Gait Sequence Estimation using Hidden Markov Models

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UCT

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Introduction

Presentation content:

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Presentation content:

1. Introduction
2. System and Model Design
3. Parameters Estimation/ Training
4. Experiments, Results, & Discussions
5. Conclusions & Recommendations
6. Poster Presentation

Problem Description

1. *The Markov assumption*

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2. *The stationary assumption*

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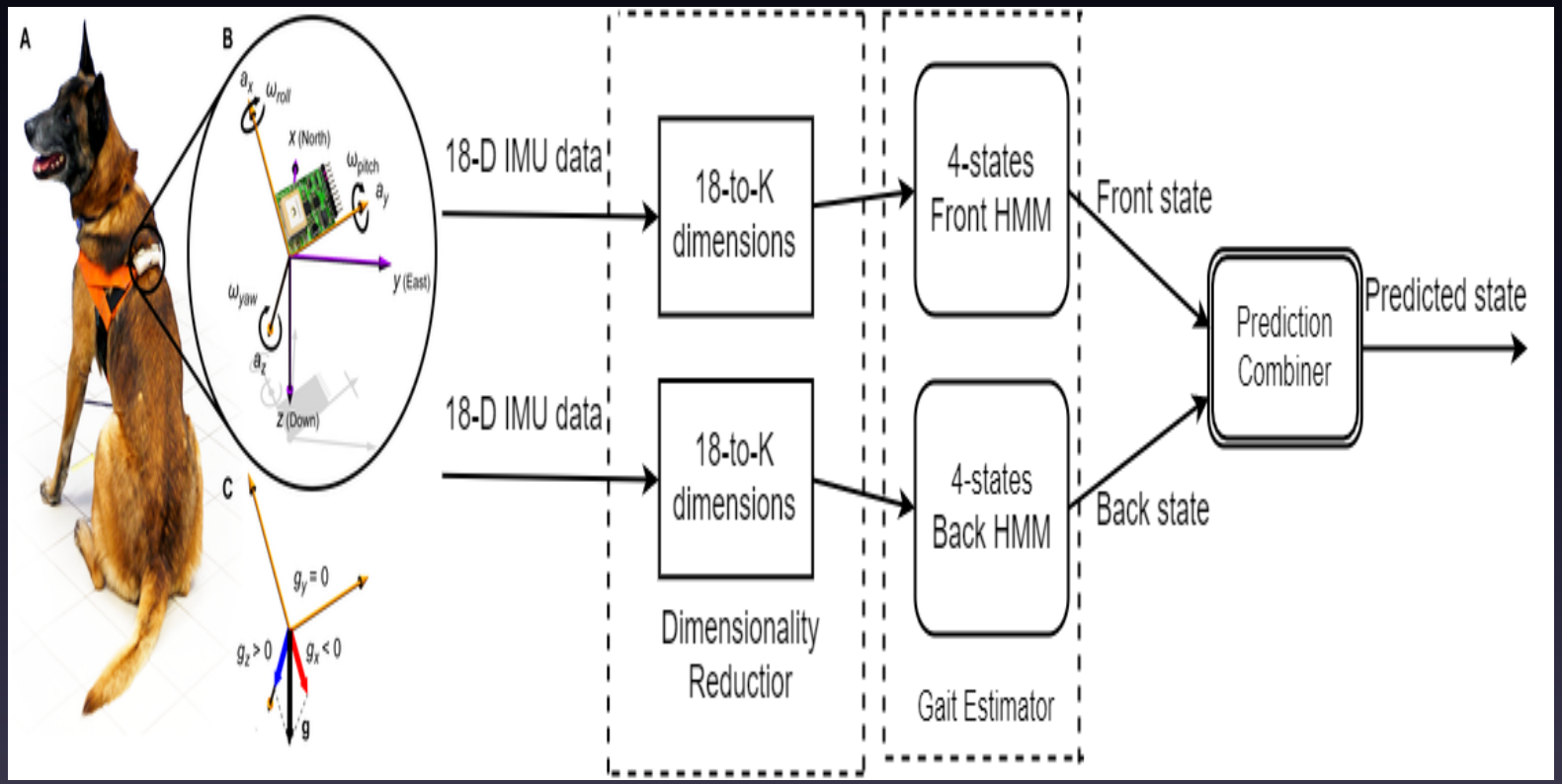
3. *The output/observation independence assumption*

System Overview



(a) System Block Diagram

HMM parameters

- $\pi = \pi_i$

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- $A = \{a_{ij}\}$

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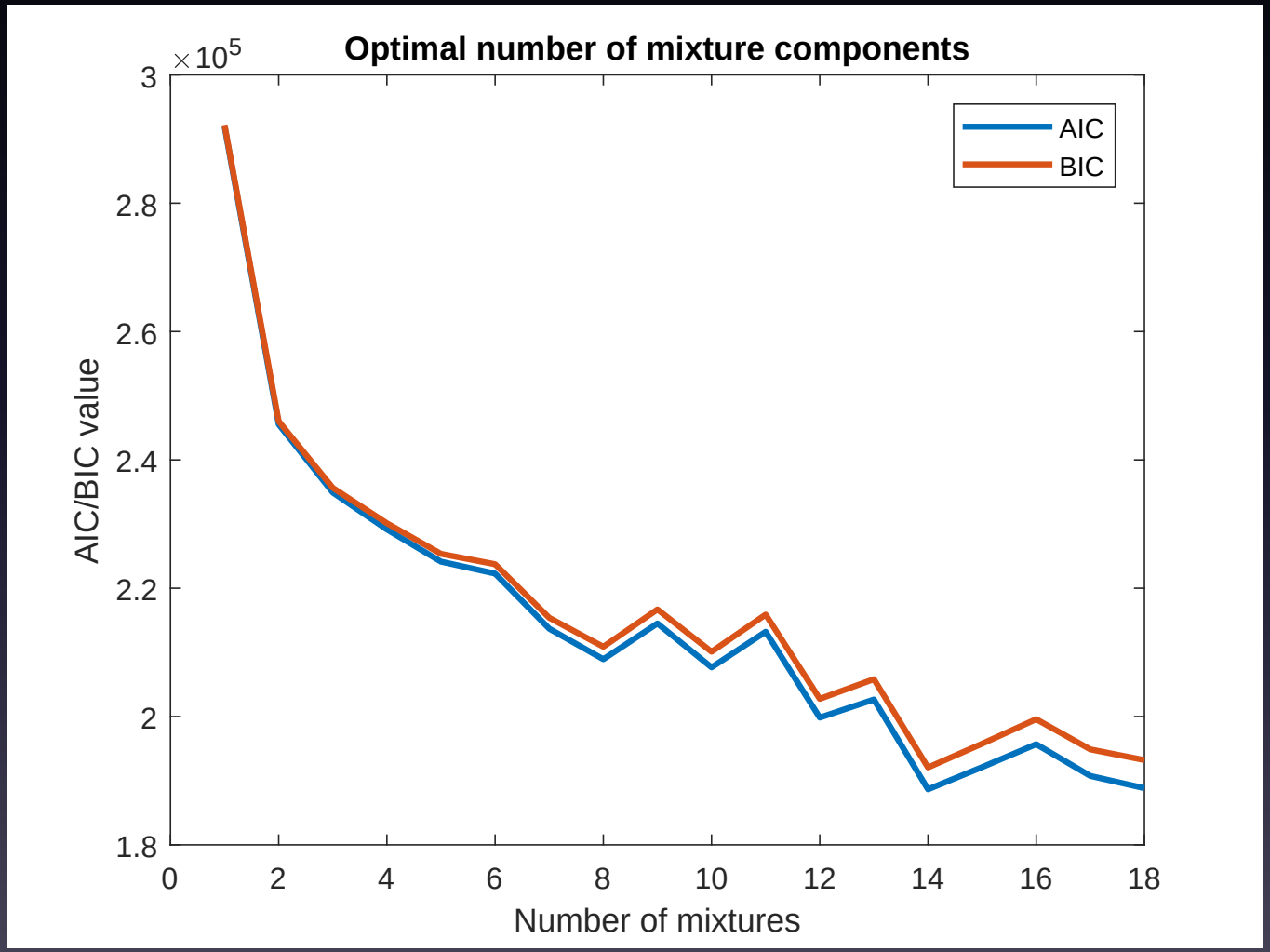
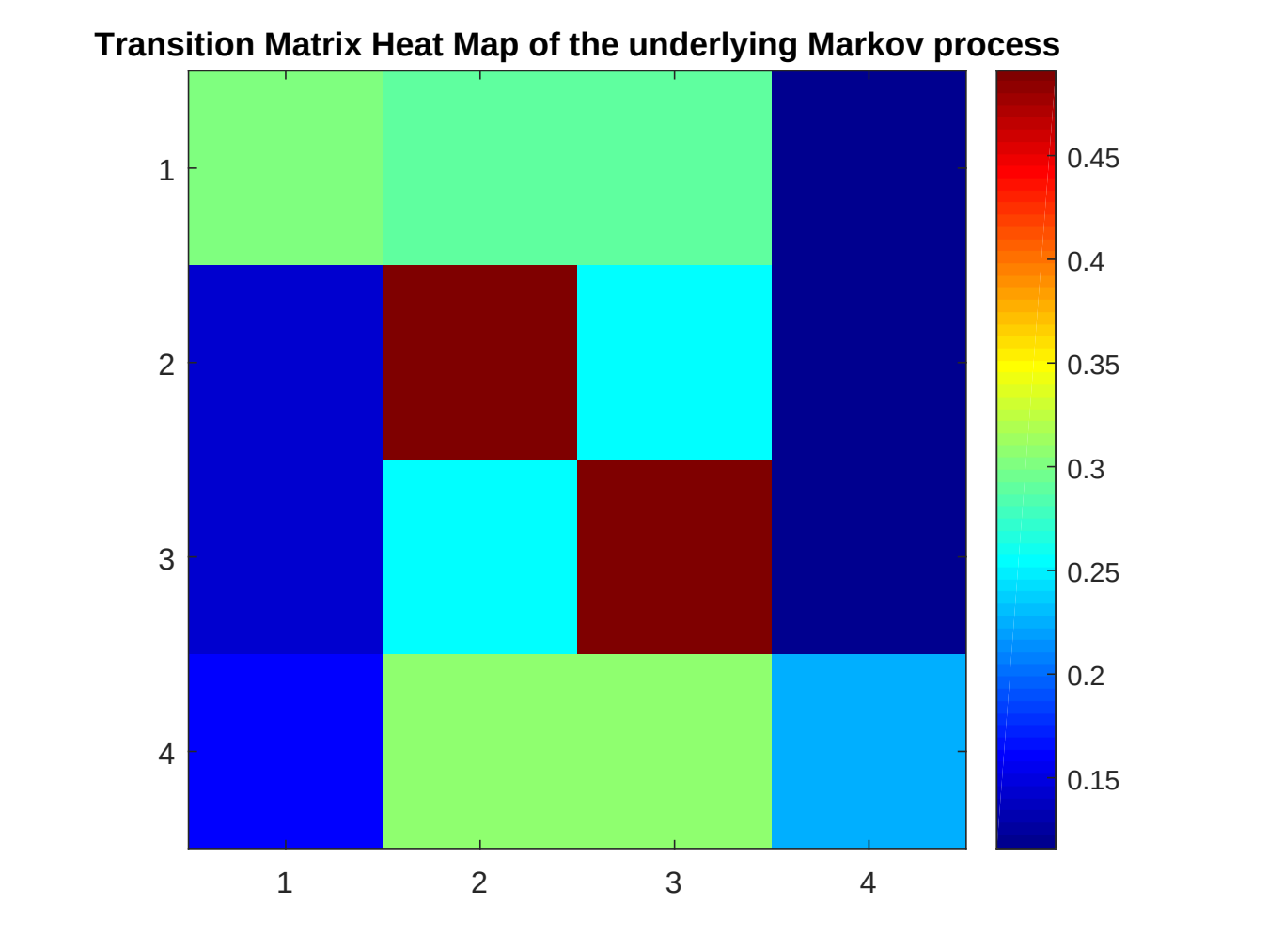
$$\phi(O_t) = \sum_{m=1}^{M} \beta_{jm} \eta(\mu_{jm}, \Sigma_{jm}, O_t),$$

Solution to the Training Problem

Optimal mixture number with AIC



State transition matrix



Hidden Markov Process

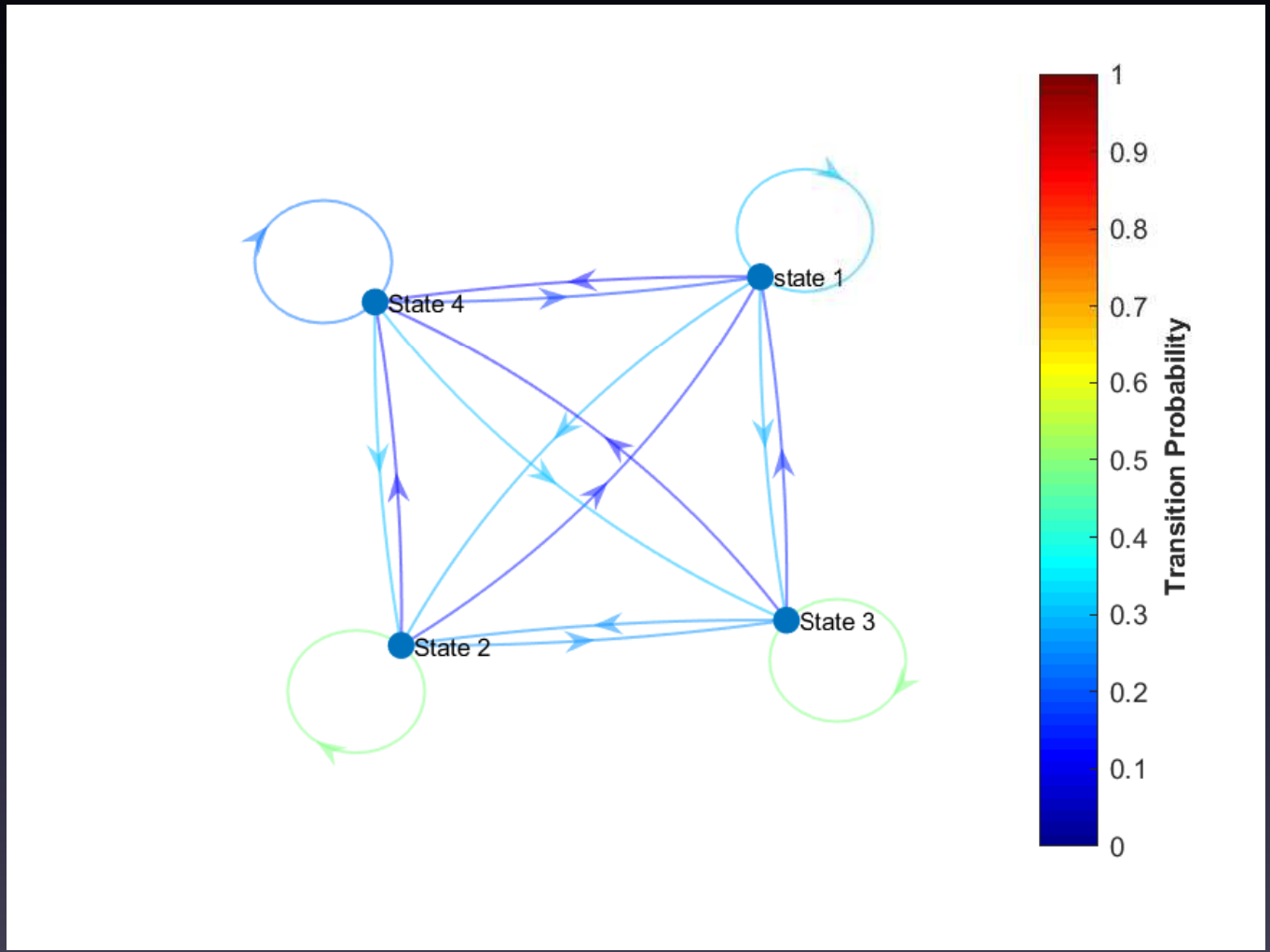
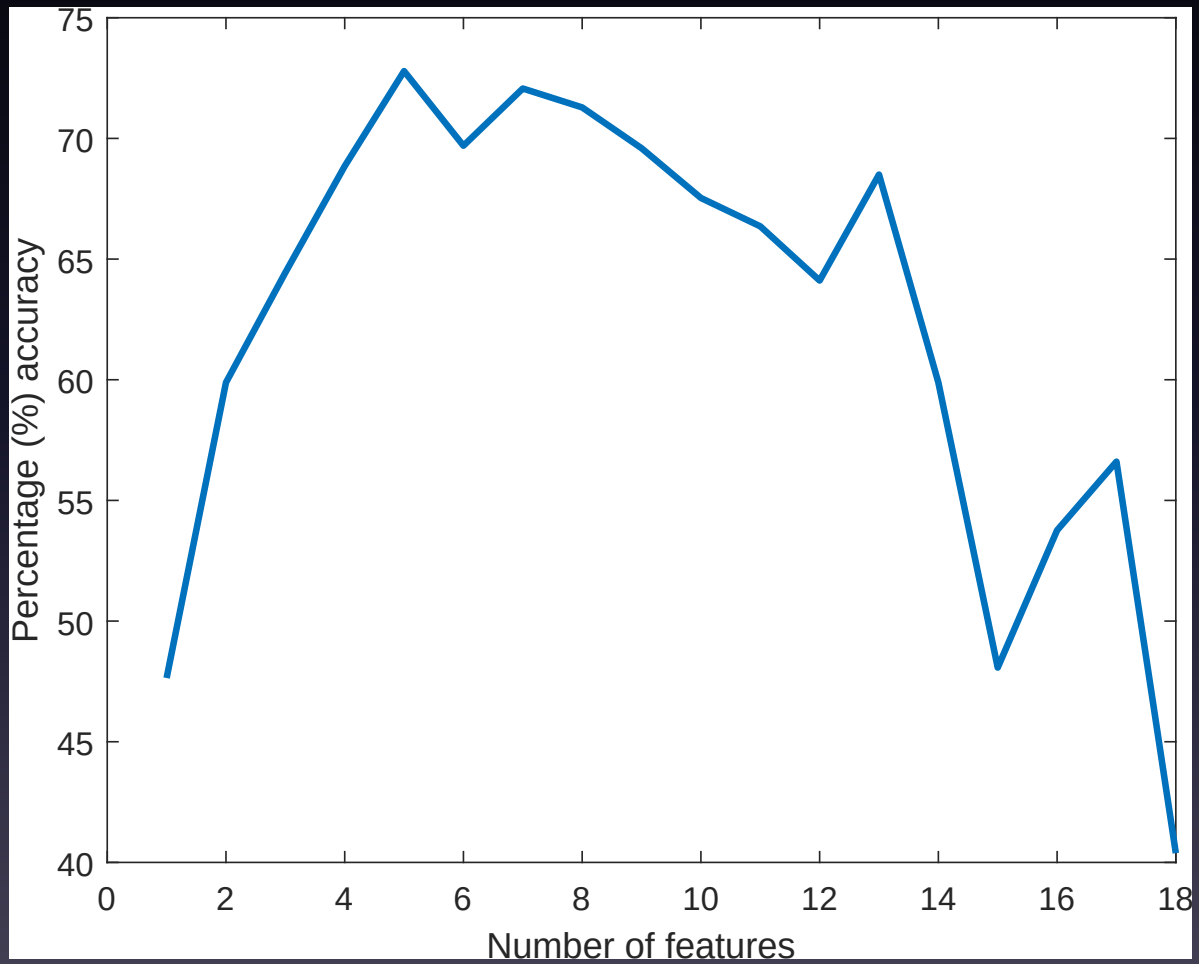


Figure: Graphical model of state transition

Effect of feature dimensionality



Feature Subset Selection

1. Feature ranking with Separability Index

Feature Subset Selection

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2. Forward feature selection

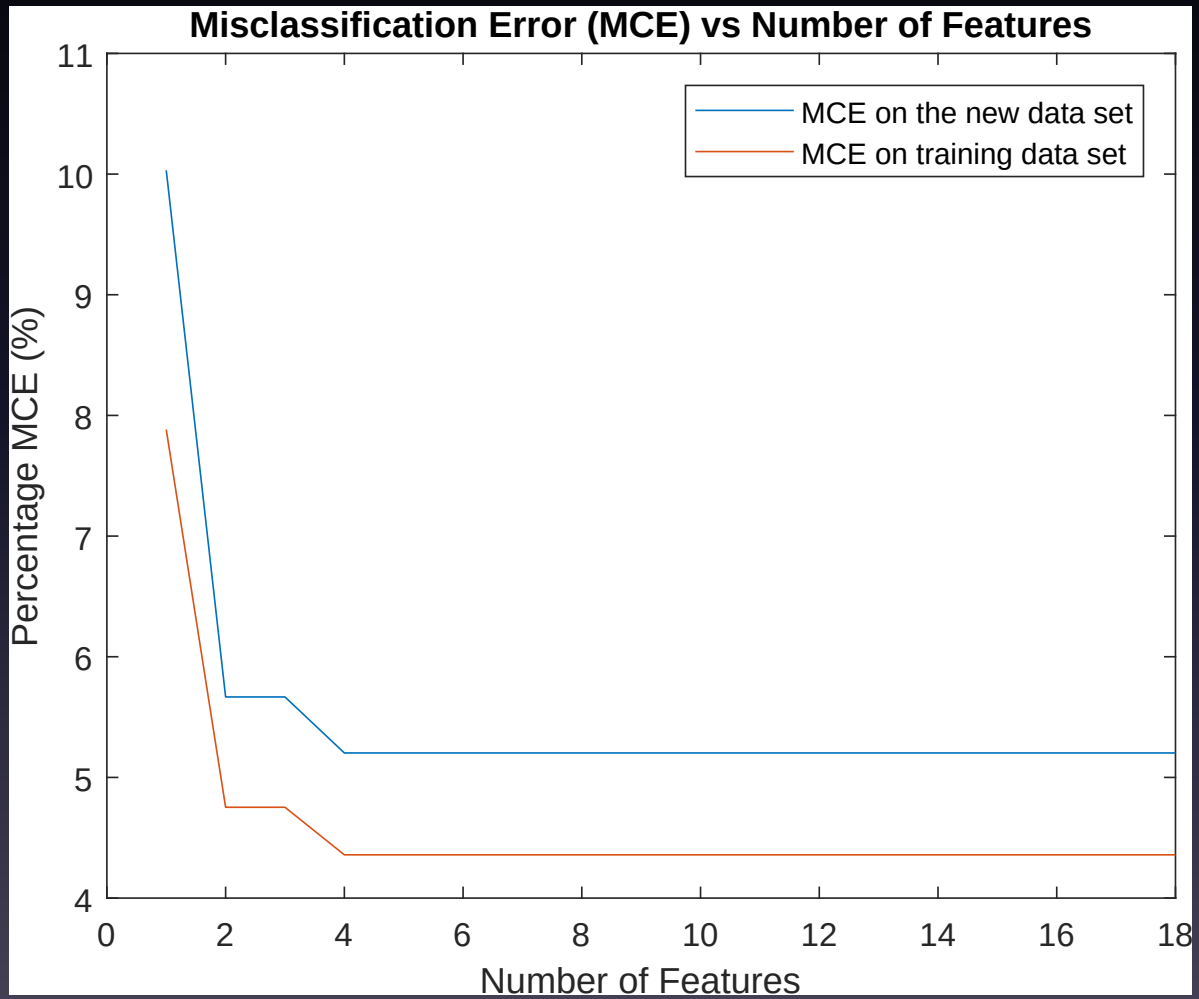
Feature Extraction

1. Princpal Component Analysis: PCA

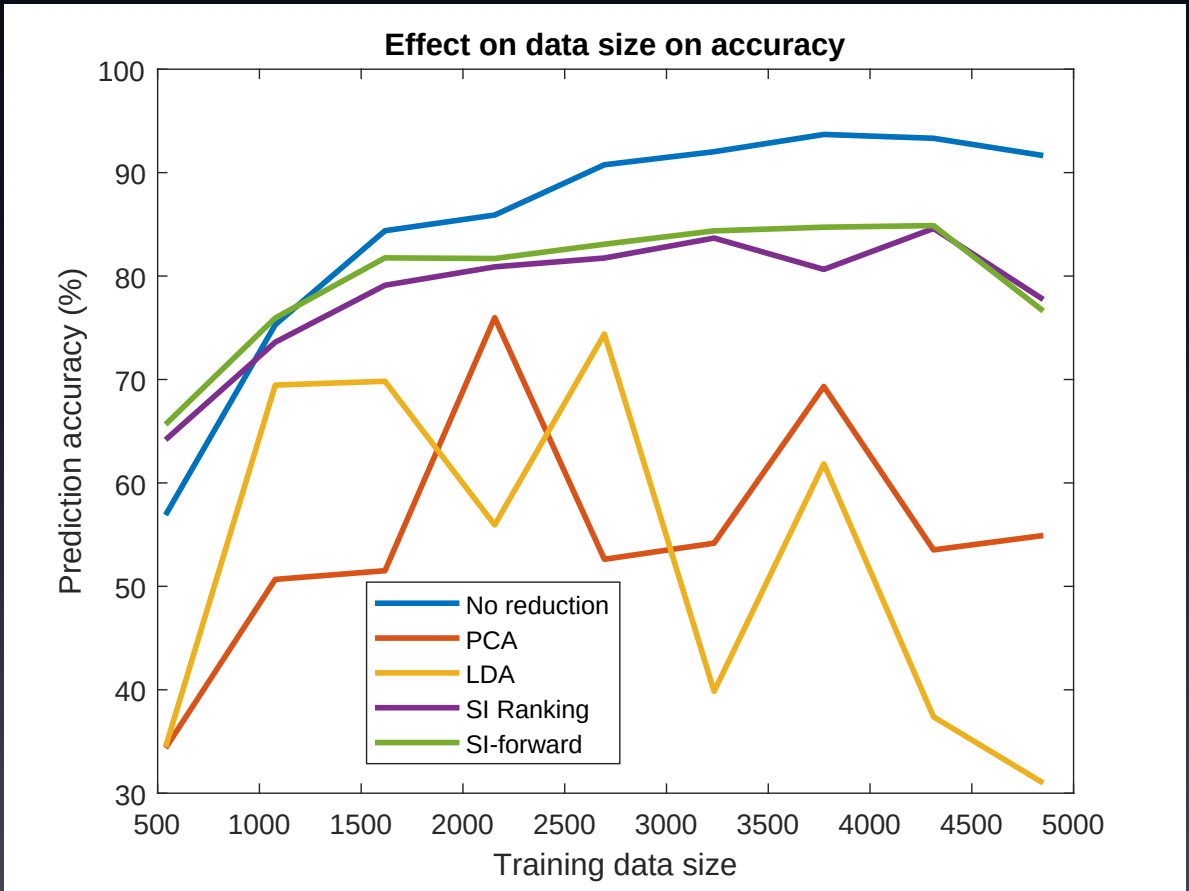
Feature Extraction

1. Princpal Component Analysis: PCA
2. Linear Discriminant Analysis: LDA

Optimal feature number with KNN



The impact of dimensionality reduction



Motion type recognition with log-likelihood

	Running Data	Walking Data	Trotting Data
Model of Run	0.00	-0.00$\times 10^{14}$	-0.00$\times 10^{14}$
Model of Walk	-0.00$\times 10^{14}$	0.00	-0.00$\times 10^{14}$
Model of Trot	-1.44$\times 10^{12}$	-0.1302	0.00

Table: Classification with prediction accuracy

Motion type recognition with accuracy

	Running Data	Walking Data	Trotting Data
Model of Run	91.16%	2.06%	0.22%
Model of Walk	21.06%	100.00%	75.53%
Model of Trot	27.40%	45.72%	100.00%

Table: Classification with log-likelihood

Front sensors or both?

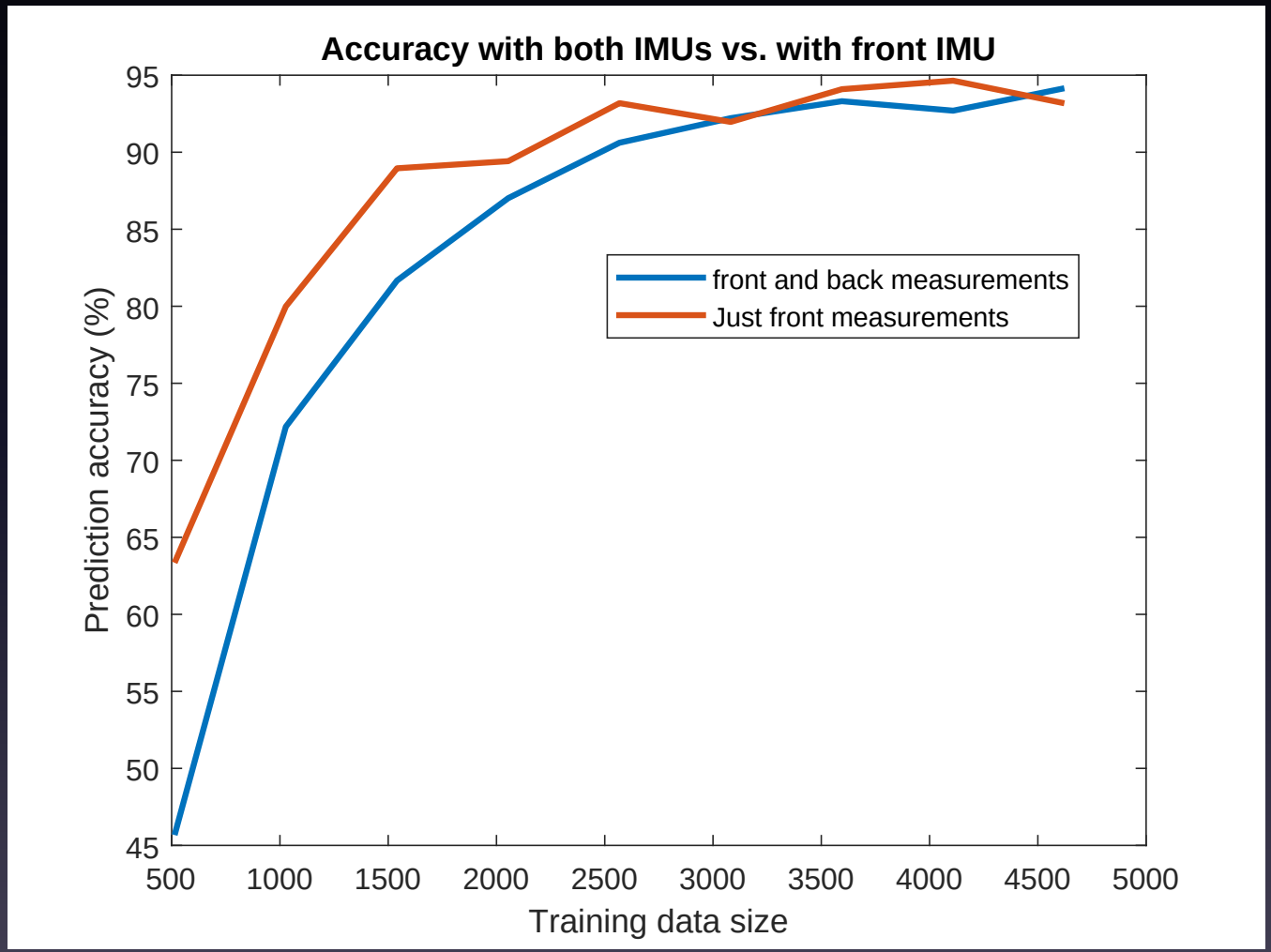


Figure: Front footfalls prediction accuracy of both IMUs vs with only the front IMU

Back sensors or both?

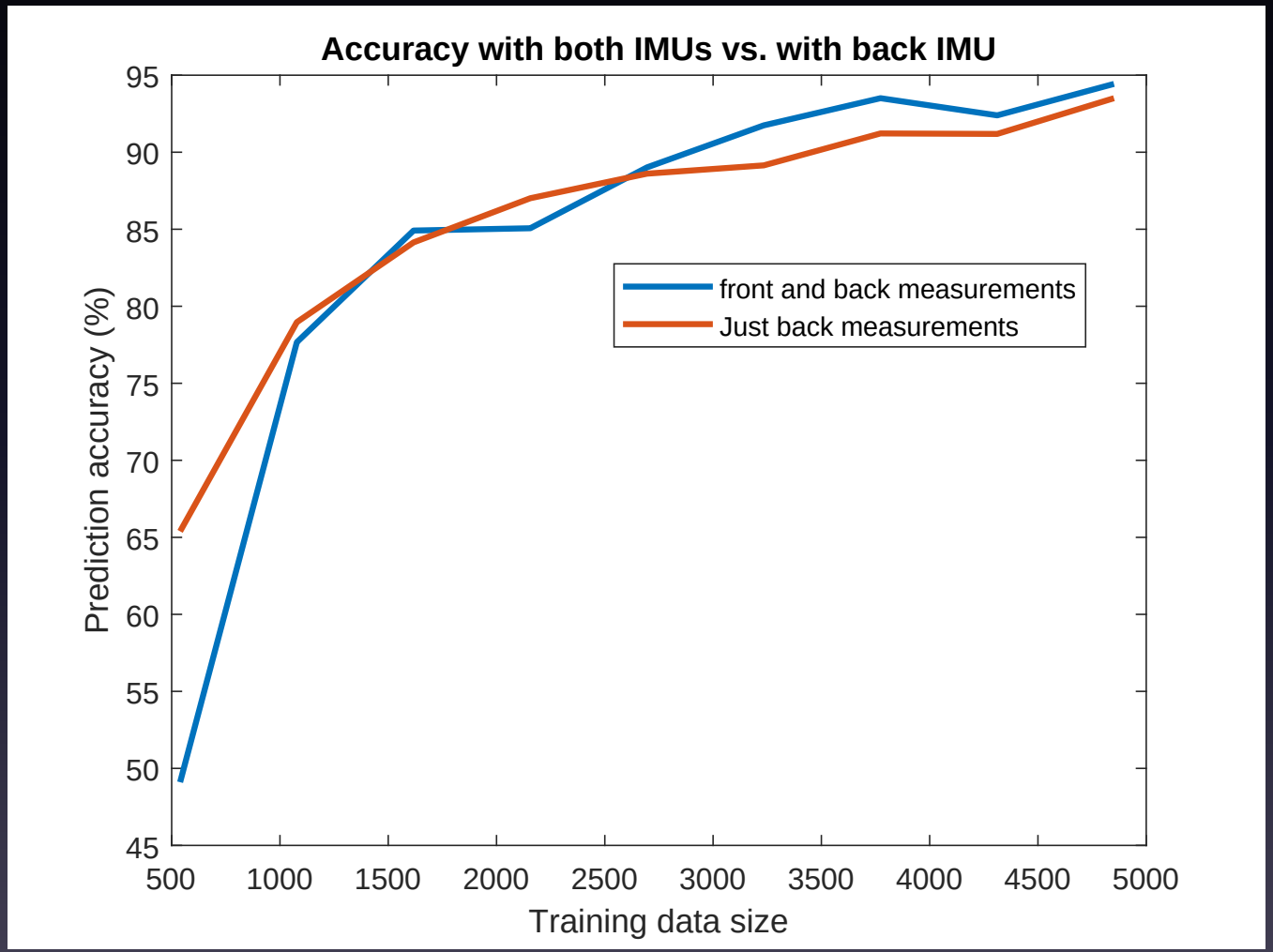


Figure: Back footfalls prediction accuracy of both IMUs vs with only the front IMU

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1. *Quadruped* Gait Estimation from *18-dimensional observations*

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2. *Data aggregation* and/or *Mirroring* to increase dataset

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Contribution:

1. *Quadruped* Gait Estimation from *18-dimensional observations*
2. *Data aggregation* and/or *Mirroring* to increase dataset
3. Algorithm is applicable to *Human Gait Analysis*

Questions