EFFICIENT MISALIGNMENT-ROBUST FACE RECOGNITION VIA LOCALITY-CONSTRAINED REPRESENTATION

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Introduction

- Current prevailing approaches [1, 2] for misaligned face recognition achieve satisfactory accuracy.
- However, the efficiency and scalability have not yet been well addressed.
- We propose a highly efficient algorithm for misaligned face recognition, namely misalignment-robust locality-constrained representation (MRLR).

Contributions

- MRLR avoids the exhaustive search in every subject of the training set, greatly reducing the computational time.
- Moreover, we could further simplify the solution by making use of the block structure of the deformable matrix. The simplified solution is not sensitive to the scale of training set and make this approach scalable.
- The proposed algorithm do not sacrifice any accuracy performance which is demonstrated by experiments.

Algorithm & Code

Require: The dictionary of training samples $\boldsymbol{D}$, the warped testing image $\boldsymbol{y}_w$, the initial transformation $\boldsymbol{\tau}$ (it can be obtained by any off-the-shelf face detector, e.g. Viola-Jones detector), a constant σ.

Ensure: The aligned face $\boldsymbol{y}$

while not converge or reach maximal iteration **do**
  Compute the locality adaptor: $\boldsymbol{c} \leftarrow \exp(\frac{\boldsymbol{D}^T\boldsymbol{y}}{\sigma})$, for all i, $\boldsymbol{c}_i \leftarrow max(\boldsymbol{c}) - \boldsymbol{c}_i$.
  $j \leftarrow 1$.
  while not converge or reach maximal iteration **do**
    $\hat{\boldsymbol{y}}_w(\boldsymbol{\tau}_{j-1}) \leftarrow \frac{\boldsymbol{y}_w \circ \boldsymbol{\tau}_{j-1}}{\|\boldsymbol{y}_w \circ \boldsymbol{\tau}_{j-1}\|_2}$, $J \leftarrow \frac{\partial}{\partial \boldsymbol{\tau}_{j-1}} \hat{\boldsymbol{y}}_w(\boldsymbol{\tau}_{j-1})|_{\boldsymbol{\tau}_{j-1}}$.
    $$\Delta\boldsymbol{\tau} = \arg\min_{\Delta\boldsymbol{\tau},\boldsymbol{x},\boldsymbol{e}} \|\boldsymbol{c} \odot \boldsymbol{x}\|_2^2 + \|\boldsymbol{e}\|_2^2$$
    $$\text{s.t.} \quad \hat{\boldsymbol{y}}_w(\boldsymbol{\tau}_j) + J\Delta\boldsymbol{\tau} = \boldsymbol{D}\boldsymbol{x} + \boldsymbol{e}$$
    $\boldsymbol{\tau}_j \leftarrow \boldsymbol{\tau}_{j-1} + \Delta\boldsymbol{\tau}$.
    $j \leftarrow j + 1$.
  end while
  $\boldsymbol{\tau} \leftarrow \boldsymbol{\tau}_j$, $\boldsymbol{\tau}_0 \leftarrow \boldsymbol{\tau}_j$.
end while
Output the final aligned face $\boldsymbol{y} = \boldsymbol{y}_w \circ \boldsymbol{e}$.

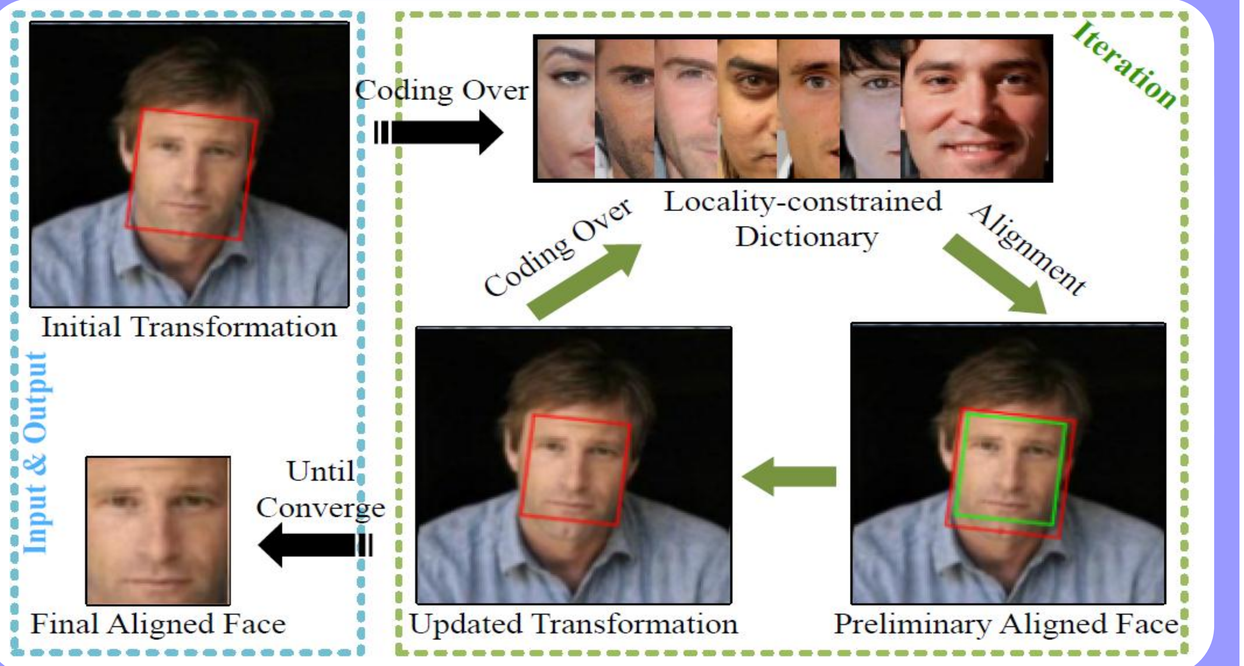
Code is available

Reference

[1] Wagner, Andrew, et al. "Toward a practical face recognition system: Robust alignment and illumination by sparse representation." IEEE Transactions on PAMI 34.2 (2012): 372-386.[2]

[2] Yang, Meng, et al. "Efficient misalignment-robust representation for real-time face recognition." ECCV 2012. Springer Berlin Heidelberg. 850-863.

Overview



Experimental Results

Table 1: The recognition accuracy (%) and running time (s) on Extended Yale B, CAS-PEAL and LFW datasets.

Method	Extended Yale B		CAS-PEAL		LFW	
	Acc.	Time	Acc.	Time	Acc.	Time
TSR	81.61	7.396	86.96	4.2695	73.63	4.3477
RASR	92.42	9.7587	89.92	5.4466	81.43	5.9201
MRR	90.95	0.7773	90.00	0.5684	78.84	0.6339
SIT	84.53	9.9823	86.76	6.0329	55.91	6.3751
MRLR1	92.31	0.6207	89.76	0.3307	**82.98**	0.3403
MRLR2	**92.53**	**0.1783**	**90.43**	**0.1462**	81.75	**0.1840**

Table 2: Running time (s) under different dimensions (image size).

Method	40×35	64×56	80×70	120×105	160×140
TSR	3.645	3.861	4.270	4.672	5.468
RASR	3.499	4.452	6.110	10.324	17.111
MRR	0.133	0.342	0.593	2.259	5.997
SIT	3.564	4.637	6.565	11.035	19.215
MRLR1	0.085	0.195	0.331	0.569	0.940
MRLR2	**0.066**	**0.118**	**0.146**	**0.303**	**0.505**

Table 3: Running time (s) under different amount of classes.

Method	10	20	40	70	100
TSR	2.1533	3.2825	5.5280	8.4034	11.5327
RASR	2.7377	4.6596	8.8647	15.4644	22.1281
MRR	0.5776	0.5928	0.6082	0.6394	0.6994
SIT	2.86	5.1996	9.9817	17.6875	27.1734
MRLR1	0.1977	0.2819	0.513	0.8552	1.4096
MRLR2	**0.1318**	**0.1373**	**0.1559**	**0.197**	**0.2616**