A PRECISE SKEW ESTIMATION ALGORITHM FOR DOCUMENT IMAGES USING KNN CLUSTERING AND FOURIER TRANSFORM

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At a Glance

Problem. Digitalized documents are not perfectly oriented.

Objective. Estimate the skew in order to fix the orientation of the document. To improve O.C.R. result for example.

Contribution. A simple and very accurate method to estimate skew angle.

Winner of the DISEC'13 contest !

Our Algorithm

Basic Idea. Use the Fourier transform.

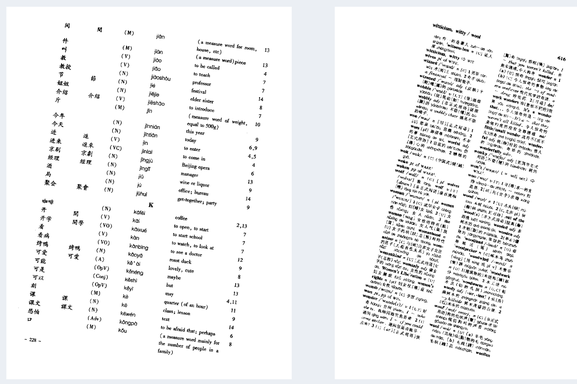
Property. A rotation in the spatial domain leads to a rotation in the magnitude spectrum.

Problem. The extraction of the angle is difficult and not precise.
⇒ The image must be preprocessed to enhance the principal direction.

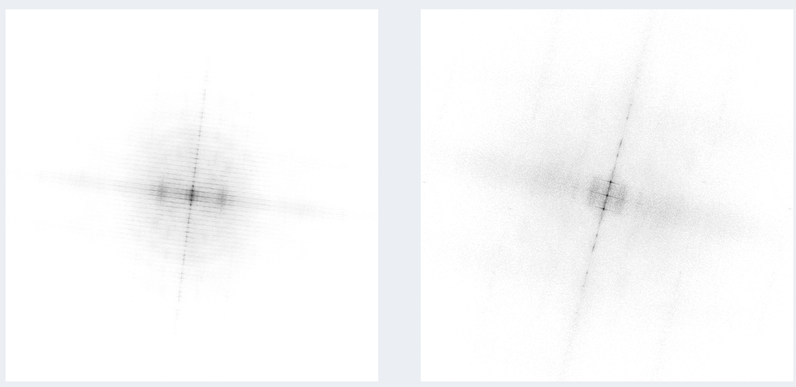
The solution:

1. Cluster all regions of the image using a KNN.
2. Generate a new image with the outlines of all clusters
   ⇒ Major orientation of the document is then enhanced.
3. Apply the Fourier Transform onto this image
   ⇒ The orientation is now enhanced in magnitude spectrum.
4. Extract the orientation of the cross
   ⇒ The skew angle of the document is then precisely deduced.

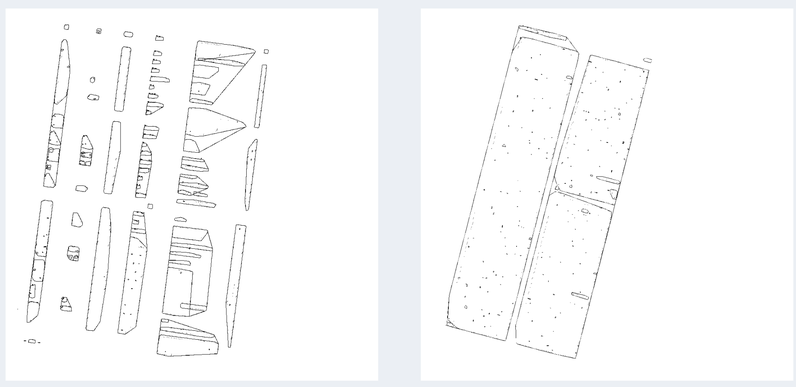
Steps



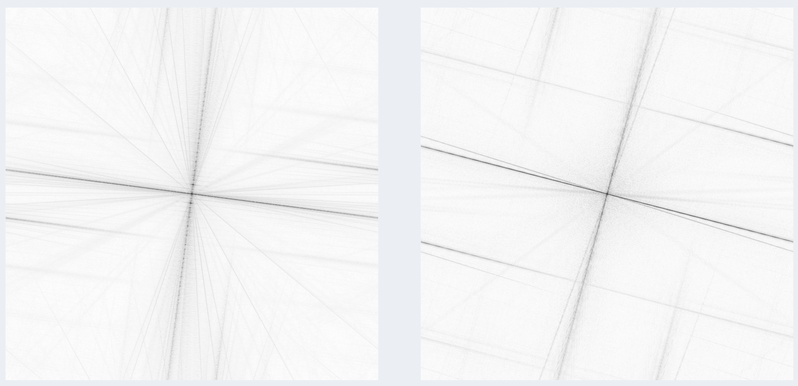
Original images



Fourier Transform of the original images



Outlines of the clusters



Fourier Transform of the outlines of the clusters

Results

Evaluation. This method reaches the first place at the DISEC'13 contest [1] among 12 methods submited.

Complete results (results are provided by the organizers of the competition)

Method	AED (°- rank)	TOP80 (°- rank)	CE (% - rank)	Overall Rank
Our	**0.072 (1)**	**0.046 (1)**	**77.48 (1)**	**1**
Ajou-SNU	0.085 (2)	0.051 (2)	71.23 (2)	2
LRDE-EPITA-b	0.097 (3)	0.053 (3)	68.32 (4)	3
Gamera	0.184 (5)	0.057 (4)	68.90 (3)	4
CVL-TUWIEN	0.103 (4)	0.058 (5)	65.42 (6)	5
HIT-ICG-a	0.730 (9)	0.061 (6)	65.74 (5)	6
HS-Hannover	0.227 (7)	0.069 (7)	58.84 (7)	7
CMC-MSU	0.184 (5)	0.089 (10)	50.39 (10)	8
HP	0.768 (12)	0.073 (8)	58.32 (8)	9
HIT-ICG-b 1	0.750 (10)	0.078 (9)	57.29 (9)	9
CST-ECSU	0.750 (10)	0.206 (11)	28.52 (11)	11
Aria	0.473 (8)	0.228 (12)	19.29 (12)	11

Details for the 3 firsts.

Method	AED (°)		TOP80 (°)		CE (%) (%)
	mean	std	TOP80	AED-TOP80	
Our	**0.072**	**0.06**	**0.046**	**0.026**	**77.48**
Ajou-SNU	0.085	0.10	0.051	0.034	71.23
LRDE-EPITA-b	0.097	0.032	0.053	0.044	68.32

Our method is the most stable.

AED: Average Error Deviation,
TOP80: AED of the Top 80% of the results,
CE: the percentage of Correct Estimations.

For all criteria, our method reaches the first place, our method is the most precise.

[1] A. Papandreou, B. Gatos, G. Louloudis, and N. Stamatopoulos. ICDAR 2013 Document Image Skew Estimation Contest (DISEC 2013). 12th International Conference on Document Analysis and Recognition, 2013. http://users.iit.demokritos.gr/~alexpap/DISEC13/