

The Supplementary Experimental Results of Speed Invariant Gait Template

Sheng Huang¹
huangsheng@cqu.edu.cn
Ahmed Elgammal²
elgammal@cs.rutgers.edu
Dan Yang¹
dyang@cqu.edu.cn

¹ College of Computer Science
Chongqing University
Chongqing, China
² Department of Computer Science
Rutgers University,
Piscataway, NJ, USA

1 The Experiments on Mobo database



Figure 1: The gait silhouettes from left to right is from view 1 to view 6 .

The Mobo database has six views. Figure 1 shows the gait silhouettes from view 1 to view 6. Figure 2 shows the performances of the different gait recognition methods under different viewpoints. Apparently, the performances of both the compared methods and our method are similar under views 3 and 6. This is because these two views are all almost frontal to the walking people and the fluctuations of the limbs under different walking speeds make no great difference. In the other words, the walking speeds affect the silhouette deformation more weakly under these two views than the other ones. With regard to the experimental results under the views 1,2,4 and 5, SIGT, Deform and Whole all keep a prominent advantage and these experimental results also demonstrate that the mapping coefficient can do well jobs for representing gait and much more robust to the walking speed variation.

2 The Experiments on OU-ISIR Treadmill Dataset A

We draw the Cumulative Match Characteristic (CMC) curves of different template-based methods using OU-ISIR Treadmill dataset A. The blue curve indicates our method, and Figure 3 shows the superiority of our method over the compared methods.

We also conduct several experiments on OU-ISIR database A for testing SIGT when the walking speed is extremely various. Due to the 2 km/h subset is not complete, so we only choose the remaining subsets. We test different methods speed by speed and tabulate the results in tables 1,2,3,4,5 and 6.

According to the observations from the following tables, SIGT+GLPP wins 40 firsts among the 64 groups of experiments (the boldface in the tables indicates the best performance in this group of experiments which crosses all the compared methods). Thus, our method is the best method among all the algorithms. As the second best algorithm, GEI+LDA wins 24 firsts among the 64 groups. CGI+LDA gets the third place and wins 5 firsts. Whole+GLPP and Deform+GLPP are all not performance well. This is due to the dynamic parts of mapping coefficients are very insensitive to walking speed particularly when the waking speeds are extremely difference. So, It is pretty hard to extract the discriminative feature from them. Another phenomenon can be observed from the experimental results is that SIGT owns more firsts in the off-diagonal entries of the tables while GEI and other gait template owns more firsts in the diagonal entries of the tables. Two points can be inferred based on this phenomenon: SIGT performs better when the walking speed is changing more extremely; Other gait templates incorporate both static features and dynamic features which can give a much better performance when the walking speed is not changing a lot but more sensitive to the walking speed variation.

gallery\ probe	3 km/h	4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	9 km/h	10 km/h
3 km/h	98.44%	96.58%	92.00%	76.24%	50.00%	17.65%	15.29%	14.29%
4 km/h	98.44%	97.95%	96.50%	86.19%	73.85%	28.76%	25.48%	19.05%
5 km/h	89.06%	97.26%	97.50%	96.69%	87.69%	37.25%	27.39%	18.10%
6 km/h	46.88%	73.97%	96.50%	98.90%	90.77%	33.99%	23.57%	23.33%
7 km/h	35.16%	54.11%	77.50%	92.27%	96.15%	43.79%	38.22%	34.29%
8 km/h	18.75%	28.08%	28.50%	30.39%	35.38%	96.73%	96.18%	95.24%
9 km/h	19.53%	23.97%	26.50%	22.65%	22.31%	86.93%	94.90%	94.76%
10 km/h	19.53%	23.29%	21.50%	16.02%	23.08%	90.20%	98.73%	99.05%

Table 1: Recognition Accuracy of SIGT+GLPP cross different walking speeds on OU-ISIR Treadmill dataset A, SIGT+GLPP (our method) wins 40 firsts among 64 experimental groups.

gallery\ probe	3 km/h	4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	9 km/h	10 km/h
3 km/h	85.94%	74.66%	26.50%	19.89%	14.62%	9.80%	8.28%	7.14%
4 km/h	59.38%	91.78%	77.00%	46.41%	30.00%	7.84%	8.28%	9.52%
5 km/h	16.41%	62.33%	96.50%	89.50%	53.85%	9.15%	7.64%	8.09%
6 km/h	8.59%	15.75%	85.00%	95.58%	86.15%	9.15%	8.28%	9.04%
7 km/h	7.81%	9.58%	22.00%	71.82%	89.23%	16.34%	10.83%	10.00%
8 km/h	10.94%	14.38%	13.00%	14.36%	16.92%	89.54%	90.45%	89.05%
9 km/h	5.46%	7.53%	6.50%	5.52%	5.38%	83.66%	96.18%	93.81%
10 km/h	7.03%	6.84%	8.00%	7.18%	8.46%	73.20%	95.54%	99.05%

Table 2: Recognition Accuracy of Whole+GLPP cross different walking speeds on OU-ISIR Treadmill dataset A.

gallery\ probe	3 km/h	4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	9 km/h	10 km/h
3 km/h	83.59%	72.60%	27.50%	18.78%	13.85%	12.42%	7.00%	8.09%
4 km/h	53.91%	91.10%	74.00%	40.88%	27.69%	8.49%	8.91%	10.00%
5 km/h	14.84%	58.22%	96.50%	86.74%	52.31%	9.80%	7.64%	8.57%
6 km/h	8.59%	14.38%	80.00%	95.58%	85.38%	8.49%	7.64%	7.14%
7 km/h	9.37%	8.90%	21.00%	70.72%	88.46%	14.38%	8.91%	8.57%
8 km/h	8.59%	13.70%	11.00%	14.36%	16.15%	88.89%	89.17%	88.10%
9 km/h	5.46%	6.84%	6.50%	7.73%	6.15%	83.01%	94.27%	93.81%
10 km/h	3.90%	7.53%	6.50%	6.63%	8.46%	73.86%	97.45%	99.05%

Table 3: Recognition Accuracy of Deform+GLPP cross different walking speeds on OU-ISIR Treadmill dataset A.

gallery\ probe	3 km/h	4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	9 km/h	10 km/h
3 km/h	100.0%	97.26%	88.00%	66.85%	45.38%	11.11%	10.83%	9.52%
4 km/h	95.31%	97.95%	94.00%	82.32%	55.38%	9.80%	11.46%	9.52%
5 km/h	88.28%	98.63%	100.0%	96.69%	86.92%	13.73%	11.46%	6.66%
6 km/h	67.19%	84.93%	95.50%	100.0%	96.15%	17.65%	12.10%	10.00%
7 km/h	42.19%	52.74%	85.50%	97.79%	100.0%	32.03%	23.57%	19.05%
8 km/h	15.62%	25.34%	34.50%	37.02%	44.62%	98.04%	96.82%	93.33%
9 km/h	11.72%	13.70%	13.50%	13.81%	30.00%	92.81%	100.0%	97.14%
10 km/h	15.62%	12.33%	12.00%	12.71%	16.92%	92.16%	100.0%	99.52%

Table 4: Recognition Accuracy of GEI+LDA cross different walking speeds on OU-ISIR Treadmill dataset A, GEI+LDA wins 24 firsts among 64 experimental groups.

gallery\ probe	3 km/h	4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	9 km/h	10 km/h
3 km/h	94.53%	89.73%	71.50%	41.44%	24.62%	7.84%	8.91%	5.23%
4 km/h	89.84%	97.26%	96.00%	80.11%	48.46%	9.80%	7.64%	7.14%
5 km/h	73.44%	91.78%	99.50%	92.82%	82.31%	13.73%	11.46%	10.95%
6 km/h	45.31%	63.01%	90.50%	98.34%	86.15%	18.95%	11.46%	13.81%
7 km/h	27.34%	32.19%	57.50%	89.50%	100.0%	20.92%	13.38%	16.67%
8 km/h	8.59%	10.96%	8.50%	11.60%	20.77%	95.42%	96.82%	94.29%
9 km/h	9.37%	8.21%	11.50%	11.05%	16.15%	87.58%	100.0%	97.62%
10 km/h	7.81%	6.84%	9.00%	8.28%	10.00%	78.43%	98.73%	100.0%

Table 5: Recognition Accuracy of CGI+LDA cross different walking speeds on OU-ISIR Treadmill dataset A, CGI+LDA wins 5 firsts among 64 experimental groups.

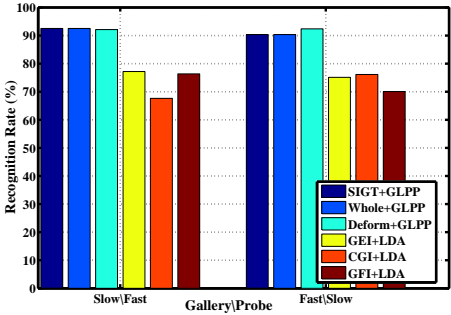
gallery\ probe	3 km/h	4 km/h	5 km/h	6 km/h	7 km/h	8 km/h	9 km/h	10 km/h
3 km/h	66.41%	60.96%	20.50%	8.84%	6.15%	5.22%	6.36%	5.23%
4 km/h	17.97%	83.56%	76.50%	28.73%	14.62%	5.88%	6.36%	6.19%
5 km/h	10.16%	37.67%	96.50%	81.77%	46.92%	9.80%	8.28%	8.57%
6 km/h	9.37%	16.44%	54.50%	95.58%	78.46%	11.11%	8.91%	7.61%
7 km/h	9.37%	8.90%	13.50%	52.49%	95.38%	15.03%	7.00%	8.57%
8 km/h	5.46%	6.16%	6.00%	8.84%	12.31%	91.50%	90.45%	79.52%
9 km/h	3.12%	4.79%	8.00%	8.84%	13.08%	79.08%	98.73%	93.81%
10 km/h	7.03%	5.47%	8.50%	7.73%	10.77%	60.78%	96.18%	100.0%

Table 6: Recognition Accuracy of GFI+LDA cross different walking speeds on OU-ISIR Treadmill dataset A, GFI+LDA wins 1 first among 64 experimental groups.

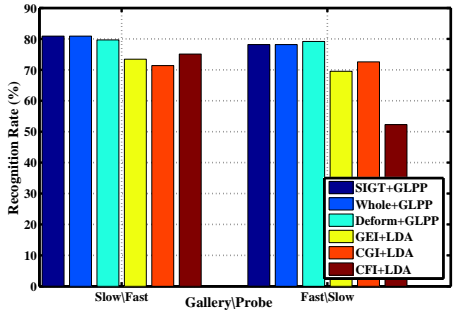
2.1 The Choice of the Number of Centers

The number of centers can affect the accuracy of manifold fitting. More centers are used for interpolation, more precise the manifold deformation can be captured, but also, more dimensions are retained. Several experiments are conducted for evaluating the influence of the number of centers.

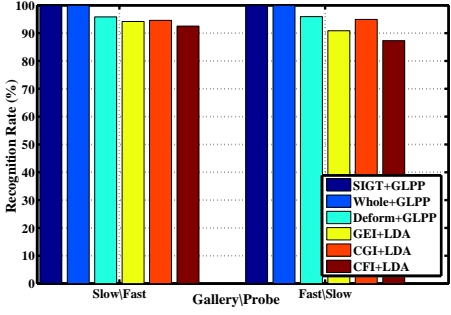
Figure 4 shows the recognition rates under different amounts of the centers on OU-ISIR database A. Based on observations of Figure 4, we can find that the recognition rate keeps steady when the amount of centers is more than eight. So, we suggest the amount of centers should be more than eight and we let it be 12 in our paper.



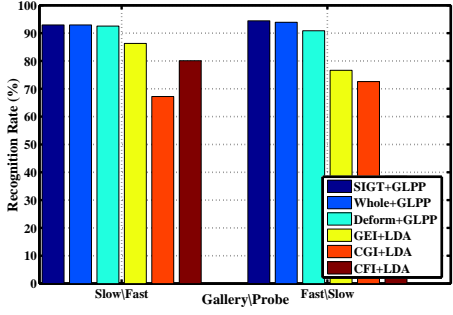
(a) View 1



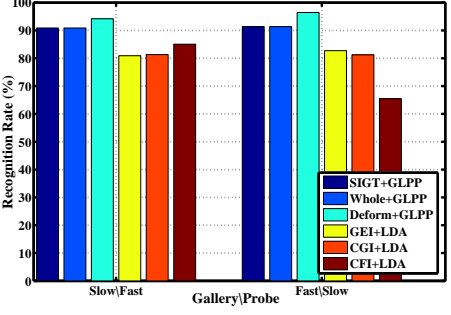
(b) View 2



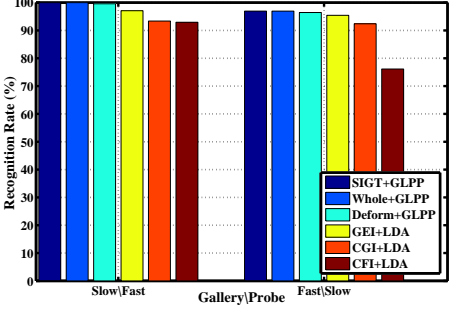
(c) View 3



(d) View 4

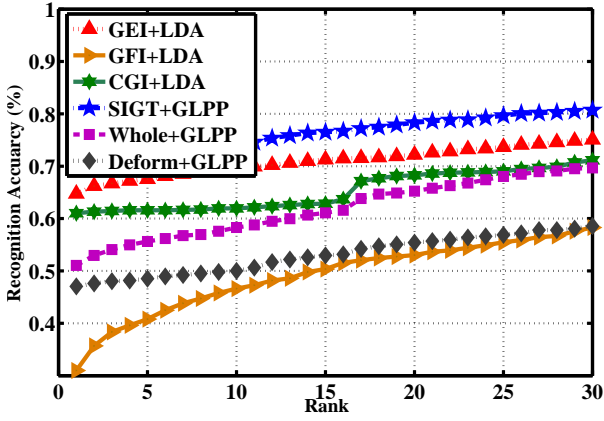


(e) View 5

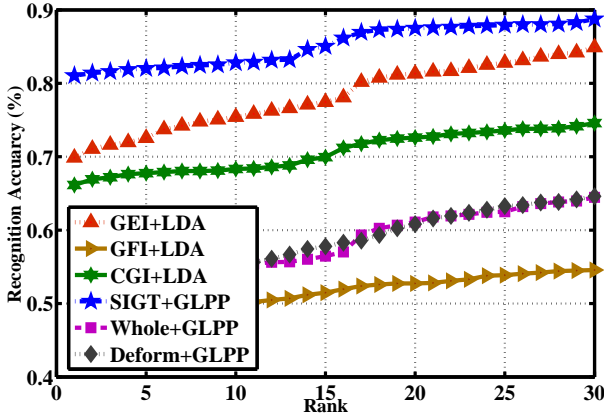


(f) View 6

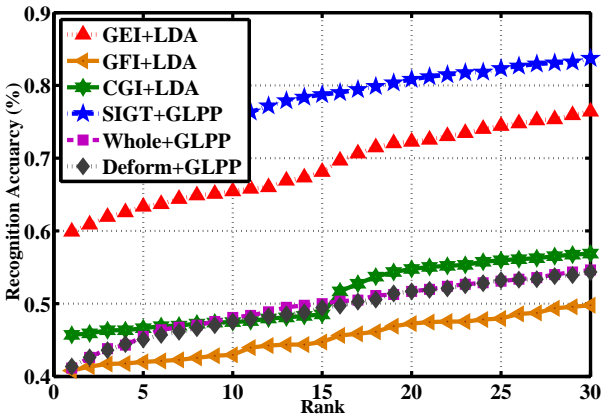
Figure 2: Experimental results (rank-1 recognition rate) with different views on Mobo database.



(a)



(b)



(c)

Figure 3: The Cumulative Match Characteristic (CMC) curves using (a) subset1, (b) subset2 and (c) subset3 of the OU-ISIR Treadmill dataset A (the blue curve is the proposed method).

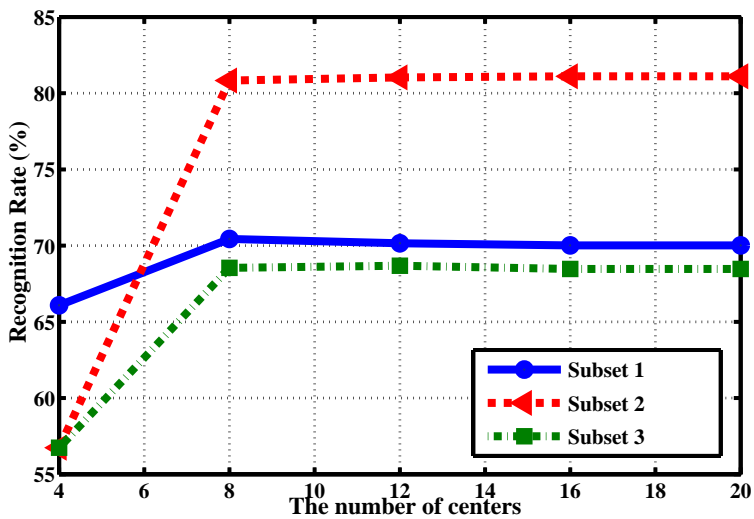


Figure 4: The recognition rates under different numbers of centers on OU-ISIR database A.