Fast Algorithms for Mining Co-evolving Motion Capture Sequences

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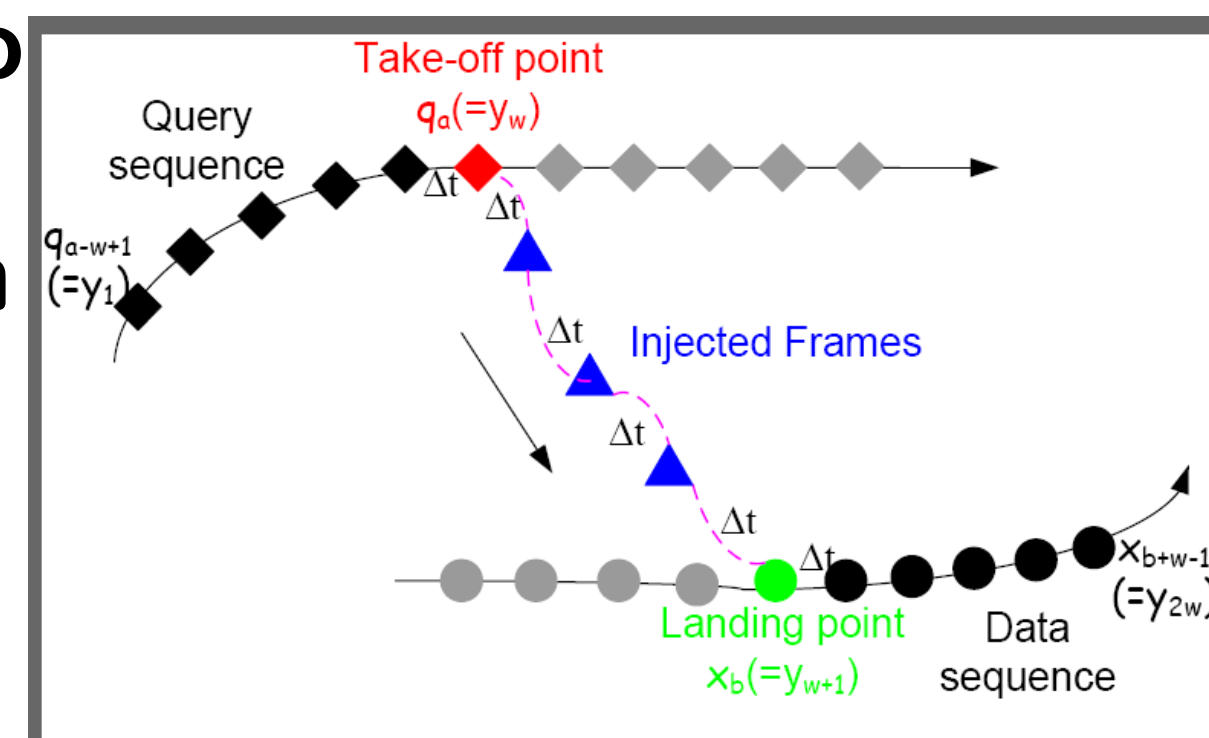Parallel Data Laboratory

Natural Motion Stitching
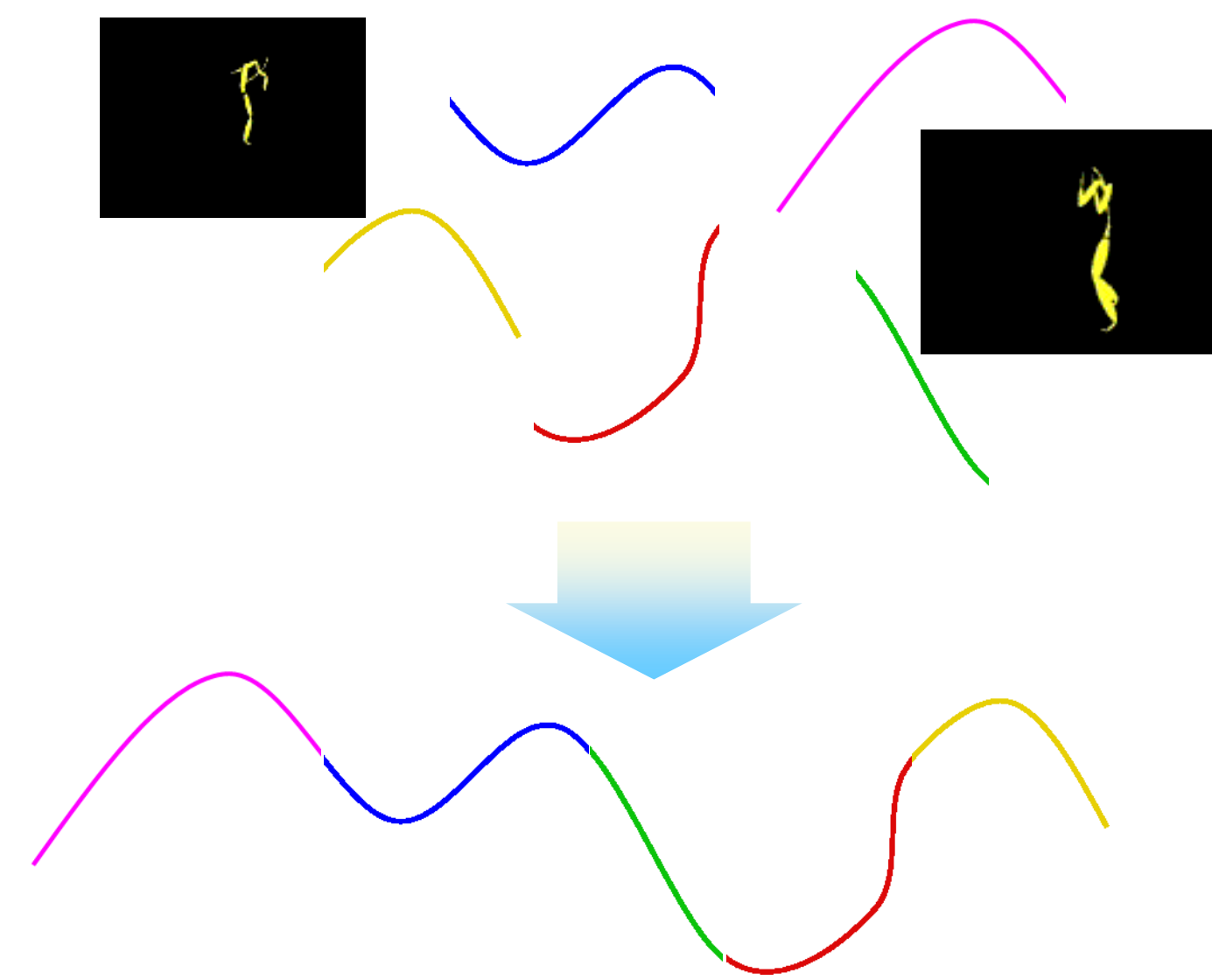
How to assess the goodness of the stitching?

Laziness Score

Conjecture:
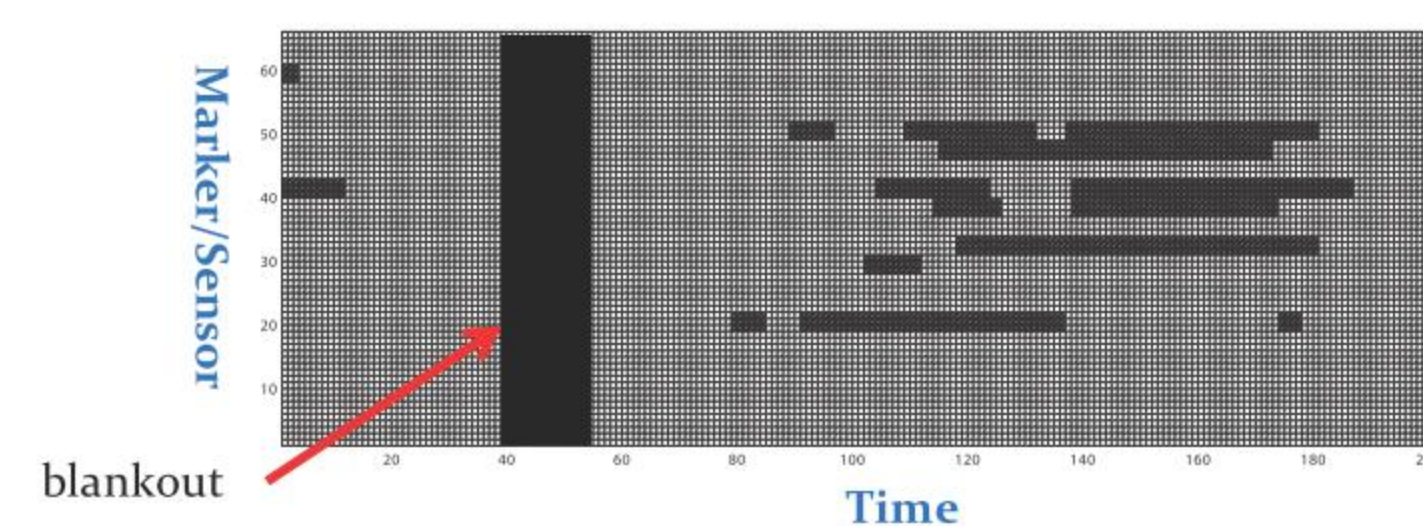*less human effort → more natural*
Proposed: use LDS to estimate position, velocity, acceleration Then compute effort
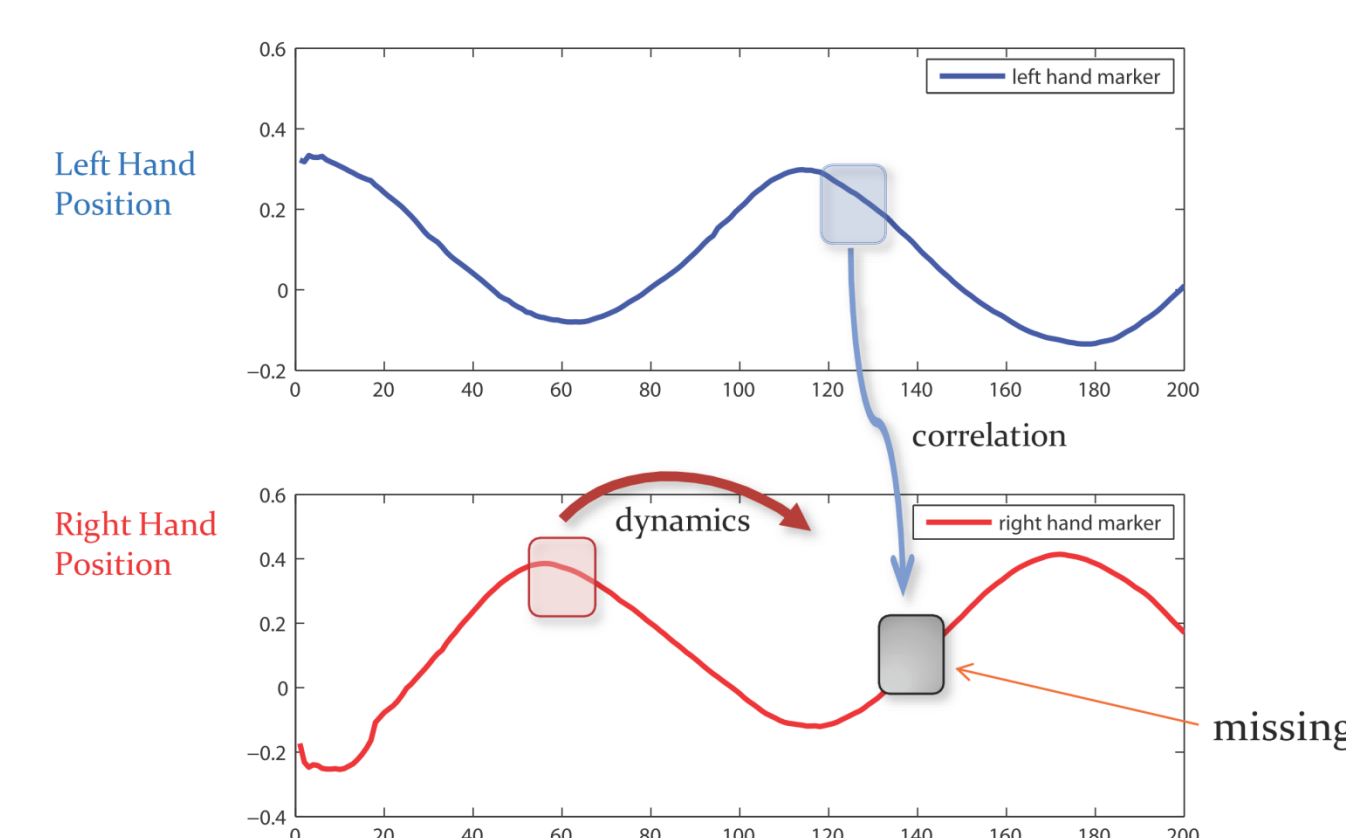

Lei Li *et al.* Laziness is a virtue: Motion stitching using effort minimization. Eurographics 2008,
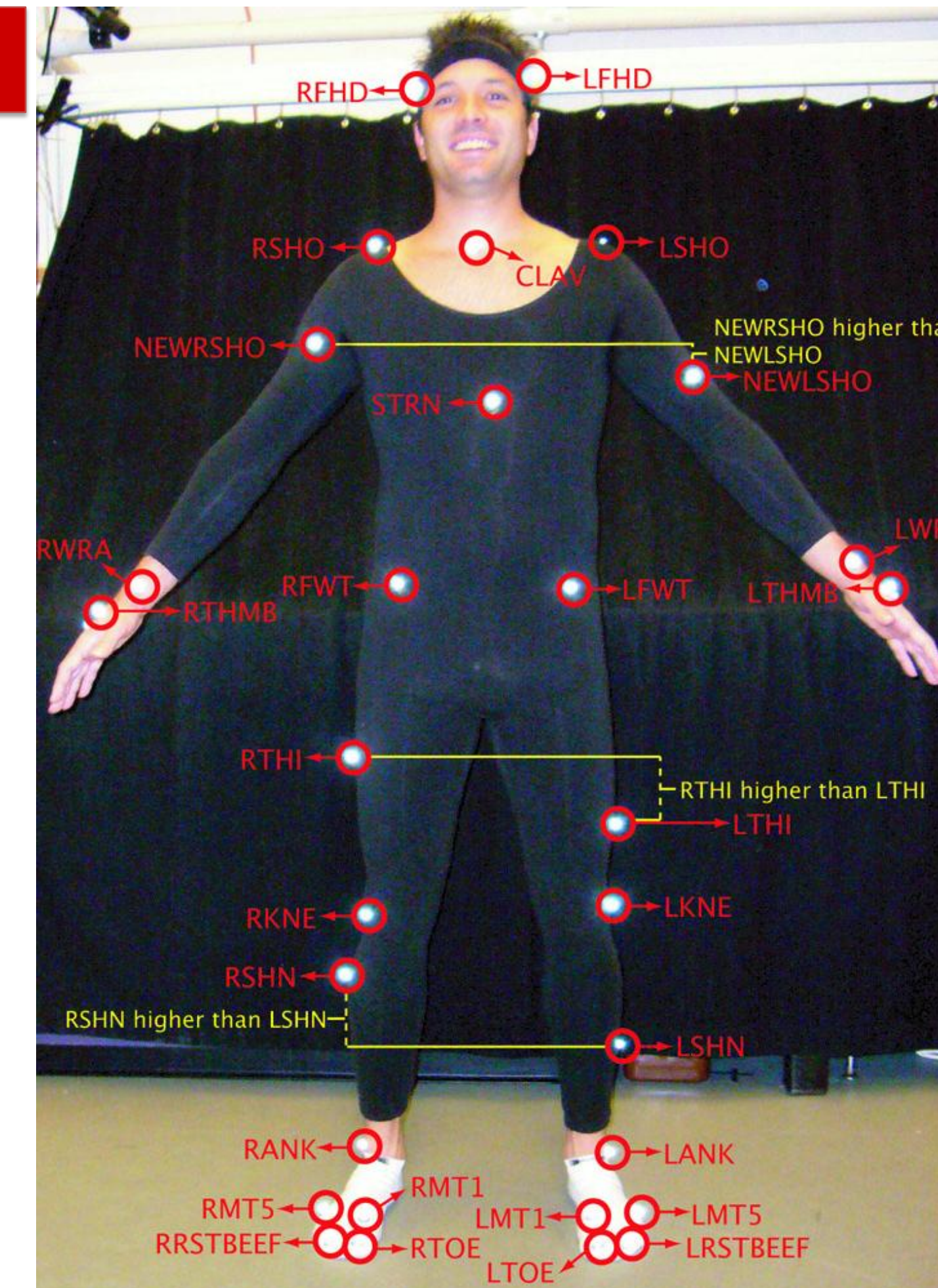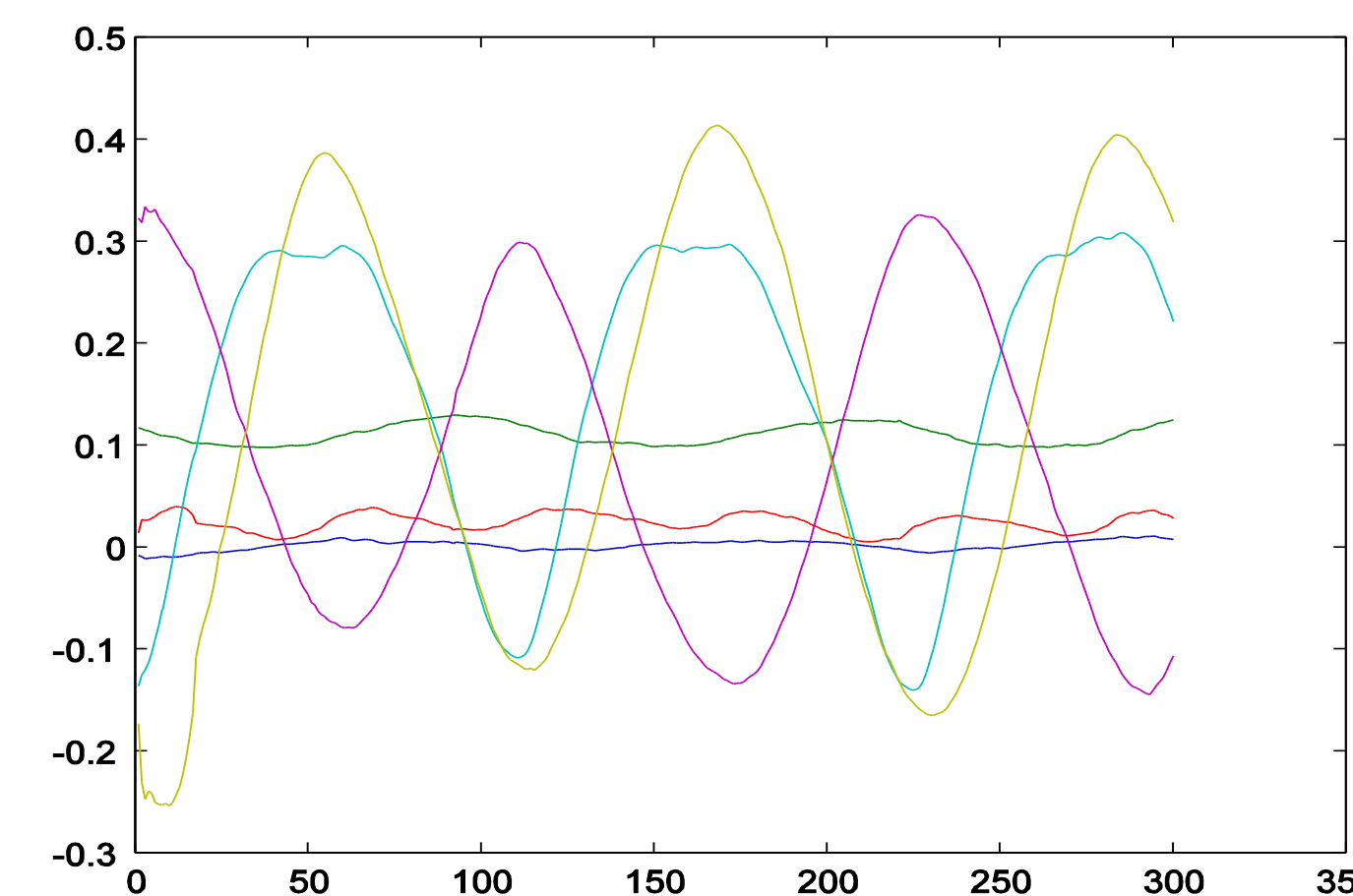
Handling Occlusions

Occlusion:

Intuition:

Scenario

Motion Capture:
- Markers on human actors
- Cameras used to track the 3D positions
- Duration: 100-2000 frames (120 fps)
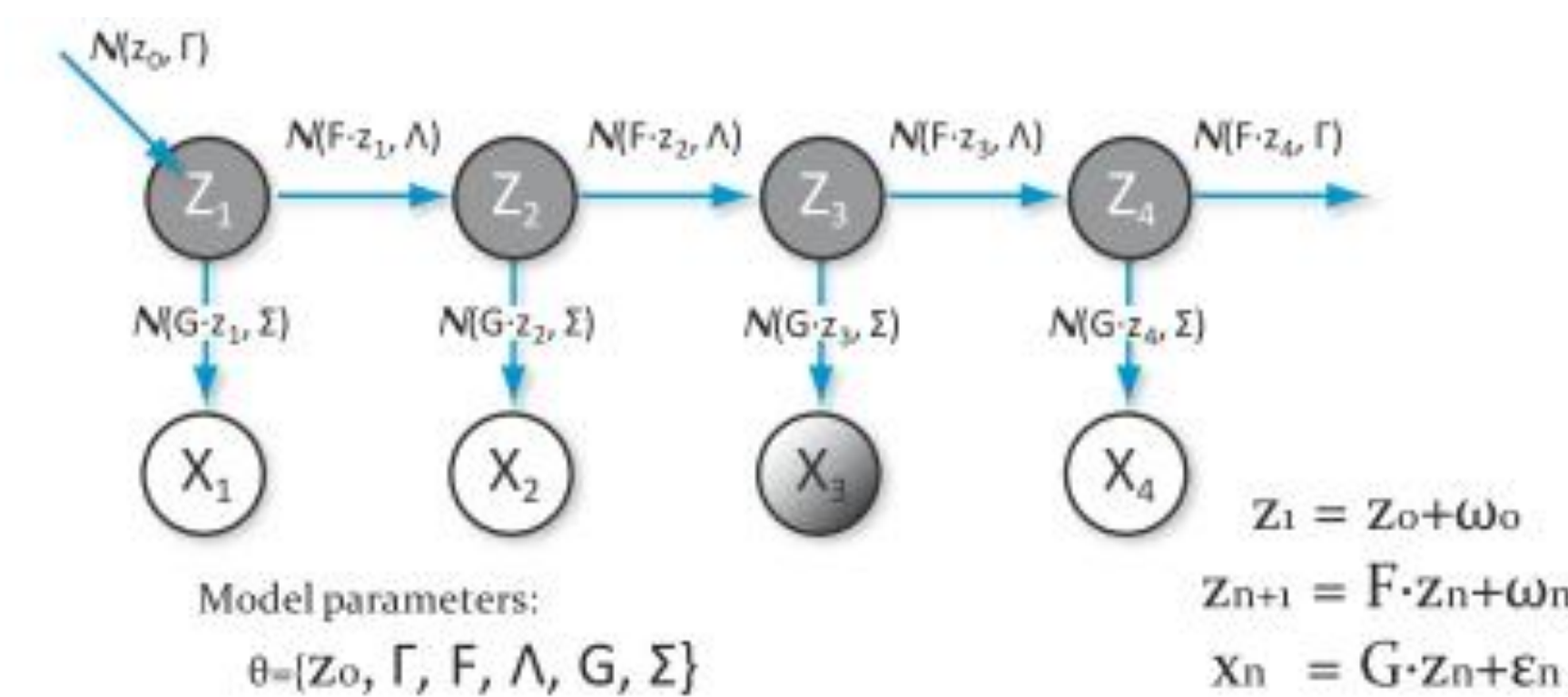- 93 dimensional body-local coordinates after preprocessing (31-bones)

Application

- Movie and Animation (e.g. Shrek)
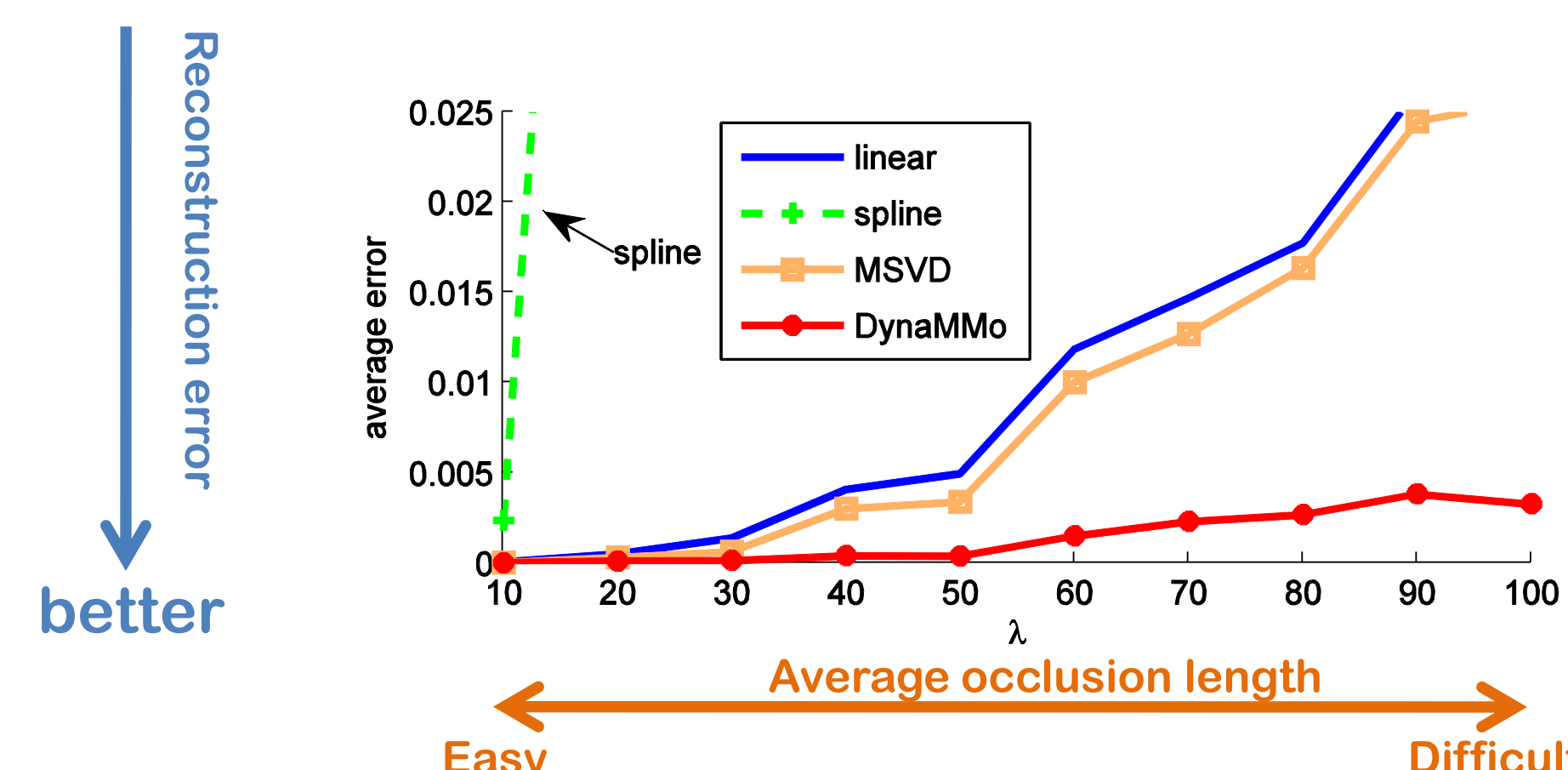- Computer Game ($57B, 2009)
- Assistive Devices (e.g. cooking robot)

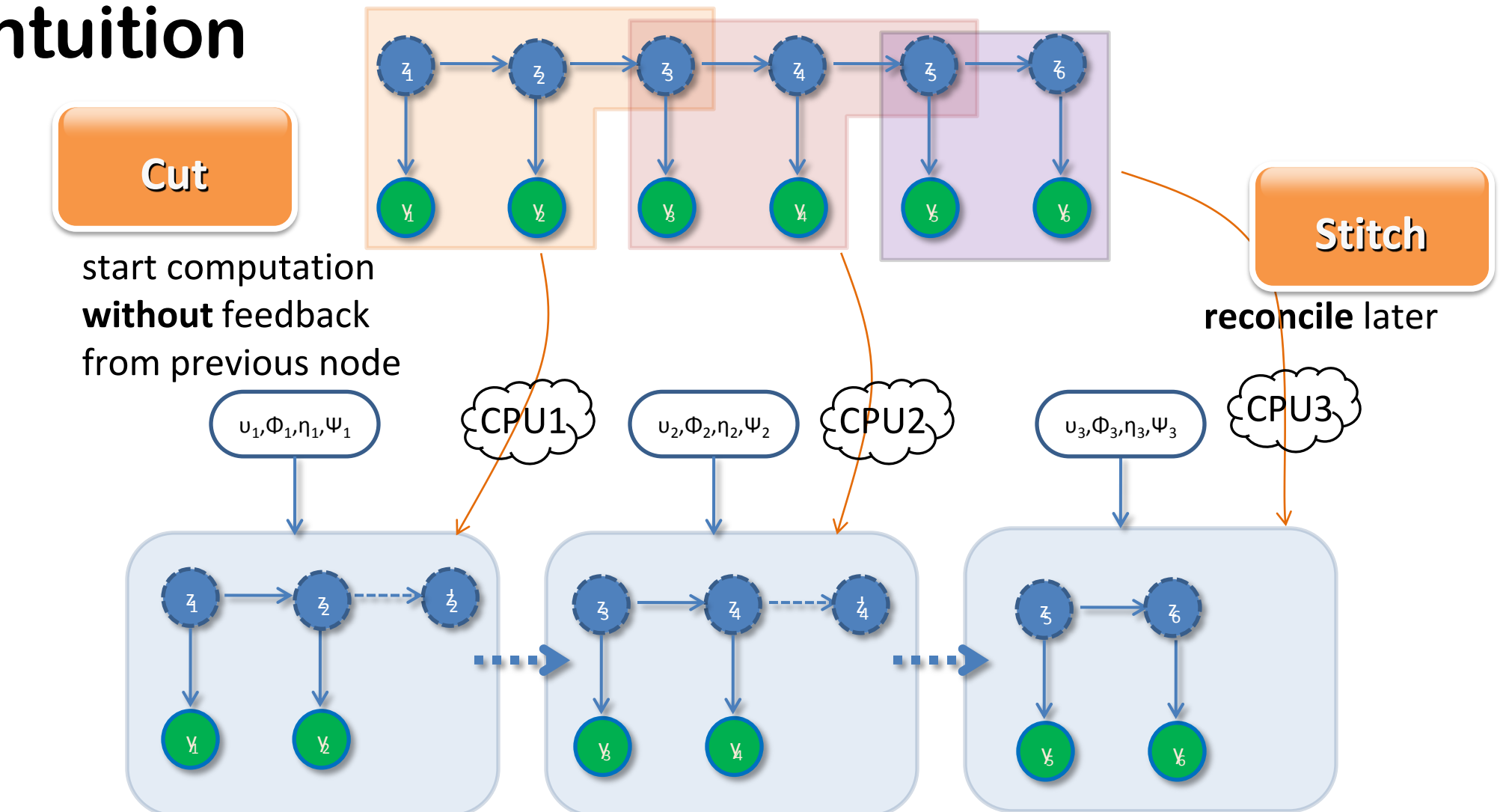## Base Model

Linear Dynamical Systems w/ or w/o missing

Model parameters:
$\theta = \{z_0, \Gamma, F, \Lambda, G, \Sigma\}$

$$z_1 = z_0 + \omega_0$$
$$z_{n+1} = F \cdot z_n + \omega_n$$
$$x_n = G \cdot z_n + \varepsilon_n$$

DynaMMo

Proposed method: maximize expected log-likelihood of observed data

Problems

1. Natural motion stitching
2. Missing values
3. Summarization, Segmentation & Forecasting
4. Scalable Learning & Mining

Parallel Learning

Intuition

Cut
start computation **without** feedback from previous node
Stitch
reconcile later

Cut-And-Stitch

Dataset:
58 motion sequences
CMU Mocap #16
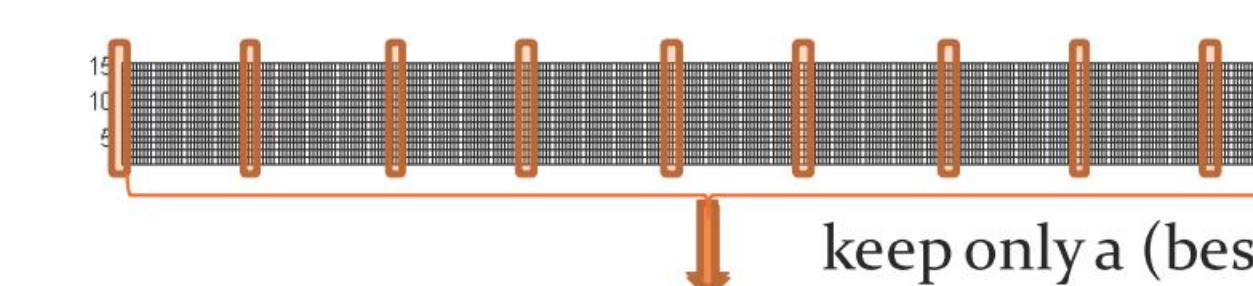mocap.cs.cmu.edu,
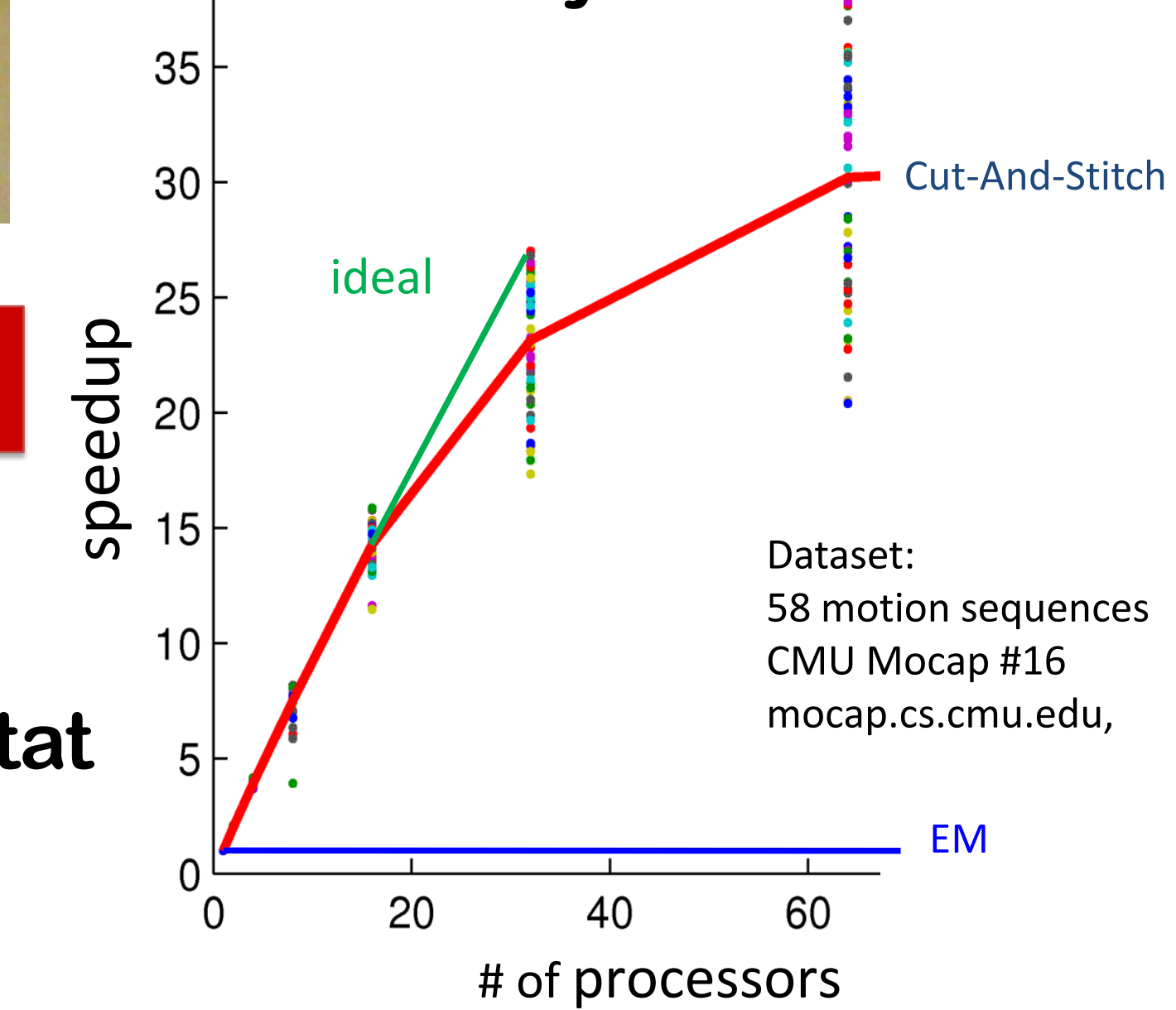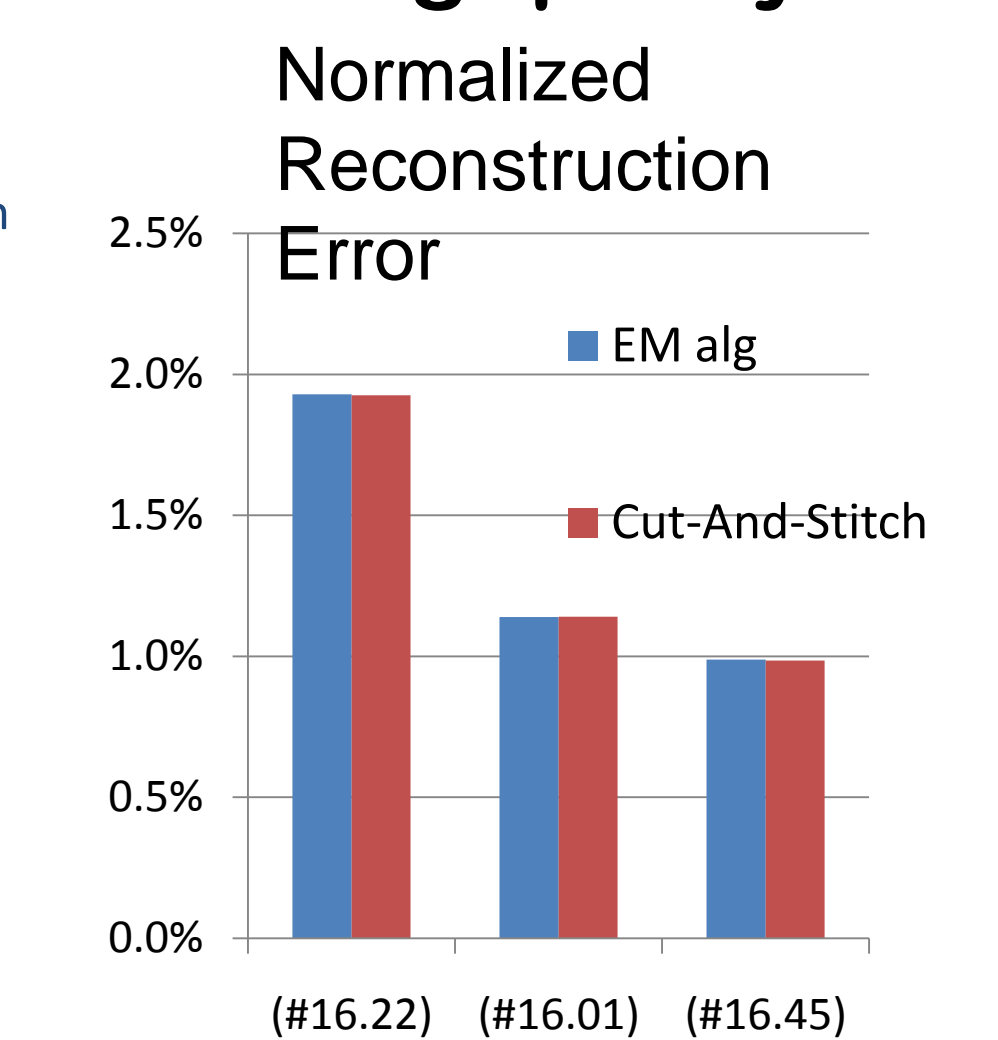
Lei Li *et al.* Cut-and-stitch: efficient parallel learning of linear dynamical systems on SMPs. KDD '08

Compression & Segmentation

Intuition:

observations w/ missing values

get hidden variables and model parameters

keep only a (best) portion of them

and model parameters

The same idea could be used in segmentation and forecasting

Compression

Segmentation

original data

reconstruction error
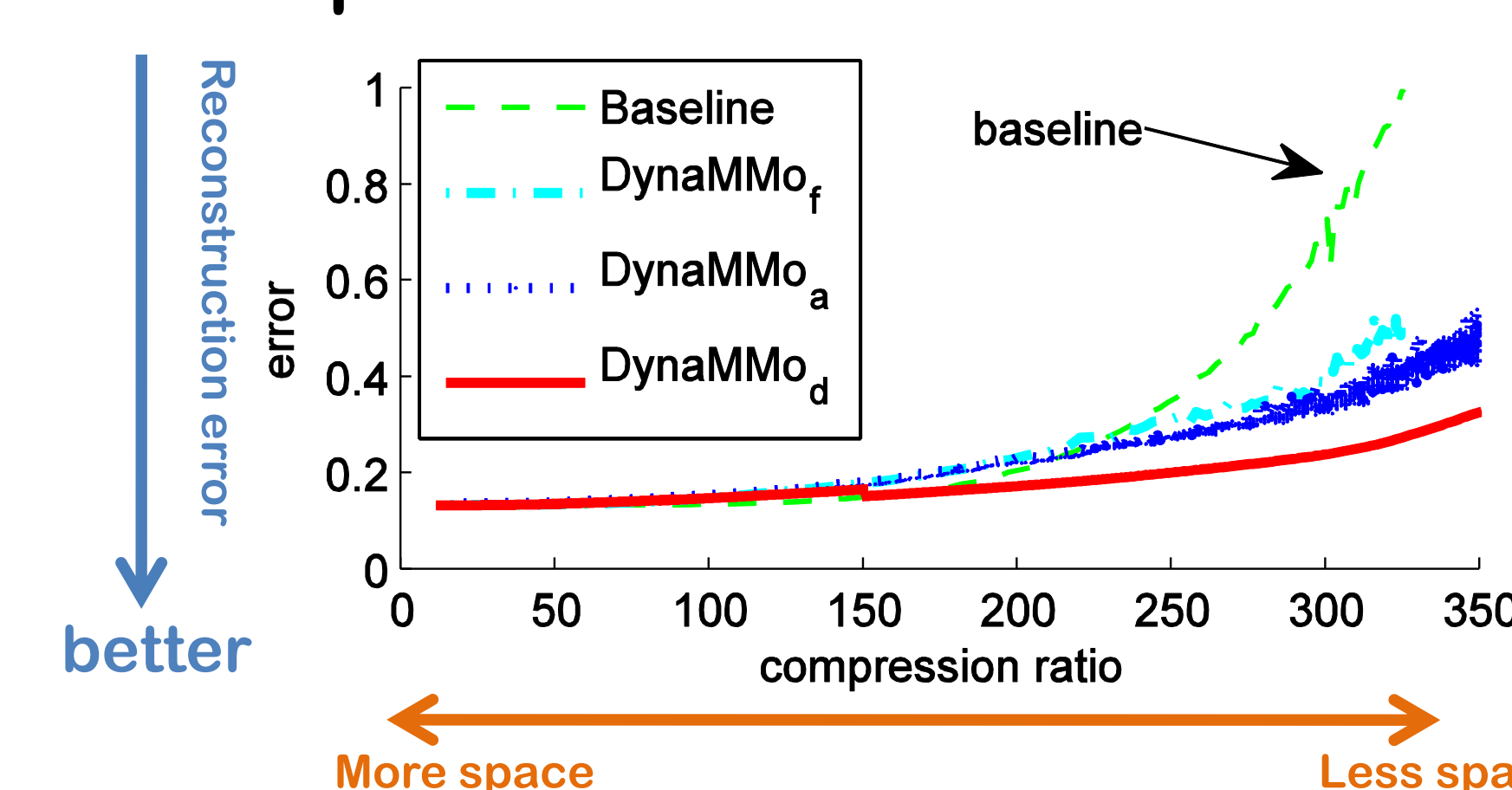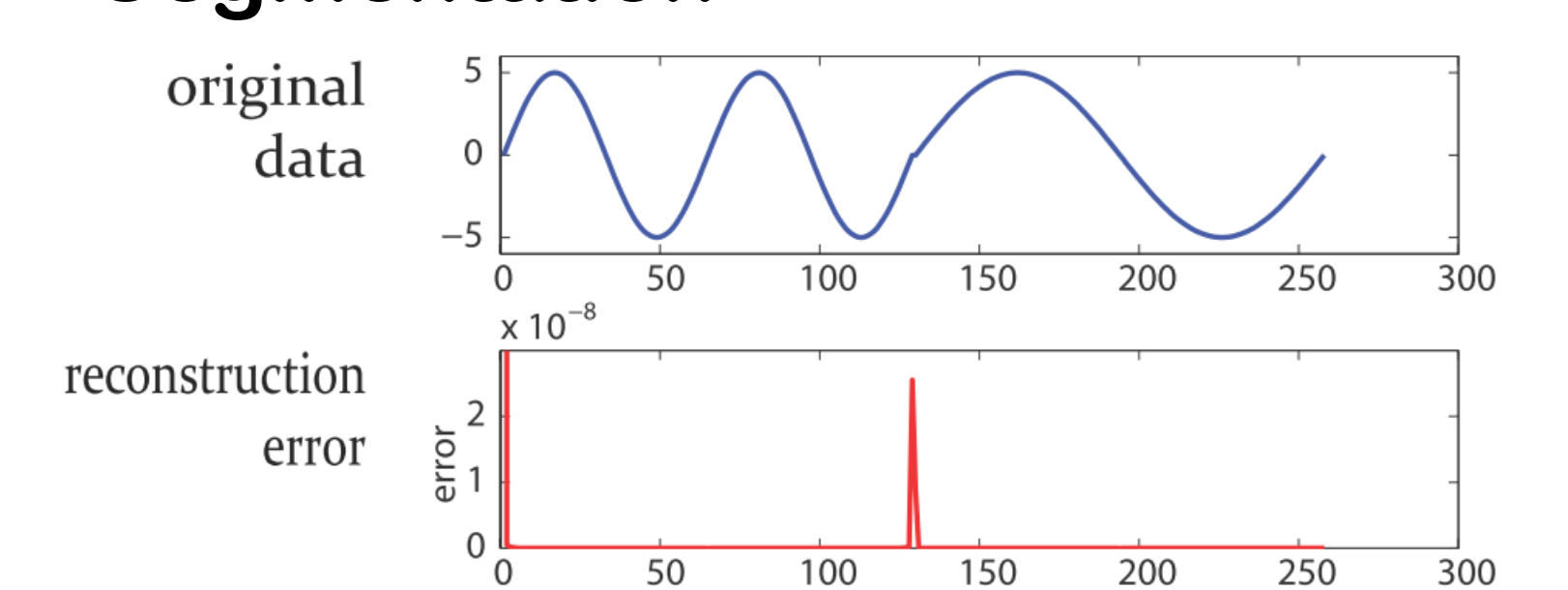
Lei Li *et al.* DynaMMo: Mining and Summarization of Coevolving Sequences with Missing Values. KDD '09