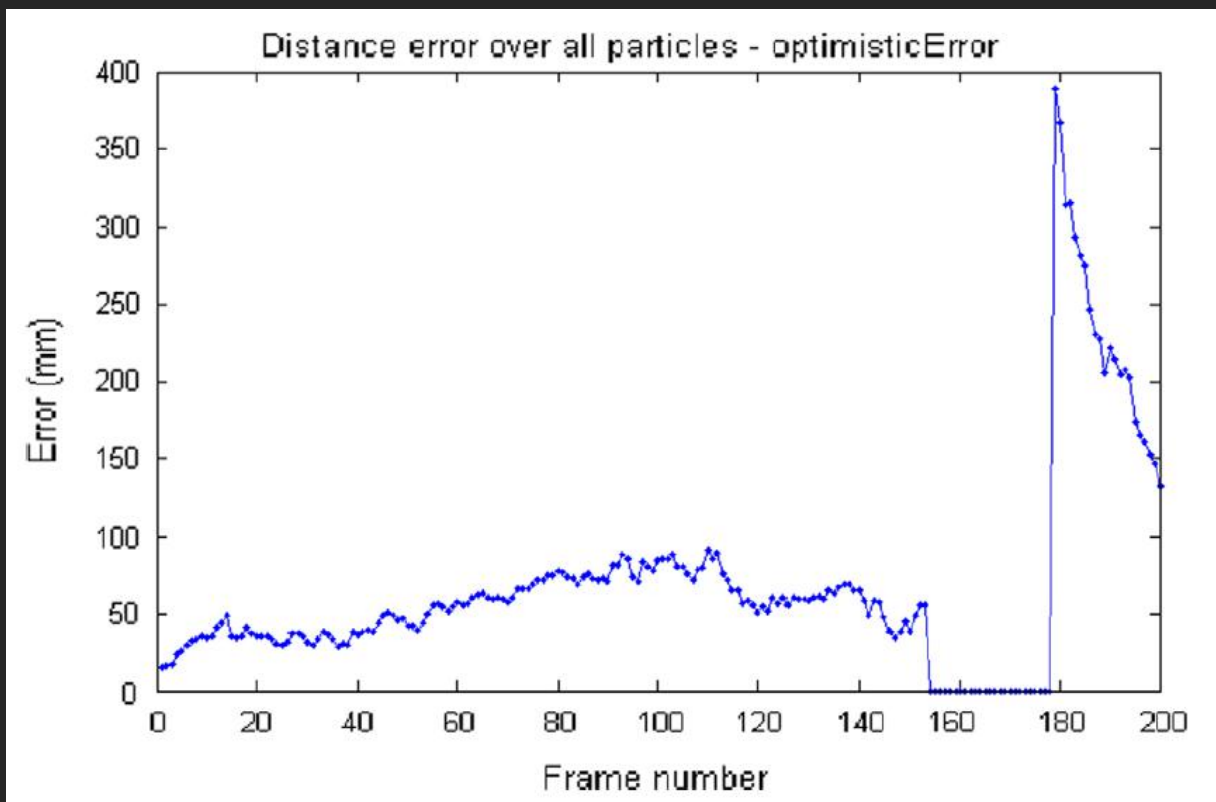


Annealed Particle

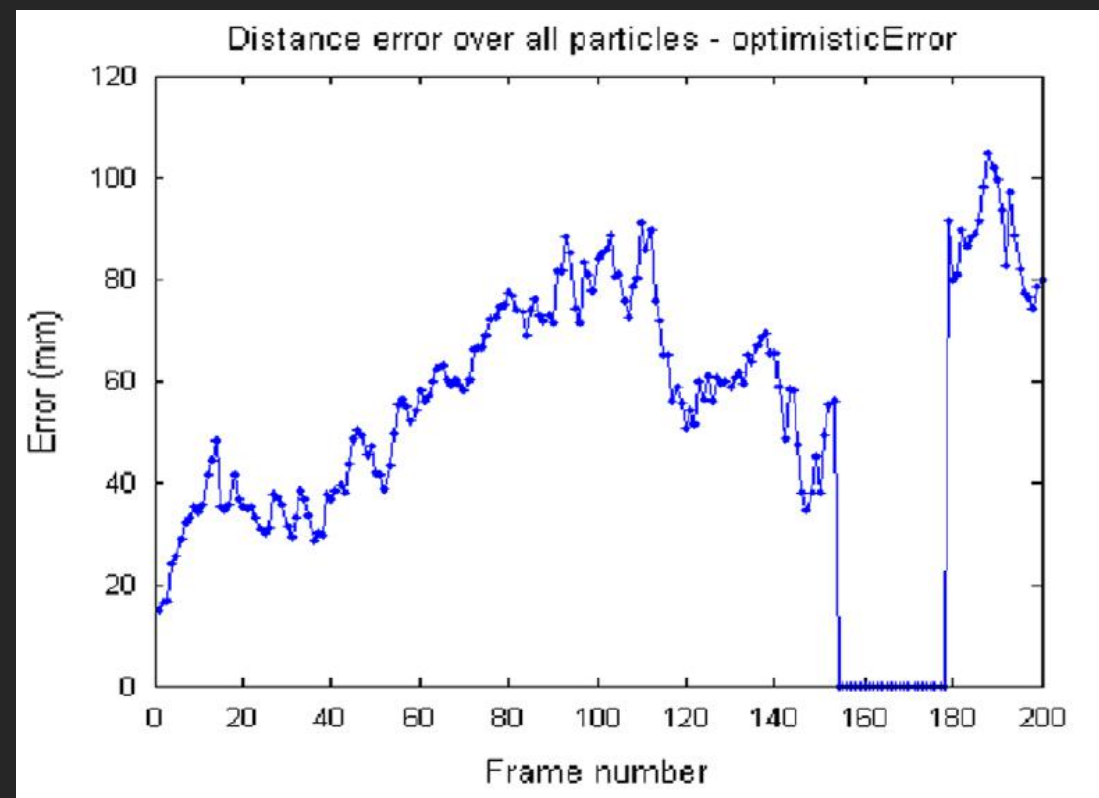


Exemplar-based conditional particle filter

Experiment: Sudden change. Tracking error



Annealed Particle



Exemplar-based conditional particle filter

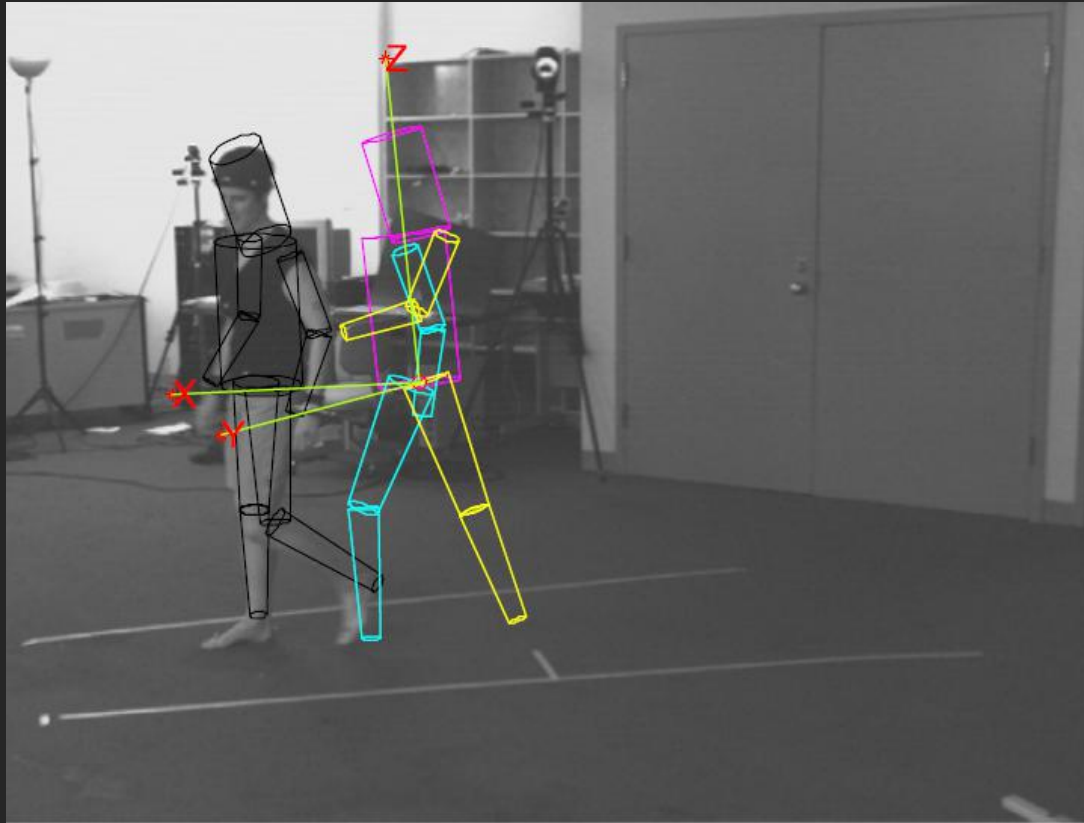
Experiment Low-frame rate camera

Brown Dataset

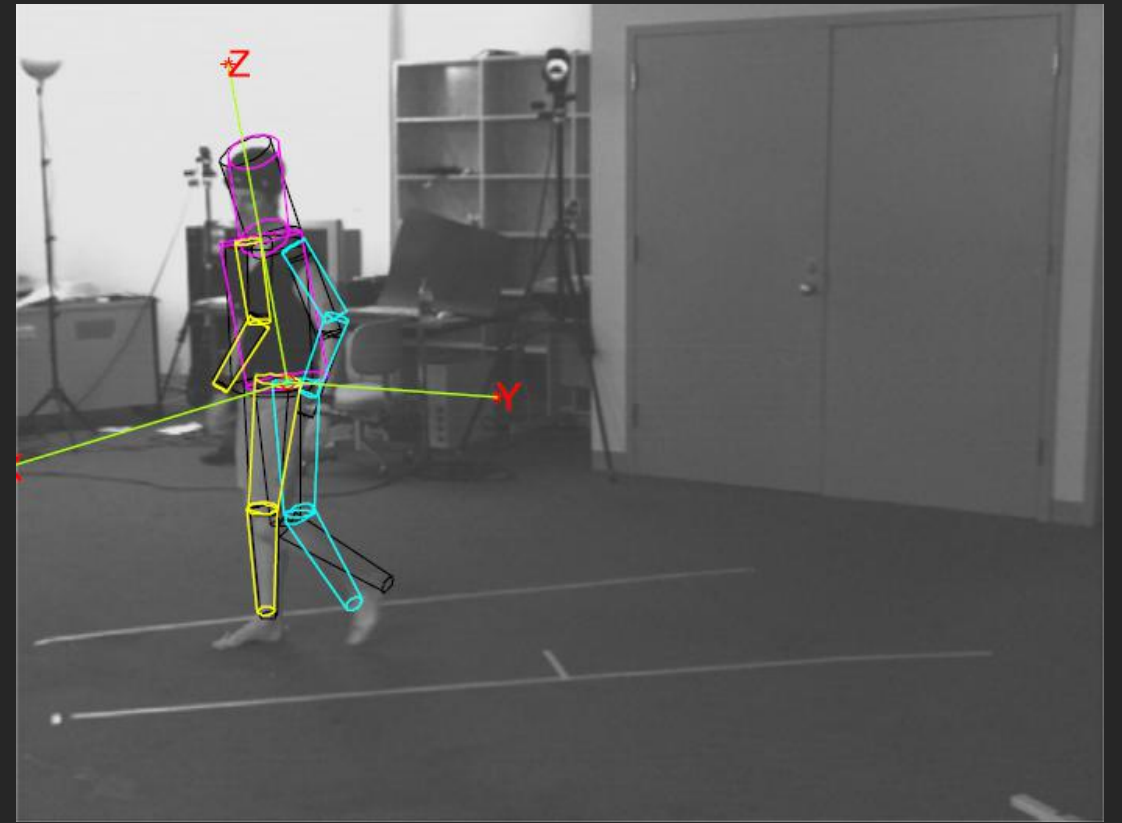
Original frames at 60Hz

Frames resampled every 4 frames, new frames at 15Hz

Experiment: Low-frame rate camera. Frame 20

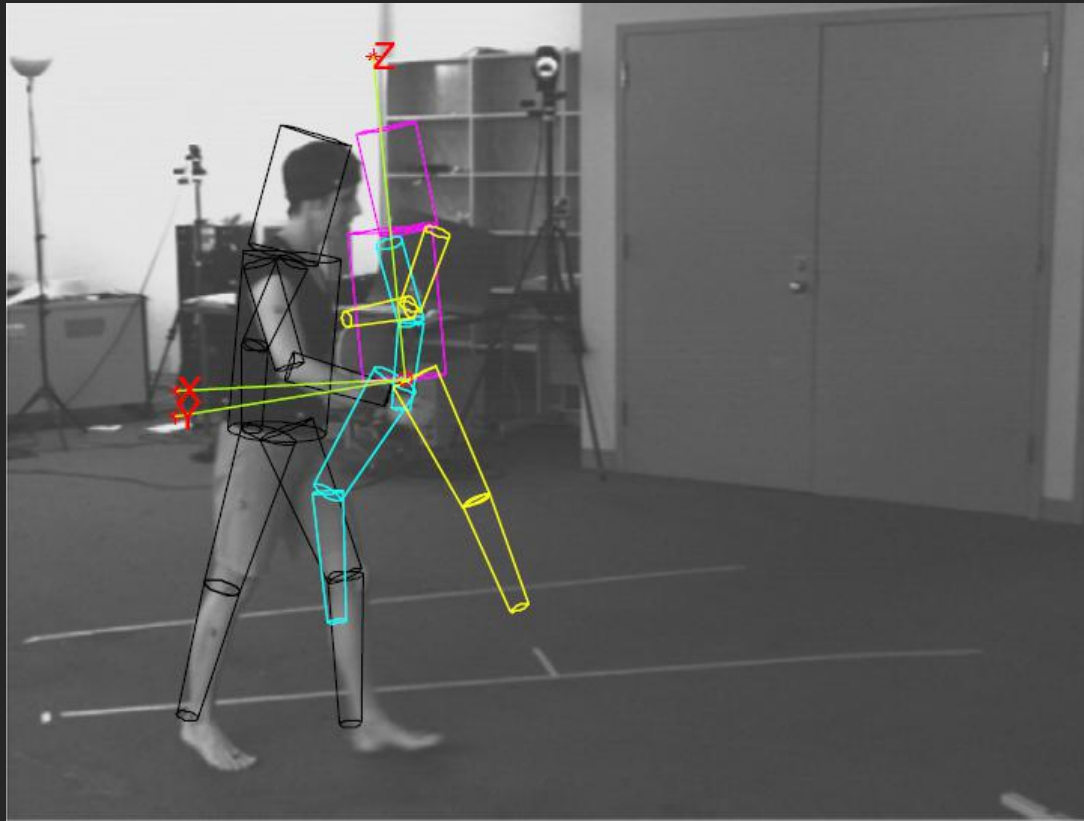


Annealed Particle

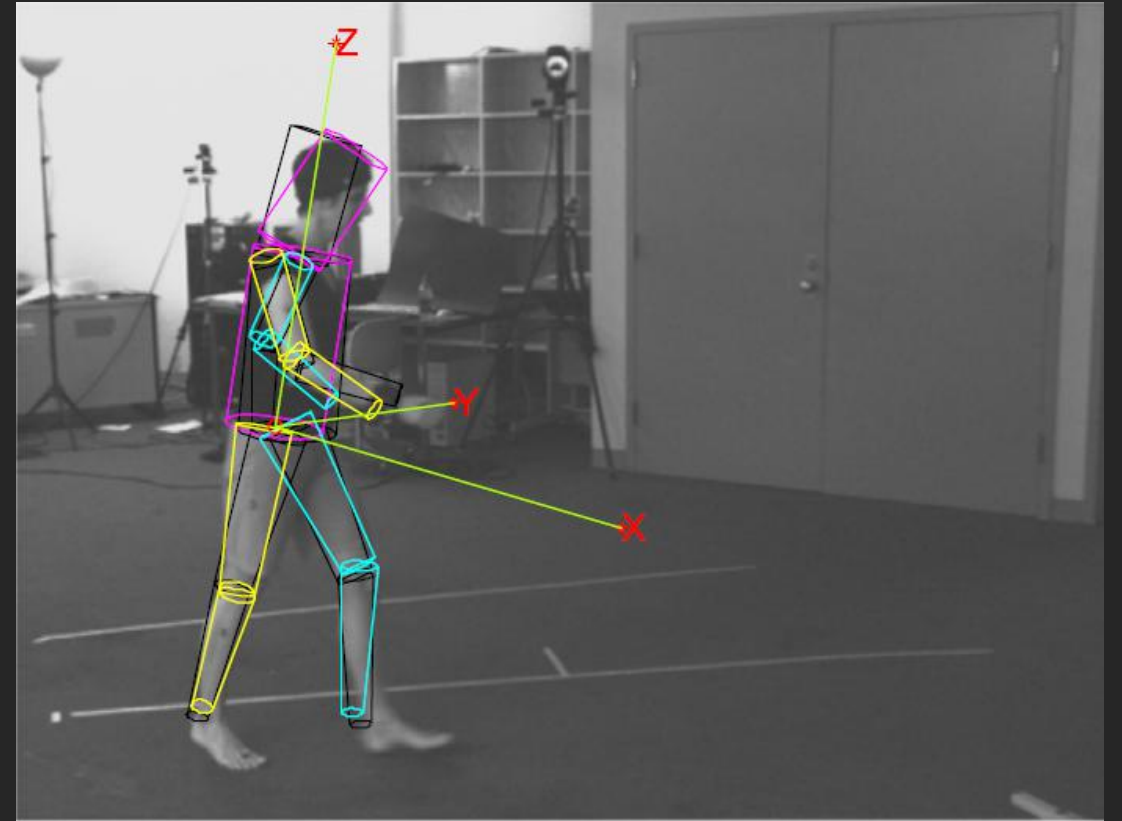


Exemplar-based conditional particle filter

Experiment: Low-frame rate camera. Frame 50

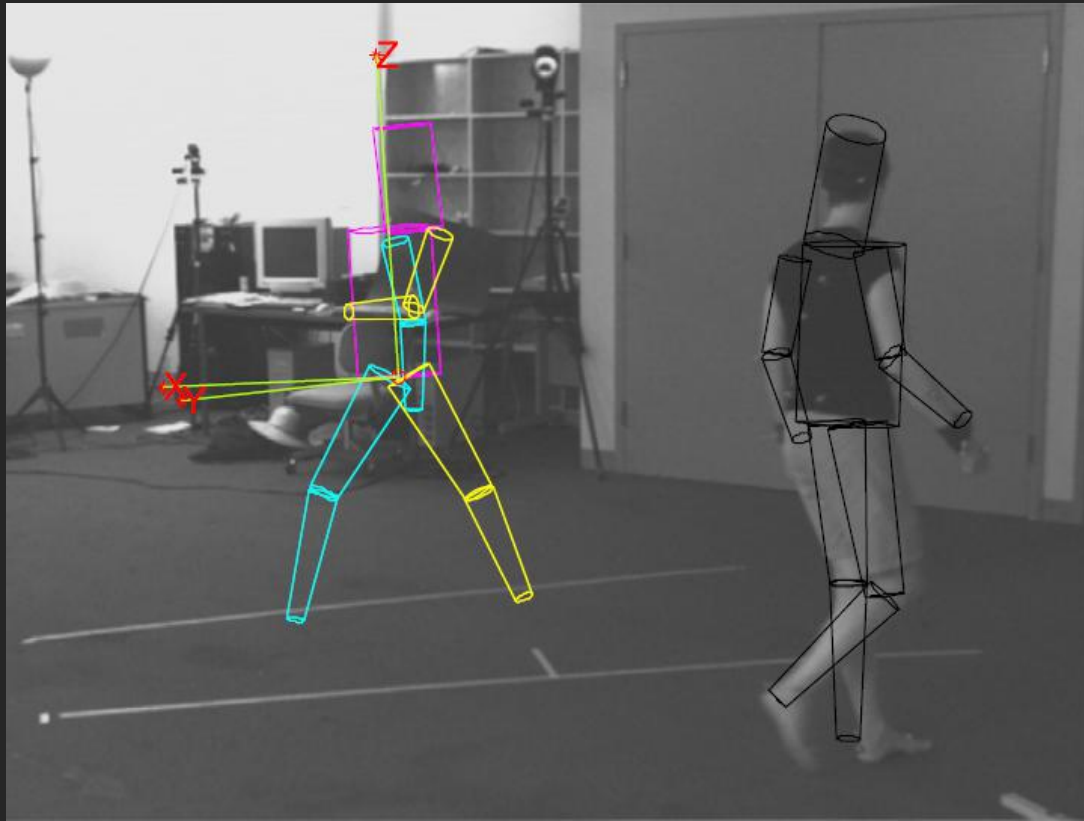


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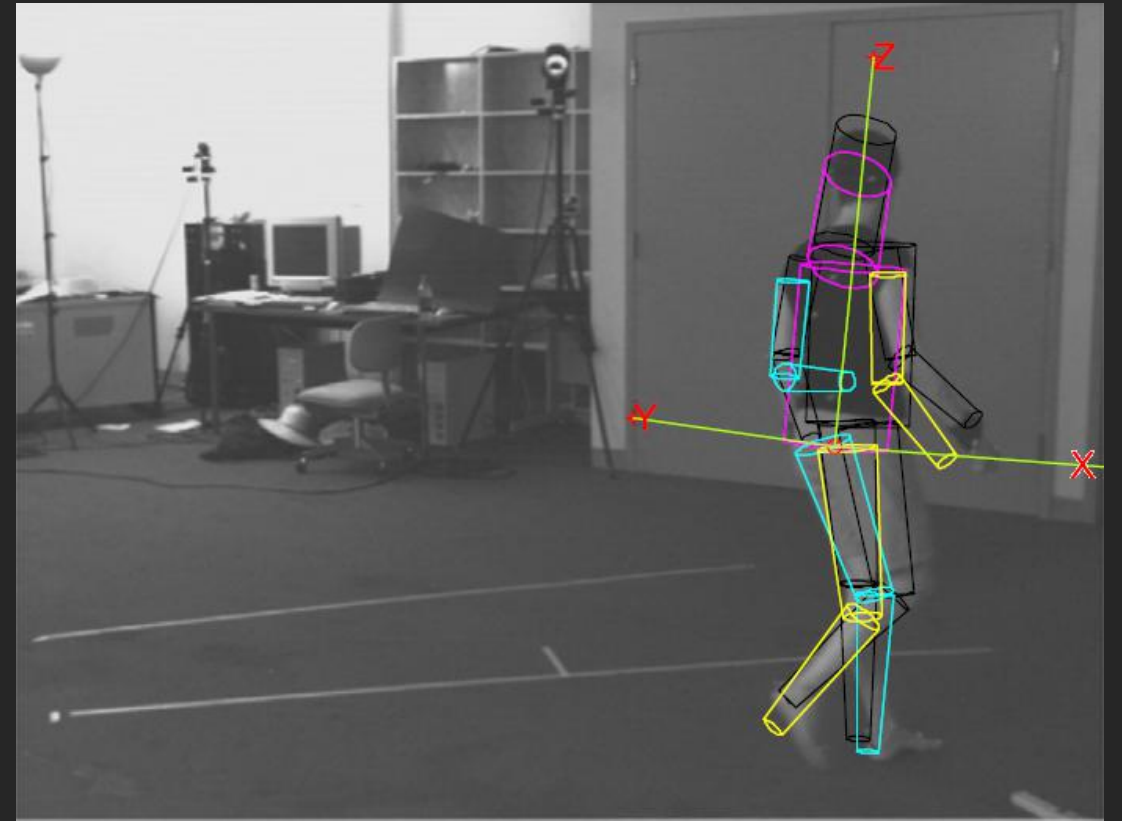


Exemplar-based conditional particle filter

Experiment: Low-frame rate camera. Frame 80

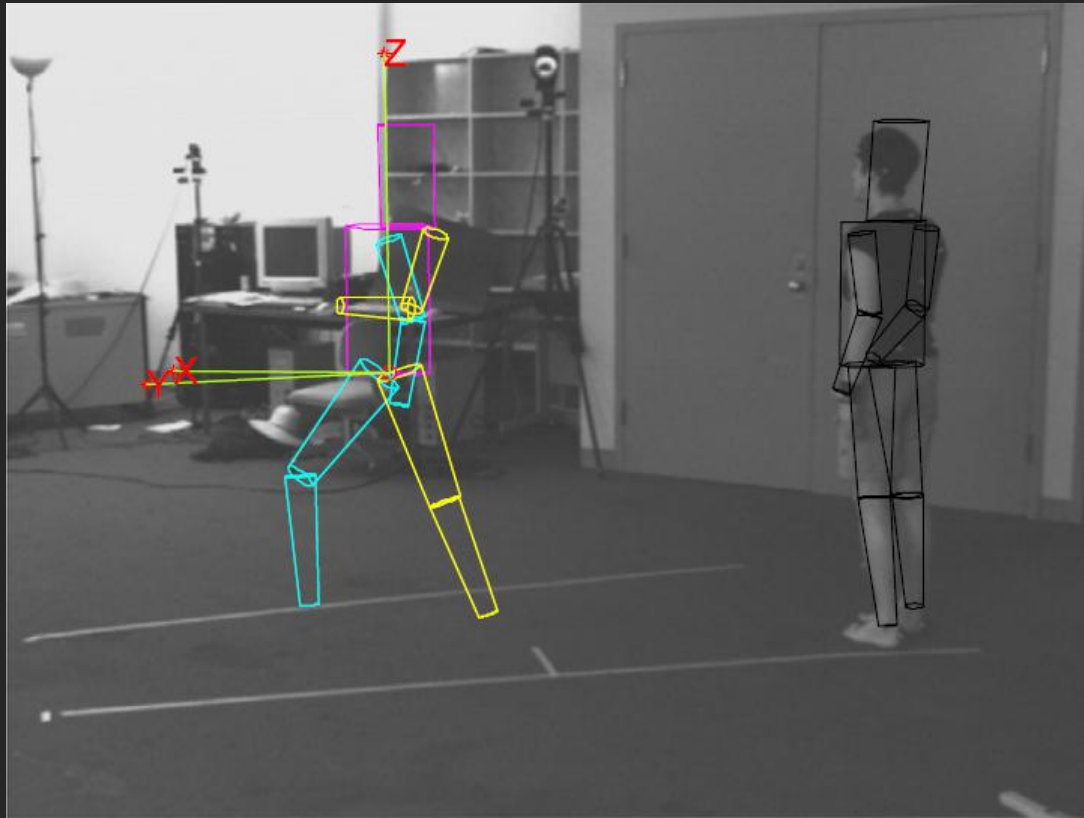


Annealed Particle

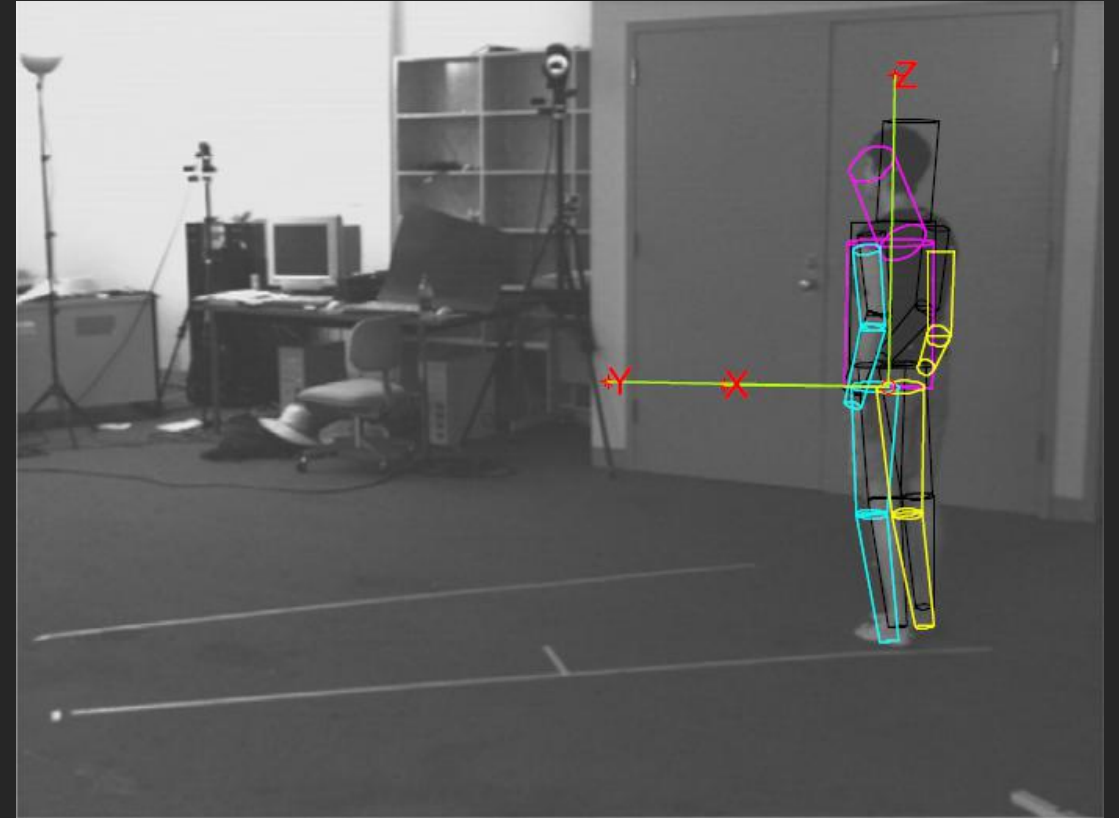


Exemplar-based conditional particle filter

Experiment: Low-frame rate camera. Frame 120

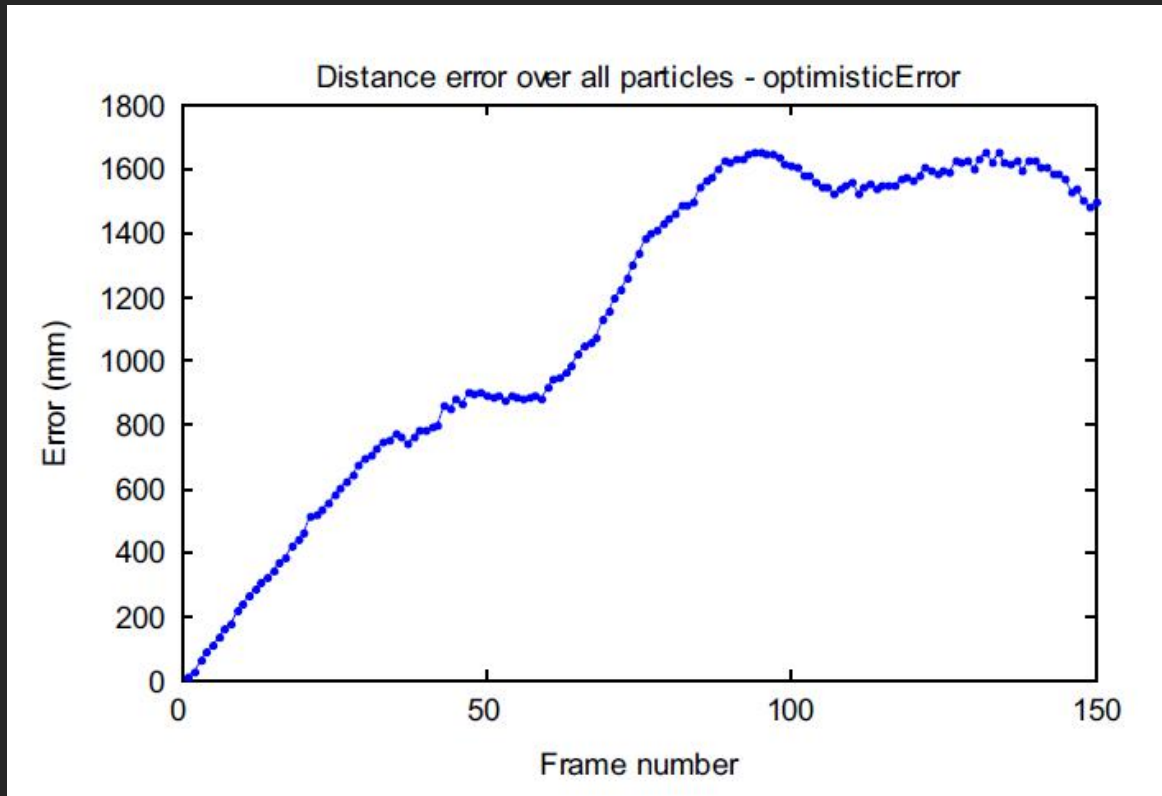


Annealed Particle

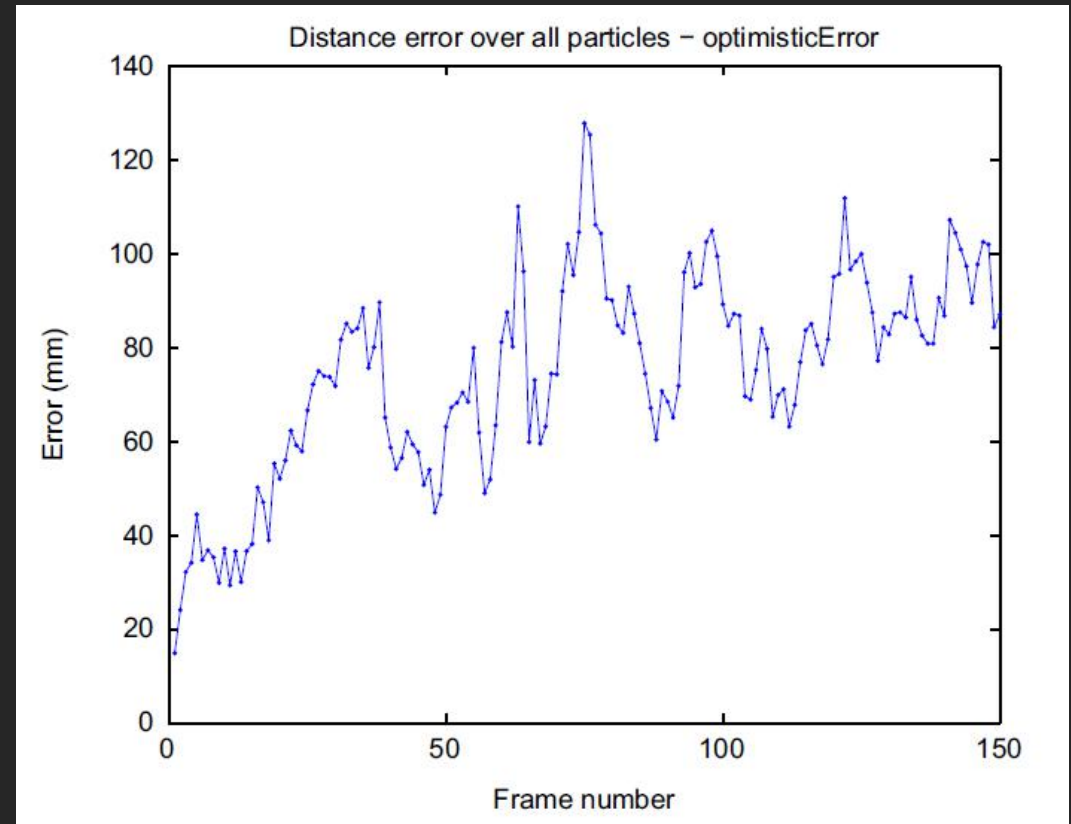


Exemplar-based conditional particle filter

Experiment: Low-frame rate camera. Tracking error



Annealed Particle



Exemplar-based conditional particle filter

Remarks

Complexity time

Online or offline?

Sciencedirect: 8 citations

Google Scholar: 11 citations