Text Line Extraction Based on Distance Map Features and Dynamic Programming

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Motivation

- Text line Segmentation (TLS) is a basic layout document task that is a pre-requisite for most KWS and HTR systems.
- TLS is usually tackled in two steps: detection and extraction
- The document layout community has currently shifted the focus to baseline detection only.
- This focus change creates the need for extraction methods that are able to capitalize on the results yielded by these new baseline detection systems.
- **We present a robust binarization-free approach inspired in path planning algorithms that uses the baseline information and a distance map in order to calculate equidistant separation frontiers**

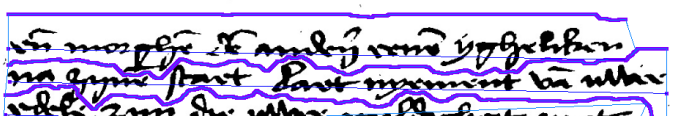
The Distance Model

- Approach inspired in DTOCS and WDTOCS ideas
- Distance map calculated on grey-scale image of page

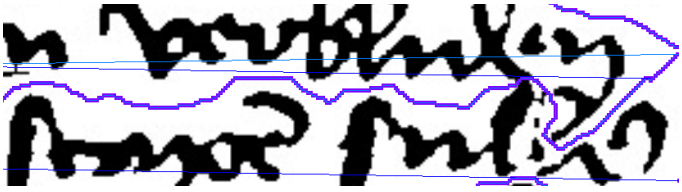
Baseline Usage and Frontier Calculation

Two levels of modelling:

- Use baselines to delimit search areas:



- Forward-Backward dynamic programming algorithm calculates best 8-connected path:



Issue Resolution

- No hard frontiers implies an optimal path will always be computed
- Collisions with black pixels can be detected and corrected

ICDAR'13 Competition Dataset Results

- ICDAR 2013 Competition corpus with standard measures used
- Two baseline scenarios: ground-truth vs automatically detected
- Automatically detected baselines were yielded by a system based on extremely randomized trees and the dbscan algorithm
- Two extraction polygon scenarios reviewed: simple projection vs dynamic programming

Method	D_R(%)	R_A(%)	F_M(%)
REGIM	40.38	35.70	37.90
AegeanUniv	77.59	77.21	77.40
PRHLT-17 + Simple Projection	89.84	83.56	86.59
ETS	86.66	86.68	86.67
Jadavpur Univ	87.78	86.90	87.34
GT. Base lines + Simple Projection	89.27	89.24	89.25
LRDE	96.70	88.20	92.25
PPSL	94.00	92.85	93.42
PRHLT-17 + Proposed Method	95.8	93.10	94.43
PortoUniv	94.47	94.61	94.54
CASIA-MSTSeg	95.86	95.51	95.68
URO-17	96.75	96.21	96.48
CVC-14	98.40	95.00	96.67
CMM	98.54	98.29	98.42
PAIS	98.49	98.56	98.52
INMC	98.68	98.64	98.66
ILSP-LWSeg-09	99.16	98.94	99.05
GT. Baselines + Proposed Method	99.62	99.58	99.60

Segmentation Results vs. HTR Results

- Experiments were carried out using the *C5 Hattem Manuscript*
- From the total of 572 leaves, a subset of 40 pages was used
- WER and CER results were calculated in a 8-block cross-validation experiment for each scenario
- Graphical error competition measure was calculated to review correlation

Extr. Method	GT	Simple Proj.		DP	
Baseline Type	NA	Straight	Line Seg.	Straight	Line Seg.
o2o	1592	1217	1306	1376	1405
F_M (%)	100	76.4	82.0	88.4	93.1
WER	34.8	36.3	35.4	37.83	35.18
CER	15.8	18.1	17.3	17.9	16.2

Conclusions

- We present a text line extraction approach that is applicable to printed as well as historical handwritten text
- The algorithm generates separation frontiers that are equidistant to the two adjacent text lines
- The method is able to capitalize on the detected baselines provided by other methods
- Our solution yields better results proportionally to the quality of the provided baselines
- We have experimentally proved that baseline detection performs the brunt of the work required for text line segmentation
- Our experimentation provides insight into the lack of correlation between the graphical error measure and the word error measure

Acknowledgements

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