

# **2016 12th IAPR Workshop on Document Analysis Systems (DAS 2016)**

**Santorini, Greece  
11-14 April 2016**



**IEEE Catalog Number: CFP1670E-POD  
ISBN: 978-1-5090-1793-5**

**Copyright © 2016 by the Institute of Electrical and Electronics Engineers, Inc  
All Rights Reserved**

*Copyright and Reprint Permissions:* Abstracting is permitted with credit to the source. Libraries are permitted to photocopy beyond the limit of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923.

For other copying, reprint or republication permission, write to IEEE Copyrights Manager, IEEE Service Center, 445 Hoes Lane, Piscataway, NJ 08854. All rights reserved.

***\*\*\*This publication is a representation of what appears in the IEEE Digital Libraries. Some format issues inherent in the e-media version may also appear in this print version.***

IEEE Catalog Number:	CFP1670E-POD
ISBN (Print-On-Demand):	978-1-5090-1793-5
ISBN (Online):	978-1-5090-1792-8

**Additional Copies of This Publication Are Available From:**

Curran Associates, Inc  
57 Morehouse Lane  
Red Hook, NY 12571 USA  
Phone: (845) 758-0400  
Fax: (845) 758-2633  
E-mail: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

CURRAN ASSOCIATES INC.  
**proceedings**  
.com

# 2016 12th IAPR Workshop on Document Analysis Systems

## DAS 2016

### Table of Contents

Message from the General Chairs and Program Chairs .....	xi
Conference Organization .....	xii
Program Committee .....	xiii
Additional Reviewers .....	xv
Sponsors .....	xvi

---

#### Camera-Based Document Image Analysis

Delaunay Triangulation-Based Features for Camera-Based Document Image Retrieval System .....	1
<i>Q. B. Dang, Marçal Rusiñol, M. Coustaty, M. M. Luqman, C. D. Tran, and Jean-Marc Ogier</i>	
High Performance OCR for Camera-Captured Blurred Documents with LSTM Networks .....	7
<i>Fallak Asad, Adnan Ul-Hasan, Faisal Shafait, and Andreas Dengel</i>	
Text Detection in Arabic News Video Based on SWT Operator and Convolutional Auto-Encoders .....	13
<i>Oussama Zayene, Mathias Seuret, Sameh M. Touj, Jean Hennebert, Rolf Ingold, and Najoua E. Ben Amara</i>	

#### Deep NN for Document Analysis

RNN Based Uyghur Text Line Recognition and Its Training Strategy .....	19
<i>Pengchao Li, Jiadong Zhu, Liangrui Peng, and Yunbiao Guo</i>	
CNN Based Transfer Learning for Historical Chinese Character Recognition .....	25
<i>Yejun Tang, Liangrui Peng, Qian Xu, Yanwei Wang, and Akio Furuhashi</i>	
Complete System for Text Line Extraction Using Convolutional Neural Networks and Watershed Transform .....	30
<i>Joan Pastor-Pellicer, Muhammad Zeshan Afzal, Marcus Liwicki, and María José Castro-Bleda</i>	

## **Document Analysis for Digital Humanities**

Historical Document Dating Using Unsupervised Attribute Learning .....	36
<i>Sheng He, Petros Samara, Jan Burgers, and Lambert Schomaker</i>	
Automatic Handwritten Character Segmentation for Paleographical Character Shape Analysis .....	42
<i>Théodore Bluche, Dominique Stutzmann, and Christopher Kermorvant</i>	
Large Scale Continuous Dating of Medieval Scribes Using a Combined Image and Language Model .....	48
<i>Fredrik Wahlberg, Lasse Mårtensson, and Anders Brun</i>	
An Interactive Transcription System of Census Records Using Word-Spotting Based Information Transfer .....	54
<i>Joan Mas, Alicia Fornés, and Josep Lladós</i>	

## **Forensic Document Analysis**

General Pattern Run-Length Transform for Writer Identification .....	60
<i>Sheng He and Lambert Schomaker</i>	
Banknote Counterfeit Detection through Background Texture Printing Analysis .....	66
<i>Albert Berenguel, Oriol Ramos Terrades, Josep Lladós, and Cristina Cañero</i>	
Performance of an Off-Line Signature Verification Method Based on Texture Features on a Large Indic-Script Signature Dataset .....	72
<i>Srikanta Pal, Alireza Alaei, Umapada Pal, and Michael Blumenstein</i>	

## **Document Image Analysis (DIA) Systems**

Word Segmentation Using the Student's-t Distribution .....	78
<i>Georgios Louloudis, Giorgos Sfikas, Nikolaos Stamatopoulos, and Basilis Gatos</i>	
MSIO: MultiSpectral Document Image Binarization .....	84
<i>Markus Diem, Fabian Hollaus, and Robert Sablatnig</i>	
SDK Reinvented: Document Image Analysis Methods as RESTful Web Services .....	90
<i>Marcel Würsch, Rolf Ingold, and Marcus Liwicki</i>	
A Compliant Document Image Classification System Based on One-Class Classifier .....	96
<i>Nicolas Sidère, Jean-Yves Ramel, Sabine Barrat, Vincent Poulain D'Andecy, and Saddok Kebairi</i>	

## **Graphics Recognition and Applications**

Automatic Hyperlinking of Engineering Drawing Documents .....	102
<i>Purnendu Banerjee, Sumit Choudhary, Supriya Das, Himadri Majumdar, Rahul Roy, and Bidyut B. Chaudhuri</i>	
Understanding Line Plots Using Bayesian Network .....	108
<i>Rathin Radhakrishnan Nair, Nishant Sankaran, Ifeoma Nwogu, and Venu Govindaraju</i>	
What You See is What You Get? Automatic Image Verification for Online News Content .....	114
<i>Sarah Elkasrawi, Andreas Dengel, Ahmed Abdelsamad, and Syed Saqib Bukhari</i>	

Semi-automatic Text and Graphics Extraction of Manga Using Eye Tracking Information .....	120
<i>Christophe Rigaud, Thanh-Nam Le, J.-C. Burie, Jean-Marc Ogier, Shoya Ishimaru, Motoi Iwata, and Koichi Kise</i>	

## **Performance Evaluation and Ground Truthing**

Creating Ground Truth for Historical Manuscripts with Document Graphs and Scribbling Interaction .....	126
<i>Angelika Garz, Mathias Seuret, Fotini Simistira, Andreas Fischer, and Rolf Ingold</i>	
Document Image Quality Assessment Based on Texture Similarity Index .....	132
<i>Alireza Alaei, Donatello Conte, Michael Blumenstein, and Romain Raveaux</i>	
Quality Prediction System for Large-Scale Digitisation Workflows .....	138
<i>Christian Clausner, Stefan Pletschacher, and Apostolos Antonacopoulos</i>	

## **Handwriting Recognition and Word Spotting**

Keyword Retrieval Using Scale-Space Pyramid .....	144
<i>Irina Rabaev, Klara Kedem, and Jihad El-Sana</i>	
A Segmentation-Free Handwritten Word Spotting Approach by Relaxed Feature Matching .....	150
<i>Anders Hast and Alicia Fornés</i>	
Increasing Robustness of Handwriting Recognition Using Character N-Gram Decoding on Large Lexica .....	156
<i>Martin Schall, Marc-Peter Schambach, and Matthias O. Franz</i>	
Word Spotting in Historical Document Collections with Online-Handwritten Queries .....	162
<i>Christian Wieprecht, Leonard Rothacker, and Gernot A. Fink</i>	

## **OCR Systems**

QATIP — An Optical Character Recognition System for Arabic Heritage Collections in Libraries .....	168
<i>Felix Stahlberg and Stephan Vogel</i>	
OCRoRACT: A Sequence Learning OCR System Trained on Isolated Characters .....	174
<i>Adnan Ul-Hasan, Syed Saqib Bukhari, and Andreas Dengel</i>	
Error Detection in Indic OCRs .....	180
<i>V. S. Vinitha and C. V. Jawahar</i>	
Multilingual OCR for Indic Scripts .....	186
<i>Minesh Mathew, Ajeet Kumar Singh, and C. V. Jawahar</i>	

## **Poster Papers 1**

A Fine-Grained Approach to Scene Text Script Identification .....	192
<i>Lluís Gómez and Dimosthenis Karatzas</i>	

OCR Error Correction Using Character Correction and Feature-Based Word Classification .....	198
<i>Ido Kissos and Nachum Dershowitz</i>	
New Sharpness Features for Image Type Classification Based on Textual Information .....	204
<i>K. S. Raghunandan, Palaiahnakote Shivakumara, G. Hemantha Kumar, Umapada Pal, and Tong Lu</i>	
Removal of Gray Rubber Stamps .....	210
<i>Soumyadeep Dey, Jayanta Mukhopadhyay, and Shamik Sural</i>	
Evaluation of the Stability of Four Document Segmentation Algorithms .....	215
<i>Sébastien Eskenazi, Petra Gomez-Krämer, and Jean-Marc Ogier</i>	
Combination of Structural and Factual Descriptors for Document Stream Segmentation .....	221
<i>Romain Karpinski and Abdel Belaïd</i>	
Document Image Quality Assessment Using Discriminative Sparse Representation .....	227
<i>Xujun Peng, Huaigu Cao, and Prem Natarajan</i>	
Modified X-Y Cut for Re-Ordering Strokes of Online Handwritten Mathematical Expressions .....	233
<i>Anh Duc Le, Hai Dai Nguyen, and Masaki Nakagawa</i>	
Automatic Synthesis of Historical Arabic Text for Word-Spotting .....	239
<i>Majeed Kassis and Jihad El-Sana</i>	
Analysis of Stroke Intersection for Overlapping PGF Elements .....	245
<i>Yan Chen, Xiaoqing Lu, Jingwei Qu, and Zhi Tang</i>	
Recognition-Based Approach of Numeral Extraction in Handwritten Chemistry Documents Using Contextual Knowledge .....	251
<i>Nabil Ghanmi and Abdel Belaïd</i>	
Entity Local Structure Graph Matching for Mislabeled Correction .....	257
<i>Nihel Kooli, Abdel Belaïd, Aurélie Joseph, and Vincent Poulain D'Andecy</i>	
Unsupervised Word Clustering Using Deep Features .....	263
<i>Mandar Kulkarni, Shirish Subhash Karande, and Sachin Lodha</i>	
An Interactive Approach with Off-Line and On-Line Handwritten Text Recognition Combination for Transcribing Historical Documents .....	269
<i>Emilio Granell, Verónica Romero, and Carlos D. Martínez-Hinarejos</i>	
Handwriting Transcription and Keyword Spotting in Historical Daily Records Documents .....	275
<i>Verónica Romero, Alejandro H. Toselli, Joan Andreu Sánchez, and Enrique Vidal</i>	
Text Extraction in Document Images: Highlight on Using Corner Points .....	281
<i>Vikas Yadav and Nicolas Ragot</i>	
A Table Detection Method for PDF Documents Based on Convolutional Neural Networks .....	287
<i>Leipeng Hao, Liangcai Gao, Xiaohan Yi, and Zhi Tang</i>	
Efficient Document Image Segmentation Representation by Approximating Minimum-Link Polygons .....	293
<i>George Retsinas, Georgios Louloudis, Nikolaos Stamatopoulos, and Basilis Gatos</i>	

Page Segmentation for Historical Document Images Based on Superpixel Classification with Unsupervised Feature Learning .....	299
<i>Kai Chen, Cheng-Lin Liu, Mathias Seuret, Marcus Liwicki, Jean Hennebert, and Rolf Ingold</i>	
Isolated Handwritten Digit Recognition Using oBIFs and Background Features .....	305
<i>Abdeljalil Gattal, Chawki Djeddi, Youcef Chibani, and Imran Siddiqi</i>	
Fuzzy Integral for Combining SVM-Based Handwritten Soft-Biometrics Prediction .....	311
<i>Nesrine Bouadjenek, Hassiba Nemmour, and Youcef Chibani</i>	
<b>Poster Papers 2</b>	
OCR Accuracy Prediction Method Based on Blur Estimation .....	317
<i>Van-Cuong Kieu, Florence Cloppet, and Nicole Vincent</i>	
Marginal Noise Reduction in Historical Handwritten Documents — A Survey .....	323
<i>Arpita Chakraborty and Michael Blumenstein</i>	
Preserving Text Content from Historical Handwritten Documents .....	329
<i>Arpita Chakraborty and Michael Blumenstein</i>	
Globally Optimal Text Line Extraction Based on K-Shortest Paths Algorithm .....	335
<i>Luan Wang, Seiichi Uchida, Wei Fan, and Jun Sun</i>	
Natural Scene Character Recognition Using Robust PCA and Sparse Representation .....	340
<i>Zheng Zhang, Yong Xu, and Cheng-Lin Liu</i>	
Recognition of Greek Polytonic on Historical Degraded Texts Using HMMs .....	346
<i>Vassilis Katsouros, Vassilis Papavassiliou, Fotini Simistira, and Basilis Gatos</i>	
Effective Candidate Component Extraction for Text Localization in Born-Digital Images by Combining Text Contours and Stroke Interior Regions .....	352
<i>Kai Chen, Fei Yin, and Cheng-Lin Liu</i>	
Interactive Definition and Tuning of One-Class Classifiers for Document Image Classification .....	358
<i>Nathalie Girard, Roger Trullo, Sabine Barrat, Nicolas Ragot, and Jean-Yves Ramel</i>	
Election Tally Sheets Processing System .....	364
<i>Juan Ignacio Toledo, Alicia Fornés, Jordi Cucurull, and Josep Lladós</i>	
Human-Document Interaction Systems — A New Frontier for Document Image Analysis .....	369
<i>Dimosthenis Karatzas, Vincent Poulain D'Andecy, Marçal Rusiñol, Antonio Chica, and Pere-Pau Vazquez</i>	
Named Entity Recognition from Unstructured Handwritten Document Images .....	375
<i>Chandranath Adak, Bidyut B. Chaudhuri, and Michael Blumenstein</i>	
Visual Analysis System for Features and Distances Qualitative Assessment: Application to Word Image Matching .....	381
<i>Frédéric Rayar, Tanmoy Mondal, Sabine Barrat, Fatma Bouali, and Gilles Venturini</i>	
An Adaptive Zoning Technique for Word Spotting Using Dynamic Time Warping .....	387
<i>A. Papandreou, Basilis Gatos, and K. Zagoris</i>	
Visual Script and Language Identification .....	393
<i>Angelos Nicolaou, Andrew D. Bagdanov, Lluís Gómez, and Dimosthenis Karatzas</i>	

Handwritten and Machine-Printed Text Discrimination Using a Template Matching Approach .....	399
<i>Mehryar Emambakhsh, Yulan He, and Ian Nabney</i>	
Making Europe's Historical Newspapers Searchable .....	405
<i>Clemens Neudecker and Apostolos Antonacopoulos</i>	
Keyword Spotting in Handwritten Documents Using Projections of Oriented Gradients .....	411
<i>George Retsinas, Georgios Louloudis, Nikolaos Stamatopoulos, and Basilis Gatos</i>	
Online Arabic Handwriting Recognition with Dropout Applied in Deep Recurrent Neural Networks .....	417
<i>Rania Maalej, Najiba Tagougui, and Monji Kherallah</i>	
Automatic Selection of Parameters for Document Image Enhancement Using Image Quality Assessment .....	422
<i>Ritu Garg and Santanu Chaudhury</i>	
A Simple and Effective Solution for Script Identification in the Wild .....	428
<i>Ajeet Kumar Singh, Anand Mishra, Pranav Dabral, and C. V. Jawahar</i>	
Camera-Based System for User Friendly Annotation of Documents .....	434
<i>Yusuke Oguma and Koichi Kise</i>	
Searching Corrupted Document Collections .....	440
<i>Jason Soo and Ophir Frieder</i>	
<b>Author Index</b> .....	<b>446</b>