

Introduction

Problem Statement

- Gender estimation using human metrology

Objective

- Explore the use of ratios of anthropometric measurements for gender estimation
- Exploit privileged information available during training

Background

- Observable features: Information available at both training and testing
- Privileged features: Information available only at training time

Overview

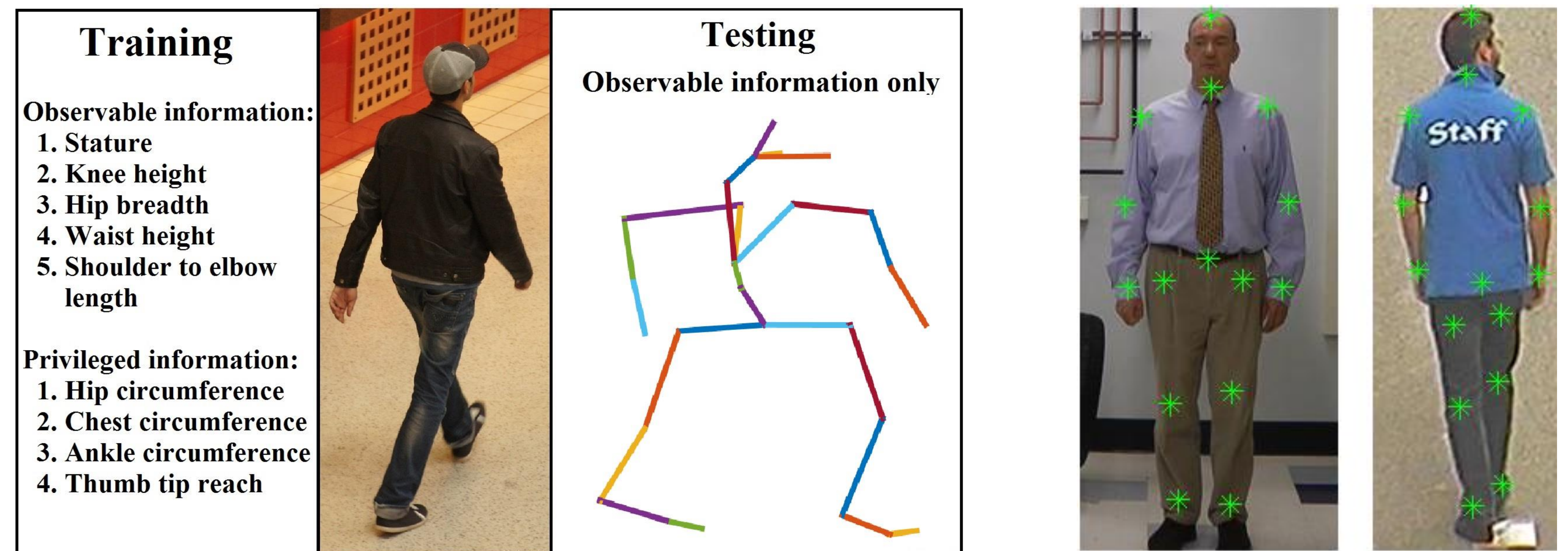


Fig. 1: Given an image, the 3D pose is estimated and the observable features are obtained. Privileged information is employed at training time and the gender of the human is estimated.

Method

Ratios of Anthropometric Measurements

- Original features: $X = NxM_1, M_1 = \frac{F_1 x(F_1 - 1)}{2}$, F_1 the number of original measurements
- Privileged features $X^* = NxM_2, M_2 = \frac{F_2 x(F_2 - 1)}{2}$, F_2 the number of privileged measurements
- Features are split to upper body (X_U) and lower body (X_L) sets

Classification

$$\text{SVM: } \min_{\xi_1, \dots, \xi_N, w, b} \left\{ \frac{1}{2} \|w\|^2 + C \sum_{i=1}^N \xi_i \right\}$$

$$\text{s. t. } y_i (\langle w_i, x_i \rangle + b) \geq 1 - \xi_i, \xi_i \geq 0, i = 1, \dots, N$$

$$\text{SVM+: } \min_{\xi_1, \dots, \xi_N, w, b} \left\{ \frac{1}{2} (\|w\|^2 + \gamma \|w^*\|^2) + C \sum_{i=1}^N \xi_i (w^*, b^*) \right\}$$

$$\text{s. t. } y_i (\langle w_i, x_i \rangle + b) \geq 1 - \xi_i (w^*, b^*) \quad \xi_i (w^*, b^*) \geq 0, \\ i = 1, \dots, N$$

$$\text{Margin Transfer: } \min_{\xi_1, \dots, \xi_N, w, b} \left\{ \frac{1}{2} \|w\|^2 + C \sum_{i=1}^N \xi_i \right\}$$

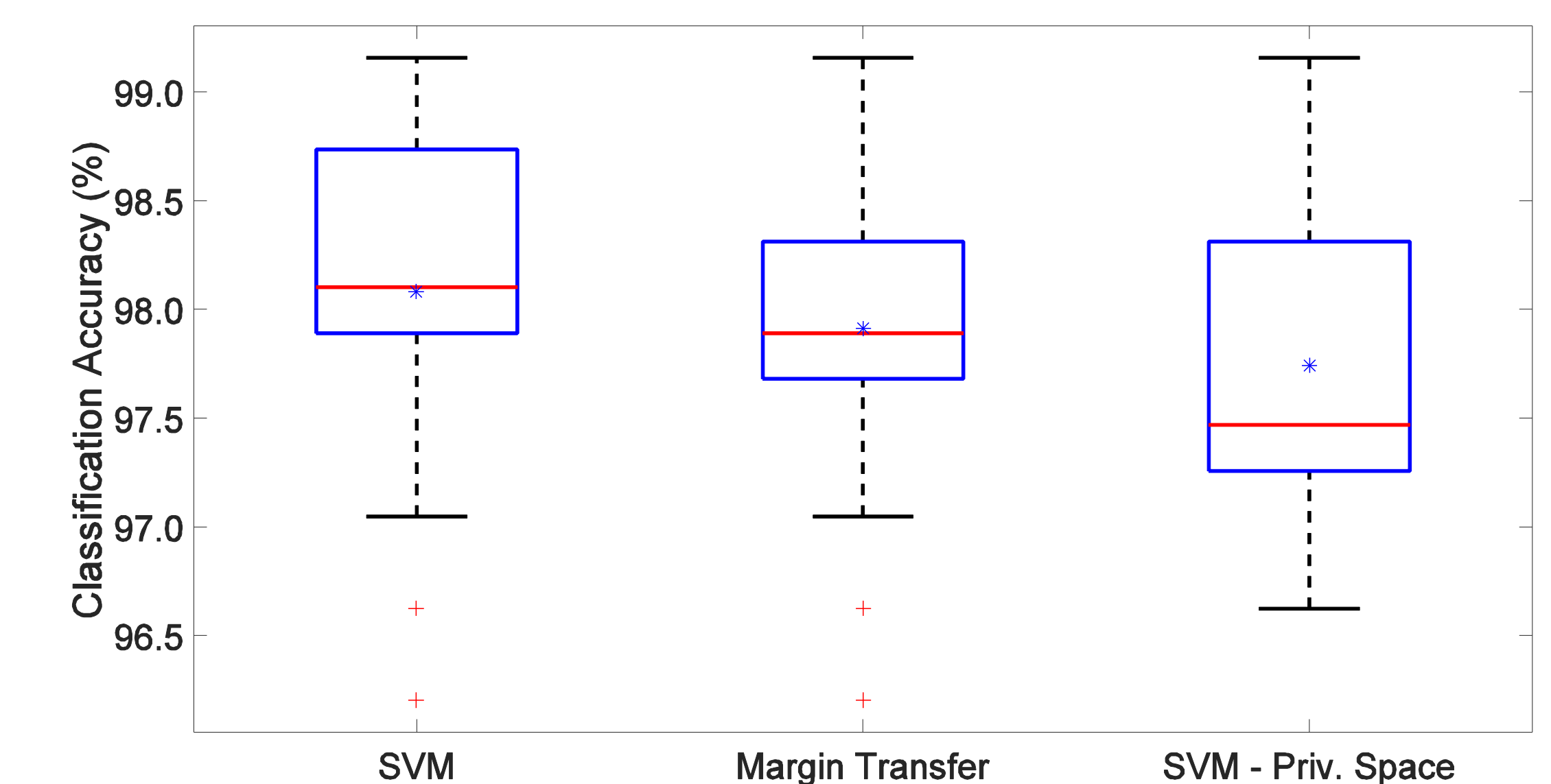
$$\text{s. t. } y_i (\langle w_i, x_i \rangle + b) \geq \rho_i - \xi_i, \xi_i \geq 0, i = 1, \dots, N$$

w the weight vector, b the bias parameter, ξ_i is the slack, C denotes the penalty parameter

Results

Testing Features	SVM	SVM+
X	97.61 ± 0.44	98.18 ± 0.56
X_L	95.34 ± 0.74	95.82 ± 0.81
X_U	76.69 ± 2.98	76.54 ± 2.95
$X + X^*$	99.10 ± 0.23	-
Cao <i>et al.</i> [1]	99.37	-

Dataset	Set of features		
	X	X_L	X_U
PaSC	71.37 ± 1.64	57.65 ± 2.82	58.06 ± 2.73
SARC3D	86.00 ± 2.00	78.00 ± 4.00	72.00 ± 4.00



Conclusions

- Using privileged information results to better accuracy
- Ratios of measurements are as discriminative as the actual values
- Predicting the gender from images is feasible

[1] D. Cao, C. Chen, D. Adjeroh and A. Ross, "Predicting gender and weight from human metrology using a copula model," in Proc. 5th IEEE International Conference on Biometrics Theory, Applications and Systems, Washington, DC, USA, Sep. 23-26 2012, pp. 162-169.

Acknowledgement: This research was funded in part by the UH Hugh Roy and Lillie Cranz Cullen Endowment Fund and the European Commission (H2020-MSCA-IF-2014), under grant agreement No 656094.

