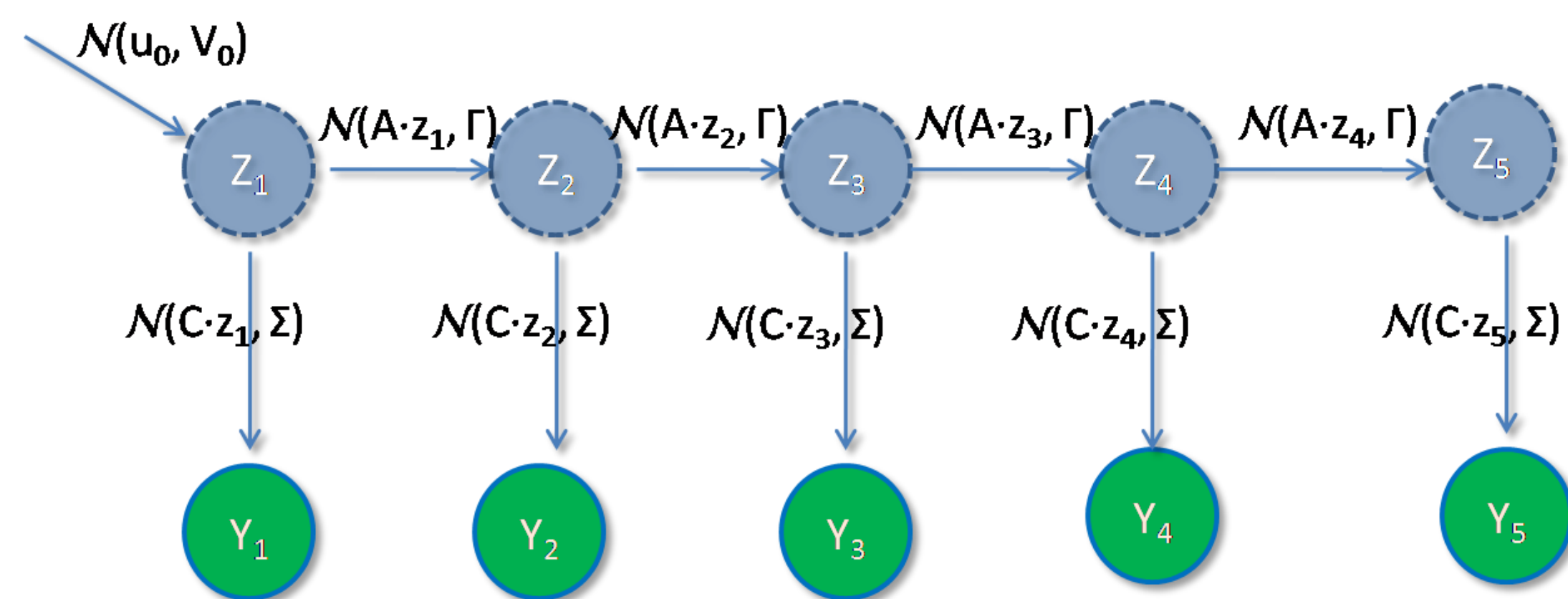




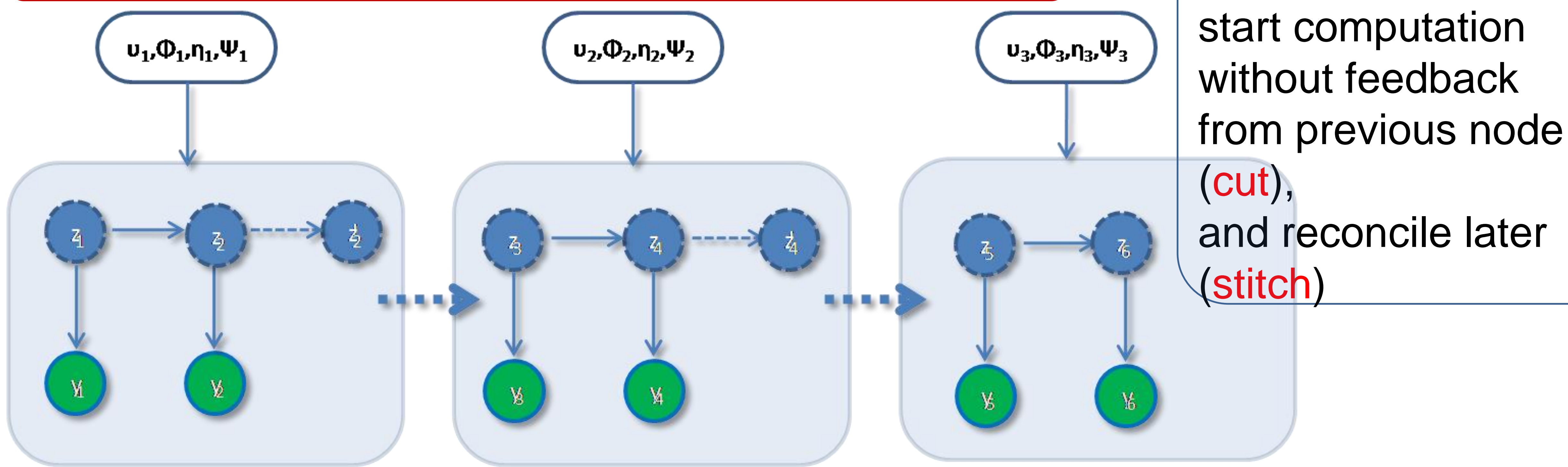
### Problem Definition

- **Problem:**  
Given a Linear Dynamical System, to find the model parameters.
- **Traditional Method:**  
Maximum Likelihood Estimation via Expectation-Maximization(EM) algorithm
- **Objective:**  
Parallelize the learning algorithm
- **Tool:**  
OpenMP with shared memory parallelism

Parameters:  $\theta=(u_0, v_0, A, \Gamma, C, \Sigma)$   
Observation:  $y_1...y_n$   
Hidden variables:  $z_1...z_n$



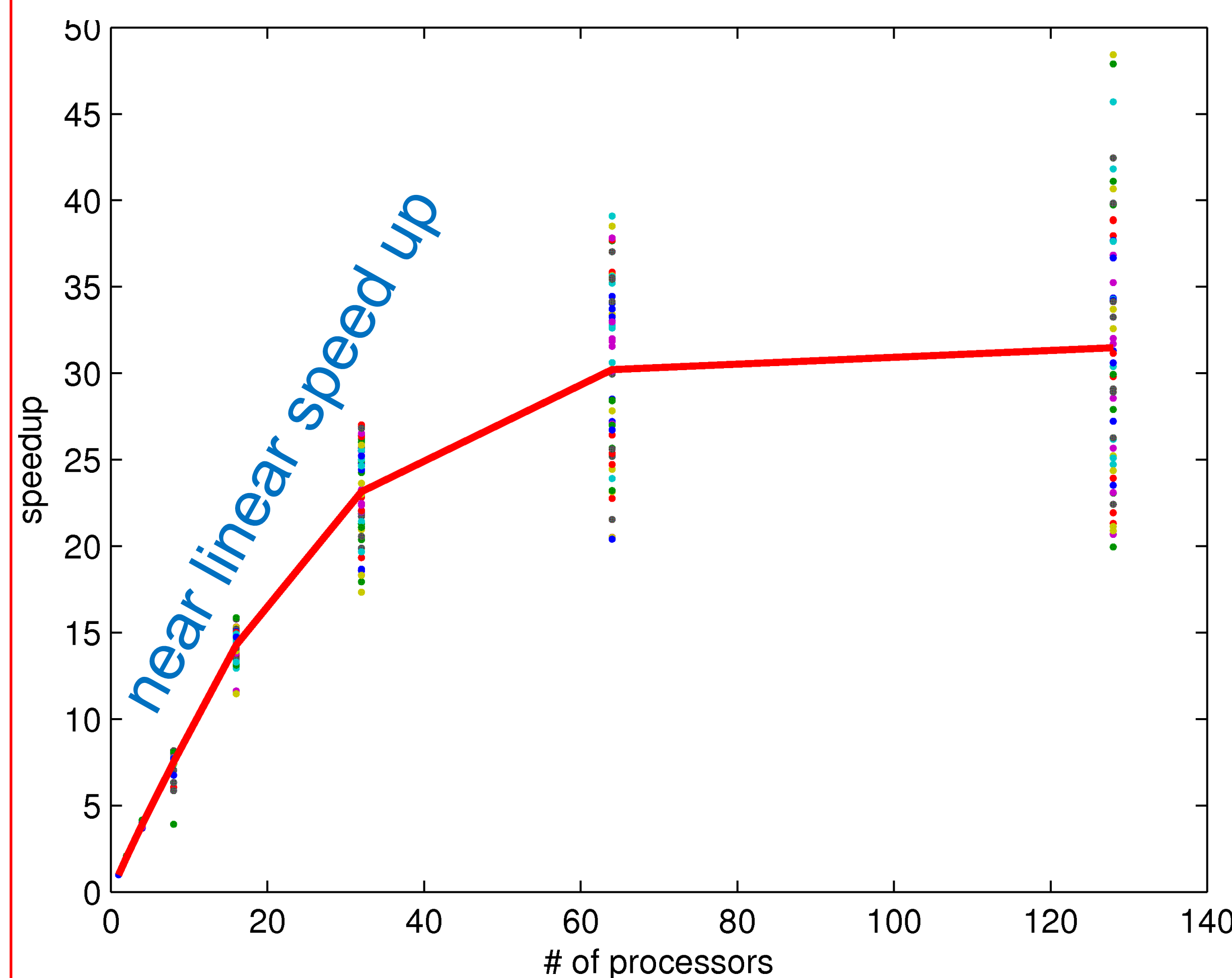
### Proposed Method: Cut-And-Stitch



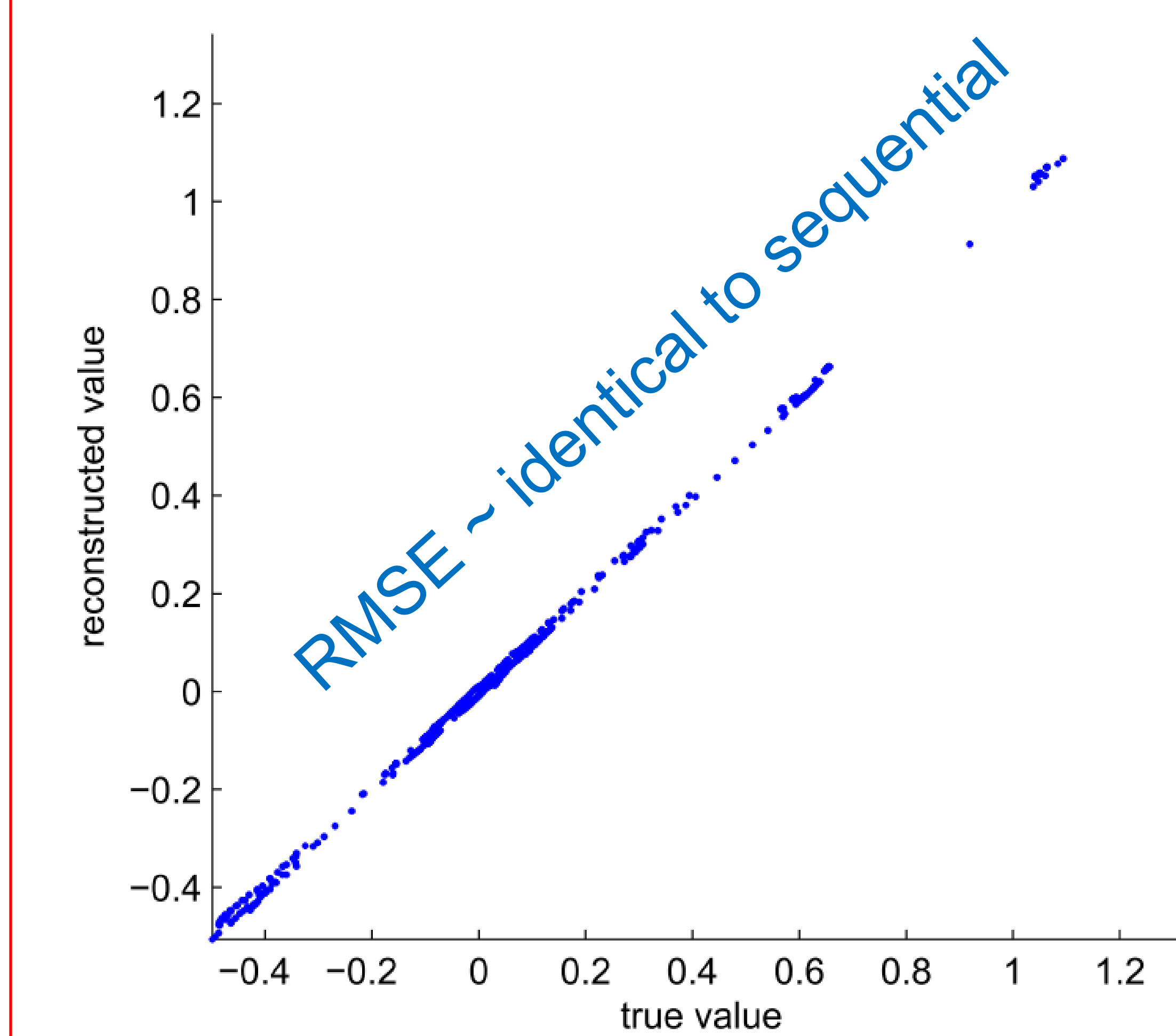
### Experiments

- **Dataset:**  
58 motion capture sequences. Each with 93 dimensions (bone positions).
- **Setup:**  
tested on both SMP (SGI Altix) and desktop multicore (4-core)

Speed up over the sequential algorithm

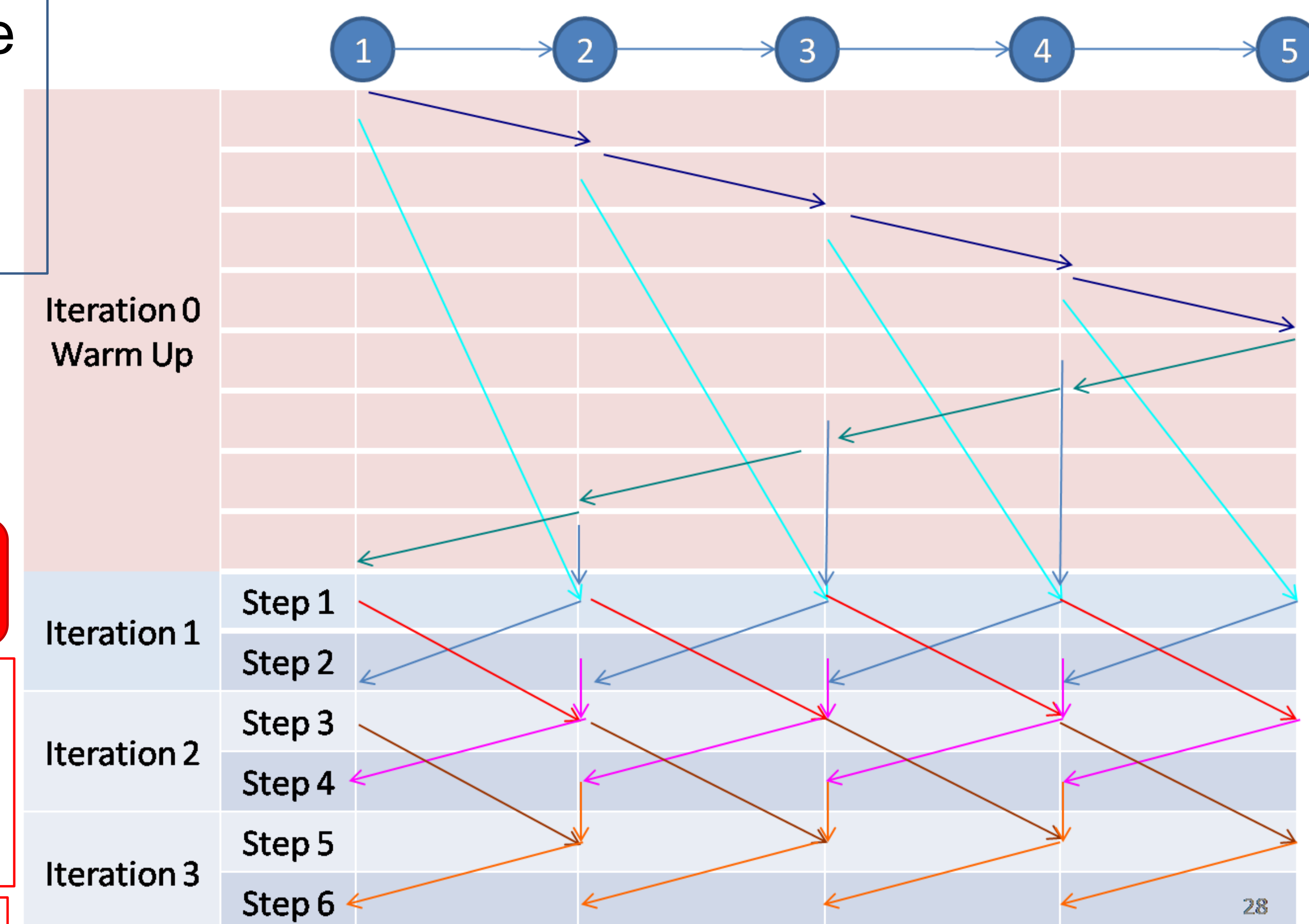
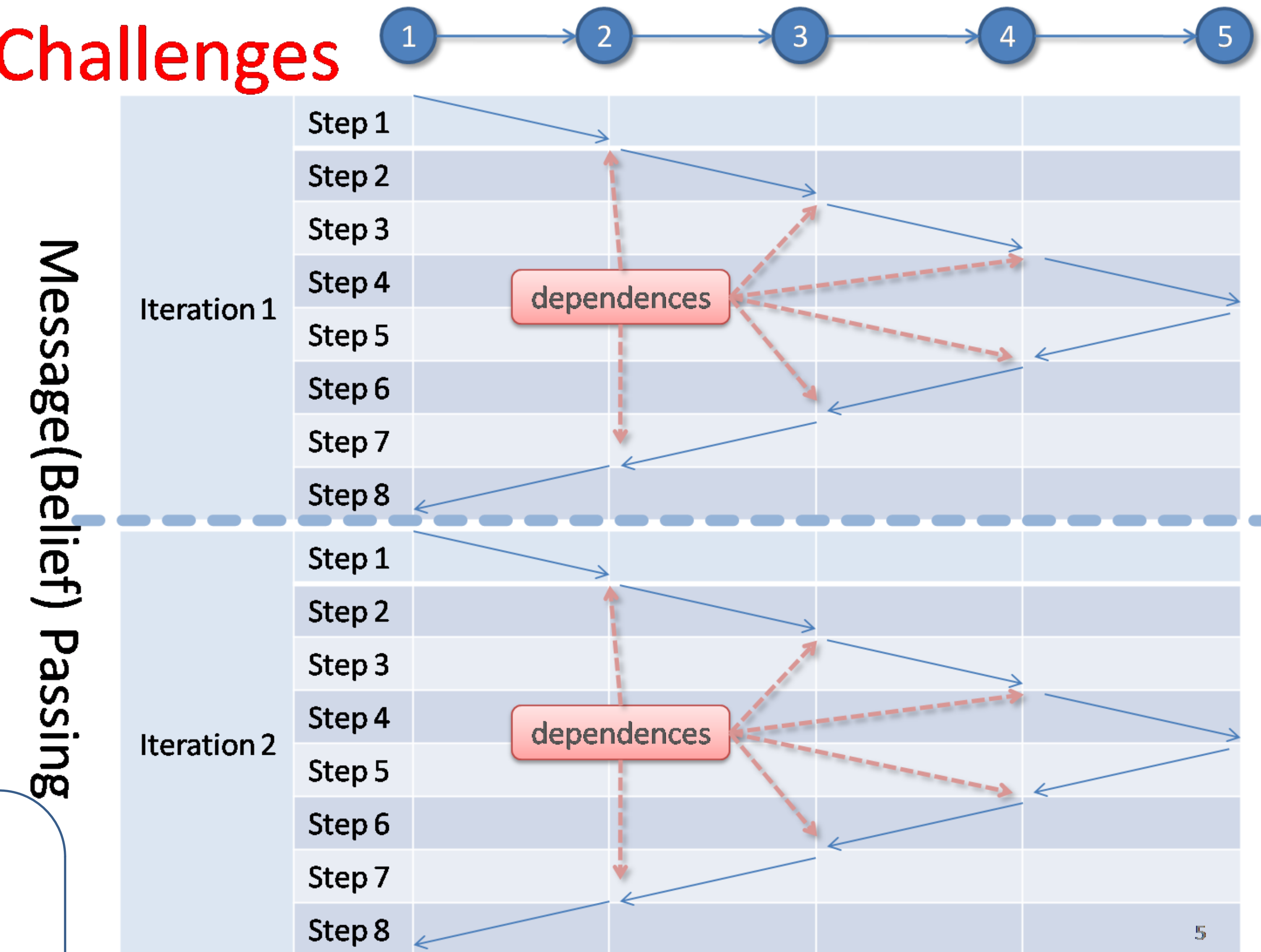


Quality: Reconstructed v.s. Real



### Traditional Learning

#### Challenges



### Conclusion

- General approximate parallel learning algorithm for LDS
- Near linear speed up
- Quality (RMSE): ~ identical to sequential learning
- Promising Extensions:
  - Cut-And-Stitch for HMM
  - Cut-And-Stitch for general Markov models

Dataset and software available at  
<http://www.cs.cmu.edu/~leili/paralearn/>