Reconocimiento de Escritura
Lecture 5/5
More Layout Analysis and Applications

Daniel Keysers

Jan/Feb-2008

Outline

Three More Layout Analysis Tasks

Page Frame Detection

Urdu/Arabic Document Analysis

Block Type Classification

Applications

Document Reflow

Visual Document Search

iDesk

Dewarping

Document Retrieval and Browsing

Document Image to HTML Conversion

HTML Layout Verification

Bibliographic Meta-Data Extraction

Arc and Line Detection

More Applications of RAST

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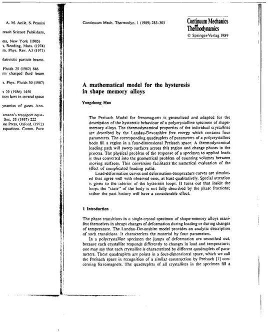
Page Frame Detection

- motivation
  - textual and non-textual noise
  - textual noise results in OCR errors
- idea: detect page contents area
- RAST for page frame detection
  - solves the problem in a general framework
  - robust against the amount of noise
  - robust against overlapping noise



A. M. Anile, S. Pennisi

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Fluids 25 (1982) 846
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Soc. 53 (1957) 222
on Press, Oxford, (1972)
equations. Comm. Pure

Continuum Mech. Thermodyn. 1 (1989) 283–303

Continuum Mechanics and Thermodynamics
© Springer-Verlag 1989

A mathematical model for the hysteresis in shape memory alloys

Yongzhong Huo

The Preisach Model for ferromagaets is generalized and adapted for the description of the hysteretic behaviour of a polycrystalline specimen of shape-memory alloys. The thermodynamical properties of the individual crystallites are described by the Landau-Devonshire free energy which contains four parameters. The corresponding quadruplets of parameters of a polycrystalline body fill a region in a four-dimensional Preisach space. A thermodynamical loading path will sweep surfaces across this region and change phases in the process. The physical problem of the response of a specimen to applied loads is thus converted into the geometrical problem of counting volumes between moving surfaces. This conversion facilitates the numerical evaluation of the effect of complicated loading paths.

Load-deformation curves and deformation-temperature curves are simulated that agree well with observed ones, at least qualitatively. Special attention is given to the interior of the hysteresis loops. It turns out that inside the loops the "state" of the body is not fully described by the phase fractions; rather the past history will have a considerable effect.

1 Introduction

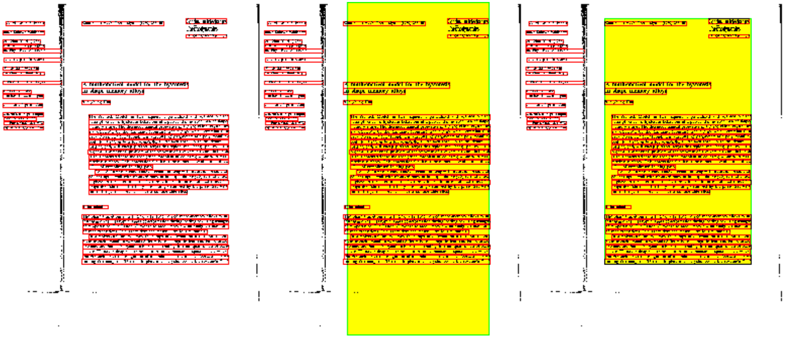
The phase transitions in a single-crystal specimen of shape-memory alloys manifest themselves in abrupt changes of deformation during loading or during changes of temperature. The Landau-Devonshire model provides an analytic description of such transitions. It characterizes the material by four parameters.

In a polycrystalline specimen the jumps of deformation are smoothed out, because each crystallite responds differently to changes in load and temperature; one may say that each crystallite is characterized by different quadruplets of parameters. These quadruplets are points in a four-dimensional space, which we call the Preisach space in recognition of a similar construction by Preisach [1] concerning ferromagnets. The quadruplets of all crystallites in the specimen fill a

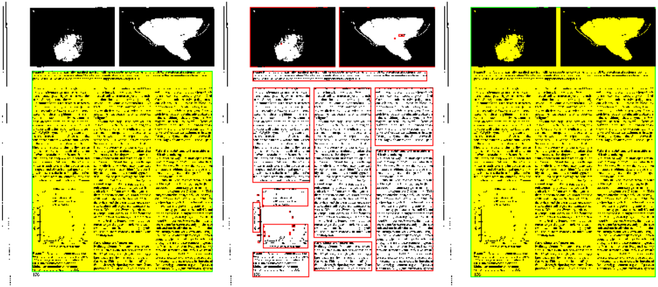
Page Frame Detection Method

- two-phase approach
- (1) determine left and right side ($\rightarrow$ RAST)
  - use text-lines
  - the quality function has two parts:
    - the left and right border should have many text-line ends on the inside of the page frame
    - but they should not have many text-line ends on the outside of the page frame
  - use soft term (bounded error) of the form $\max(0, 1 - d^2/\epsilon^2)$
- (2) determine upper and lower side
  - include all character bounding boxes in the range
  - adjust for page numbers and images

Illustration of the Two Steps



Inclusion of Images and Page Numbers



center image: zones detected by Voronoi algorithm

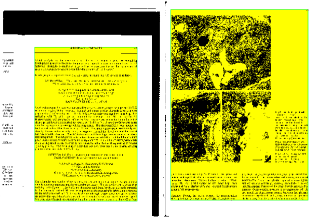
Page Frame Detection Results

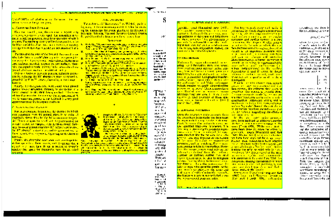
Performance measure	Error rate (%)
Area overlap	4.0
Connected components classification	1.6
Ground-truth zone detection	2.8

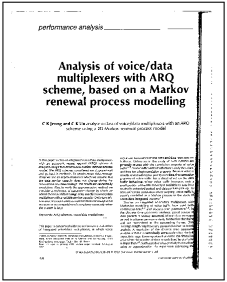
Application	Error rate (%)	
	No PFD	With PFD
OCR	4.3	1.7
Layout based document image retrieval	7.0	5.4

evaluated on the UW-III dataset with every tenth document used as training set

Examples of Page Frame Detection



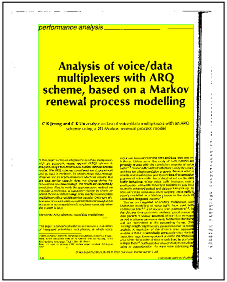




performance analysis

Analysis of voice/data multiplexers with ARQ scheme, based on a Markov renewal process modelling

C K Jeong and C K Un analyse a class of voice/data multiplexers with an ARQ scheme using a 2D Markov renewal process model



performance analysis

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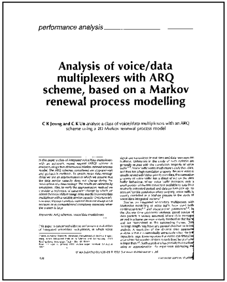

performance analysis

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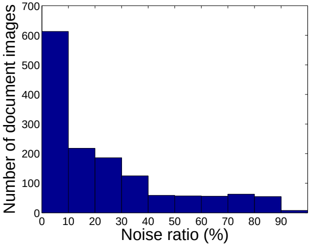
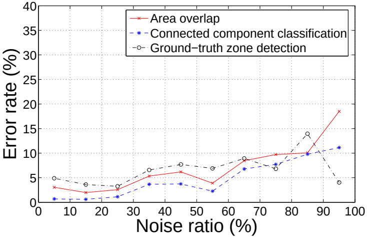
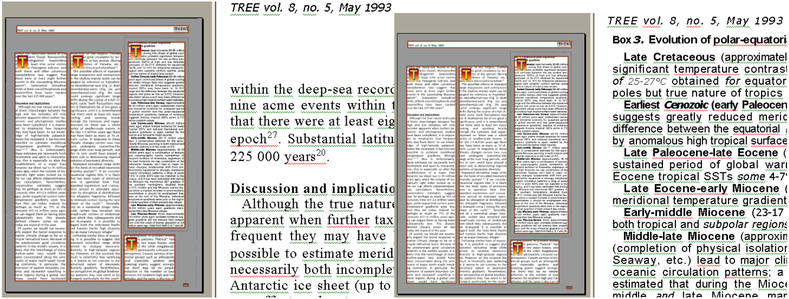
Robustness against Noise

Noise ratio = outside pixels / total pixels





Example of OCR Difference



TREE vol. 8, no. 5, May 1993

within the deep-sea record
nine acme events within t
that there were at least eig
epoch[27]. Substantial latitu
225 000 years[20].

Discussion and implicatio
Although the true nature
apparent when further tax
frequent they may have
possible to estimate merid
necessarily both incomple
Antarctic ice sheet (up to

TREE vol. 8, no. 5, May 1993

Box *3.* Evolution of polar-equatori
Late Cretaceous (approximatel
significant temperature contras
of 25-27°C obtained *for* equator
poles but true nature of tropics
Earliest *Cenozoic* (early Paleocen
suggests greatly reduced meric
difference between the equatorial
by anomalous high tropical surface
Late Paleocene-late Eocene (
sustained period of global war
Eocene tropical SSTs *some* 4-7
Late Eocene-early Miocene (
meridional temperature gradient
Early-middle Miocene (23-17
both tropical and *subpolar regions*
Middle-late Miocene (approxin
(completion of physical isolatio
Seaway, etc.) lead to major cli
oceanic circulation patterns; a
estimated that during the Mioce
middle *and* late Miocene mar

Screen-shot of Omnipage 14 showing the recognized text of the original document (left) and the document cleaned using page frame detection (right). Note that the reading order of the text has changed, probably due to the slightly changed geometry.

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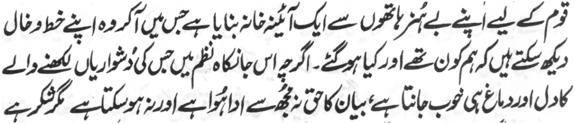
Adaptation to Urdu/Arabic Script

"We are often reminded that English is blessed with one of the simplest scripts in the world." (Nagy 2000)

Motivation for Urdu Document Analysis

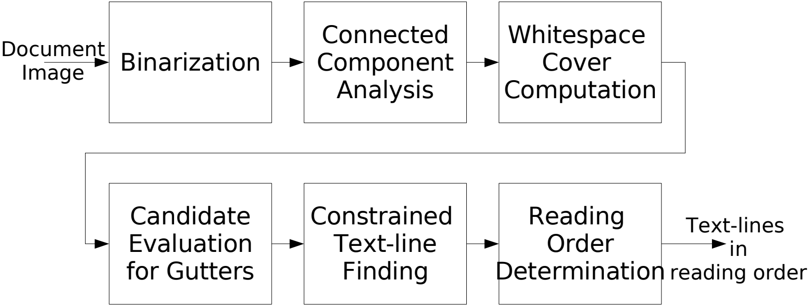
- Urdu has more than 150 million speakers
- written in Arabic script with above 20,000 ligatures



قوم کے لیے اُپنے بے ہُنر ہاتھوں سے ایک آئینہ خانہ بنایا ہے جس میں آ کر وہ اپنے خط و خال
دیکھ سکتے ہیں کہ ہم کون تھے اور کیا ہو گئے۔ اگرچہ اس جانکاہ نظم میں جس کی دُشواریاں لکھنے والے
کا دل اور دماغ ہی خوب جانتا ہے، بیان کا حق نہ مجھ سے ادا ہُوا ہے اور نہ ہو سکتا ہے مگر شکر ہے

- no Urdu OCR and layout analysis system
- large potential market

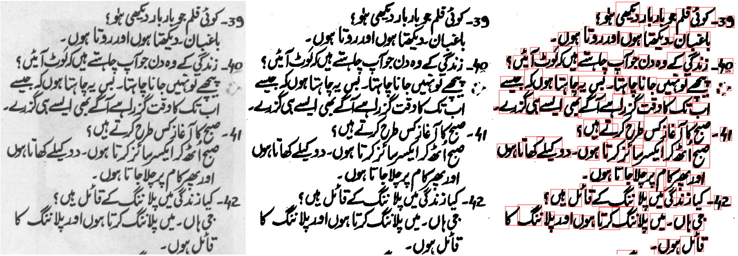
Diagram of Approach


Document Image
Binarization
Connected Component Analysis
Whitespace Cover Computation
Candidate Evaluation for Gutters
Constrained Text-line Finding
Reading Order Determination
Text-lines in reading order

Approach for Urdu Documents

1. Find empty whitespace rectangles that completely cover the page background.
2. The whitespace rectangles are evaluated as candidates for column separators or gutters based on their aspect ratio, width, and proximity to text-sized connected components.
3. Find text-lines that respect the columnar structure of the document.
4. Determine the reading order of the text-lines using constraints on the geometric arrangement of text-line segments on the page. (Change left-to-right model to right-to-left model.)

Preprocessing



39- کوئی فلم جو بار بار دیکھی ہو؟
باغبان۔ دیکھتا ہوں اور روتا ہوں۔
40- زندگی کے وہ دن جو آپ چاہتے ہیں کہ لوٹ آئیں؟
پیچھے تو نہیں جانا چاہتا۔ بس یہ چاہتا ہوں کہ جیسے
اب تک کا وقت گزرا ہے آگے بھی ایسے ہی گزرے۔
41- صبح کا آغاز کس طرح کرتے ہیں؟
صبح اٹھ کر ایکسرسائز کرتا ہوں۔ دو کیلے کھاتا ہوں
اور پھر کام پر چلا جاتا ہوں۔
42- کیا زندگی میں پلاننگ کے قائل ہیں؟
جی ہاں۔ میں پلاننگ کرتا ہوں اور پلاننگ کا
قائل ہوں۔

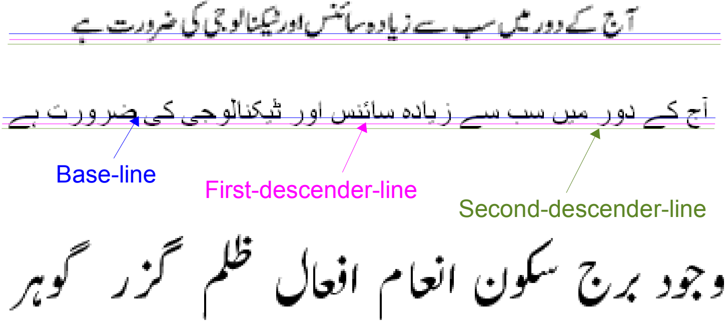
Column Separators

The whitespace rectangles are evaluated as candidates for column separators based on the following constraints:

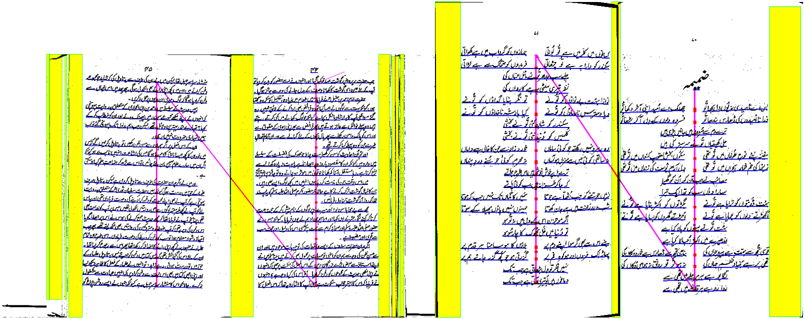
1. Column-separating rectangles must have an aspect ratio of at least 1:3
2. Column-separating rectangles must have a width of at least 1.5 times of the mode of the distribution of widths of inter-word spaces.
3. Column-separating rectangles must be adjacent to at least four character-sized connected components on their left or their right side.

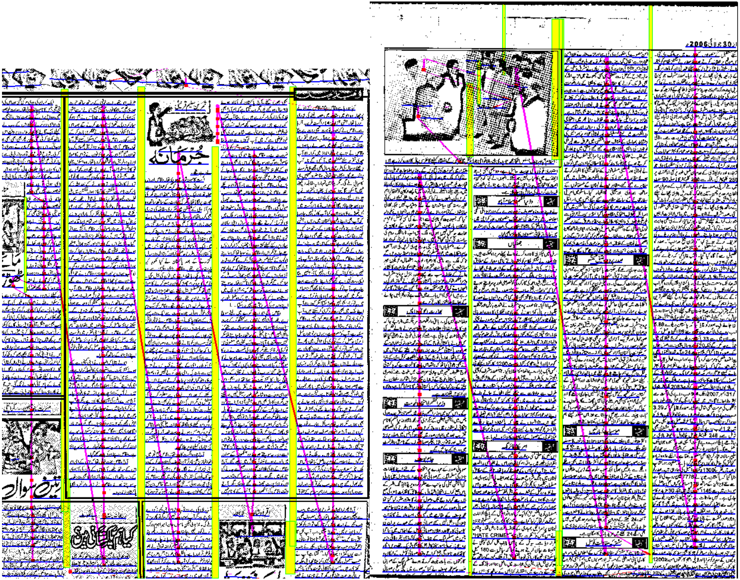
Constrained Text-Line Finding

Use Column Separators as Obstacles
adapt Roman script text-line model for Urdu/Arabic:
use two descender lines


آج کے دور میں سب سے زیادہ سائنس اور ٹیکنالوجی کی ضرورت ہے
آج کے دور میں سب سے زیادہ سائنس اور ٹیکنالوجی کی ضرورت ہے
Base-line
First-descender-line
Second-descender-line
وجود برج سکون انعام افعال ظلم گزر گوہر

Urdu Document Layout Analysis Examples





Note that images and graphics were not removed here, so they result in some spurious text-lines.

Text-Line Detection Accuracy Results

25 images of Urdu text from different sources

five classes: *book*, *poetry*, *digest*, *magazine*, and *newspaper* with 5 images each

Layout ($n =$)	Correct	Split	Merged	Missed
Book (234)	**91.45**	4.27	0.00	4.27
Poetry (286)	**92.31**	4.55	0.00	3.15
Digest (702)	**80.63**	11.54	0.00	7.84
Magazine (1158)	**90.07**	4.14	0.86	4.75
Newspaper (819)	**72.16**	7.81	4.15	15.87

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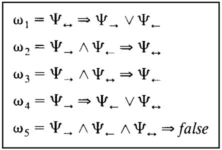
Block Types

math



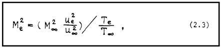
$$\omega_1 = \Psi_{\leftrightarrow} \Rightarrow \Psi_{\rightarrow} \vee \Psi_{\leftarrow}$$

$$\omega_2 = \Psi_{\rightarrow} \wedge \Psi_{\leftarrow} \Rightarrow \Psi_{\leftrightarrow}$$

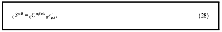
$$\omega_3 = \Psi_{\rightarrow} \wedge \Psi_{\leftrightarrow} \Rightarrow \Psi_{\leftarrow}$$

$$\omega_4 = \Psi_{\rightarrow} \Rightarrow \Psi_{\leftarrow} \vee \Psi_{\leftrightarrow}$$

$$\omega_5 = \Psi_{\rightarrow} \wedge \Psi_{\leftarrow} \wedge \Psi_{\leftrightarrow} \Rightarrow \mathit{false}$$

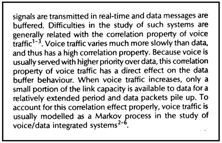


$$M_e^2 = \left(M_\infty^2 \frac{u_e^2}{u_\infty^2} \right) \Big/ \frac{T_e}{T_\infty} \,, \qquad (2.3)$$

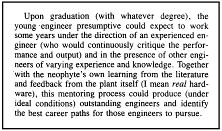


$$_0S^{\alpha\beta} = {}_0C^{\alpha\beta\rho\lambda}\, {}_0\epsilon'_{\rho\lambda}, \qquad (28)$$

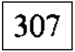
text



signals are transmitted in real-time and data messages are buffered. Difficulties in the study of such systems are generally related with the correlation property of voice traffic$^{1-3}$. Voice traffic varies much more slowly than data, and thus has a high correlation property. Because voice is usually served with higher priority over data, this correlation property of voice traffic has a direct effect on the data buffer behaviour. When voice traffic increases, only a small portion of the link capacity is available to data for a relatively extended period and data packets pile up. To account for this correlation effect properly, voice traffic is usually modelled as a Markov process in the study of voice/data integrated systems$^{2-6}$.



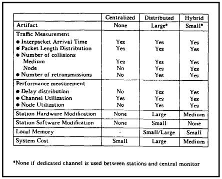
Upon graduation (with whatever degree), the young engineer presumptive could expect to work some years under the direction of an experienced engineer (who would continuously critique the performance and output) and in the presence of other engineers of varying experience and knowledge. Together with the neophyte's own learning from the literature and feedback from the plant itself (I mean *real* hardware), this mentoring process could produce (under ideal conditions) outstanding engineers and identify the best career paths for those engineers to pursue.



307

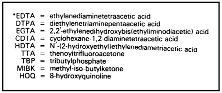
Block Types

table

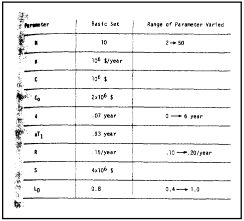


	Centralized	Distributed	Hybrid
Artifact	None	Large*	Small*
Traffic Measurement			
● Interpacket Arrival Time	Yes	Yes	Yes
● Packet Length Distribution	Yes	Yes	Yes
● Number of collisions			
Medium	Yes	Yes	Yes
Node	No	Yes	Yes
● Number of retransmissions	No	Yes	Yes
Performance measurement			
● Delay distribution	No	Yes	Yes
● Channel Utilization	Yes	Yes	Yes
● Node Utilization	No	Yes	Yes
Station Hardware Modification	None	Large	Medium
Station Software Modification	None	Small	None
Local Memory	-	Small/Large	Small
System Cost	Small	Large	Medium

*None if dedicated channel is used between stations and central monitor

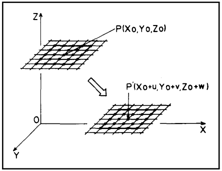


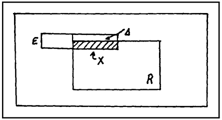
*EDTA	=	ethylenediaminetetraacetic acid
DTPA	=	diethylenetriaminepentaacetic acid
EGTA	=	2,2'-ethylenedihydroxybis(ethyliminodiacetic) acid
CDTA	=	cyclohexane-1,2-diaminetetraacetic acid
HDTA	=	N'-(2-hydroxyethyl)ethylenediametriacetic acid
TTA	=	thenoyltrifluoroacetone
TBP	=	tributylphosphate
MIBK	=	methyl-iso-butylketone
HOQ	=	8-hydroxyquinoline

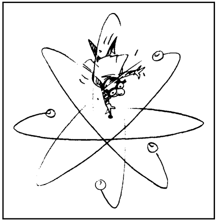


Parameter	Basic Set	Range of Parameter Varied
N	10	2 → 50
β	10^6 \$/year	
C	10^6 \$	
C_0	2×10^6 \$	
δ	.07 year	0 → 6 year
ΔT_1	.93 year	
R	.15/year	.10 → .20/year
S	4×10^6 \$	
L_D	0.8	0.4 → 1.0

drawing

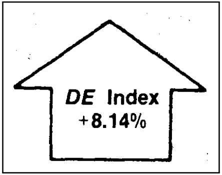




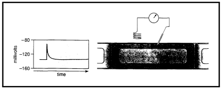


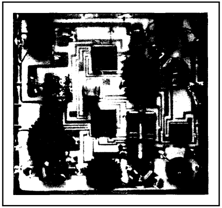
Block Types

logo

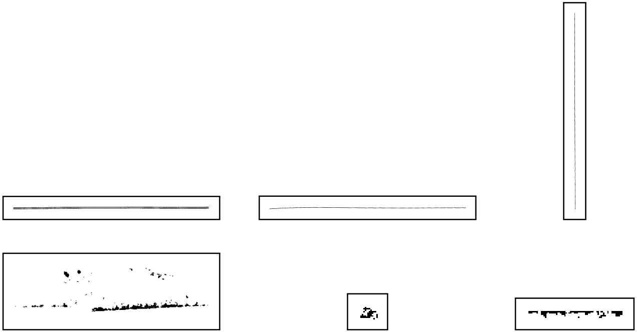


halftone





Block Types



ruling

speckles

Related Work

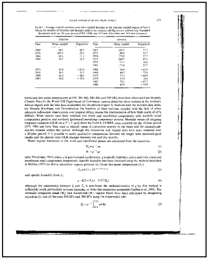
reference	# pages	# zones	# types	error [%]
Inglis and Witten, 1995	1001	13831	3	6.7
Liang et al., 1996	979	13726	8	5.4
Sivaramakrishnan et al., 1995	979	13726	9	3.3
Wang et al., 2000	1600	24177	9	2.5
Wang et al., 2006	1600	24177	9	1.5
this work	713	13811	8	1.5

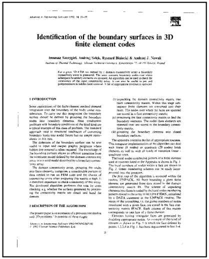
features used in the literature:

connected components, run lengths, cross-correlation between scan-lines, vertical projection profiles, wavelet coefficients, learned masks, black pixel distribution

Data Set Used

- University of Washington III (UW-III) database
- 1600 English document images
- 24177 homogeneous manually labeled page segments/blocks
- degradation types: direct scan, photocopies → duplicates
- avoid duplicates here → 713 documents
- speckles not annotated but important → automatic extraction

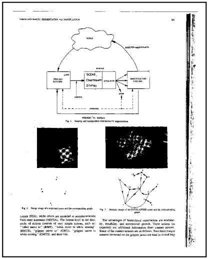


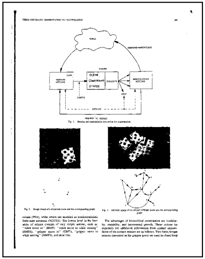


Identification of the boundary surfaces in 3D finite element codes

Ireneusz Szczygieł, Andrzej Sałęk, Ryszard Białecki & Andrzej J. Nowak

1 INTRODUCTION





Features

- Tamura texture feature histogram (TTFH)
- relational invariant feature histograms (RIFH)
- down-scaled image 32 × 32 (DSI)

- number, mean, and variance of run-lengths (RL{B,W}{X,Y,M,S}V)
- run-length histograms (RL{B,W}{X,Y,M,S}H)
- connected components size histograms (CCXH, CCYH, CCXYH)
- connected components nearest neighbor histogram (CCNNH)
- fill ratio after horizontal smearing (FR)

Classification

- nearest neighbor with leaving-one-out cross-validation
- Jensen-Shannon divergence for histograms,
  Euclidean distance for other features
- weights proportional to inverse of error rate

- for fast and small classifier
  - log-linear classifier using maximum entropy criterion
  - 50/50 split of data for evaluation

Experimental Results — Single Features

feature	dim.	extr. [s]	error [%]
TTFH	512	5.51	**3.4**
RIFH	512	12.59	7.8
DSI	1024	0.01	8.1
FR	1	0.02	27.3
CCXH	8	0.04	14.5
CCYH	8	0.04	14.9
CCXYH	64	0.04	6.2
CCNNH	8	0.05	19.0

feature	dim.	extr.[s]	error [%]
RLBXH	8	0.01	7.9
RLWXH	8	0.01	5.1
RLBYH	8	0.01	8.2
RLWYH	8	0.01	5.6
RLBMH	8	0.01	11.8
RLWMH	8	0.01	6.6
RLBSH	8	0.01	10.5
RLWSH	8	0.01	6.2
RLBXV	3	0.01	12.9
RLWXV	3	0.01	9.7
RLBYV	3	0.01	14.6
RLWYV	3	0.01	12.1
RLBMV	3	0.01	17.2
RLWMV	3	0.01	12.6
RLBSV	3	0.01	16.7
RLWSV	3	0.01	12.2

Experimental Results — Combinations

feature	error [%]
RL**V, constant weight	4.1
RL**H, constant weight	1.8
RL*, CC*, 1/error weight	**1.5**
FR, RL*, CC*, 1/error weight	1.5
TTFH, FR, RL*, CC*, 1/error weight	1.5
RL*, CC*, *logistic, 50/50 data split*	2.1

Confusion Matrix

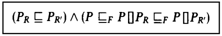
	text	speckles	math	drawing	ruling	table	halftone	logo
text	**99.8**		.1					
speckles	.5	**99.4**	.1	.1			.1	
math	8.6		**90.8**				.6	
drawing	3.0	.3	1.5	**86.0**		5.5	3.5	.3
ruling	1.3	2.2	.4	.4	**96.1**			
table	20.7		.8	9.9		**68.6**	.8	
halftone		1.8		9.7	.9		**86.7**	.9
logo	36.4	9.1	9.1	9.1			9.1	**27.3**
frequency	10450	2007	476	401	232	121	113	11

Examples of Misclassifications

speckles

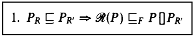
25

text



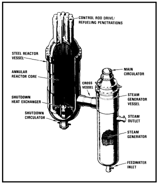
$(P_R \sqsubseteq P_{R'}) \wedge (P \sqsubseteq_F P \square P_R \sqsubseteq_F P \square P_{R'})$

math

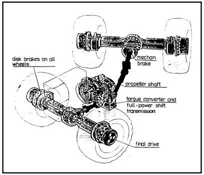


1. $P_R \sqsubseteq P_{R'} \Rightarrow \mathscr{R}(P) \sqsubseteq_F P \square P_{R'}$

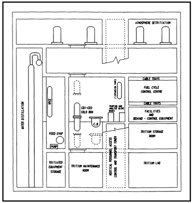
text



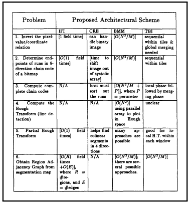
drawing


disk brakes on all wheels
mechan. brake
propeller shaft
torque converter and full-power shift transmission
final drive

halftone


ATMOSPHERE DETRITIATION
WATER DISTILLATION
VPCE
FEED EVAP
PUMP
CD1-CD3
COLD BOX
C.B
2 EXPANSION TANKS
PUMPING AND ANALYSE GLOVE BOXES
CABLE TRAYS
FUEL CYCLE CONTROL CENTRE
CABLE TRAYS
FACILITIES AND BEHIND - CONTROL EQUIPMENT
TRITIUM STORAGE ROOM
VERTICAL PERSONNEL ACCESS
CONTROL AND TRANSPORT TOWER
TRITIATED EQUIPMENT STORAGE
TRITIUM MAINTENANCE ROOM
TRITIUM LAB

drawing



Problem	Proposed Architectural Scheme			
	IFI	CRE	BMM	TBI
1. Invert the pixel-value/coordinate relation	[1 field time]	can handle binary image	$[O(N^2/M)]$	sequential within tiles & global merging needed
2. Determine end-points of runs in 8-direction chain code of a bitmap	$[O(1)$ field times]	[time to shift image out of systolic array]	$[O(N^2/M)]$	sequential within tiles
3. Compute complete chain codes	N/A	host must sort out the runs	$[O(N^2/M + P)]$, where P = perimeter	local phase followed by merging phase
4. Compute the Hough Transform (line detection)	N/A	N/A	$[O(N^2)]$ using parallel array to plot in Hough space	unclear
5. Partial Hough Transform	$[O(1)$ field times]	helps find colinear segments in 4 directions	many approaches are possible	good for local H.T. within each window
6. Obtain Region Adjacency Graph from segmentation map	$[O(R)$ field times $+O(E)]$, where R = #regions, and E = #edges	N/A	$[O(N^2/M)]$; there are several possible approaches.	$[O(N^2/M)]$

table

Conclusions for Block Classification

- use run-lengths histograms
- background run-lengths more important than foreground
- very competitive error rate of 1.5% using simple features
- simple, fast and accurate classifier at 2.1%
  - run-lengths and connected components distribution
  - maximum entropy log-linear classifier
- probable improvement: use context information

Outline

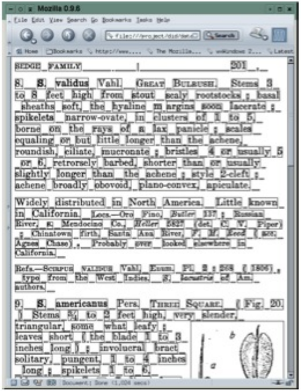
Three More Layout Analysis Tasks

- Page Frame Detection
- Urdu/Arabic Document Analysis
- Block Type Classification

Applications

- Document Reflow
- Visual Document Search
- iDesk
- Dewarping
- Document Retrieval and Browsing
- Document Image to HTML Conversion
- HTML Layout Verification
- Bibliographic Meta-Data Extraction
- Arc and Line Detection
- More Applications of RAST

Document Reflow


Mozilla 0.9.6
File Edit View Search Go Bookmarks Tasks Help
Search
Home
Bookmarks
Document: Done (1.024 secs)

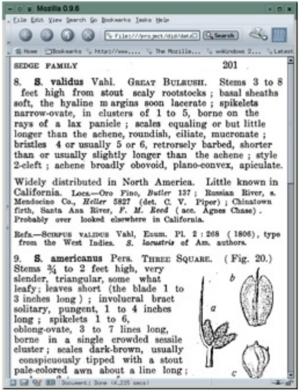
SEDGE FAMILY 201

8. S. validus Vahl. Great Bulrush. Stems 3 to 8 feet high from stout scaly rootstocks ; basal sheaths soft, the hyaline m argins soon lacerate ; spikelets narrow-ovate, in clusters of 1 to 5, borne on the rays of a lax panicle ; scales equaling or but little longer than the achene, roundish, ciliate, mucronate ; bristles 4 or usually 5 or 6, retrorsely barbed, shorter than or usually slightly longer than the achene ; style 2-cleft ; achene broadly obovoid, plano-convex, apiculate.

Widely distributed in North America. Little known in California. Locs.—Oro Fino, *Butler* 137 ; Russian River, s. Mendocino Co., *Heller* 5827 (det. C. V. Piper) ; Chinatown firth, Santa Ana River, *F. M. Reed* (acc. Agnes Chase). Probably over looked elsewhere in California.

Refs.—Scirpus validus Vahl, Enum. Pl. 2 : 268 (1806), type from the West Indies. *S. lacustris* of Am. authors.

9. S. americanus Pers. Three Square. (Fig. 20.) Stems ¾ to 2 feet high, very slender, triangular, some what leafy ; leaves short (the blade 1 to 3 inches long) ; involucral bract solitary, pungent, 1 to 4 inches long ; spikelets 1 to 6,


Mozilla 0.9.6
File Edit View Search Go Bookmarks Tasks Help
Search
Home
Bookmarks
Document: Done (4.225 secs)
b
a
c

SEDGE FAMILY 201

8. **S. validus** Vahl. Great Bulrush. Stems 3 to 8 feet high from stout scaly rootstocks ; basal sheaths soft, the hyaline m argins soon lacerate ; spikelets narrow-ovate, in clusters of 1 to 5, borne on the rays of a lax panicle ; scales equaling or but little longer than the achene, roundish, ciliate, mucronate ; bristles 4 or usually 5 or 6, retrorsely barbed, shorter than or usually slightly longer than the achene ; style 2-cleft ; achene broadly obovoid, plano-convex, apiculate.

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T.M. Breuel, W.C. Janssen, K. Popat, H.S. Baird:
“Paper-to-PDA,” Procs. ICPR 2002, Quebec City, Quebec, Canada

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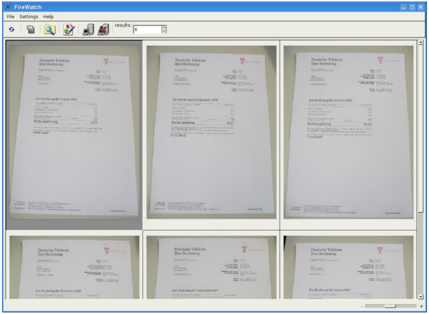
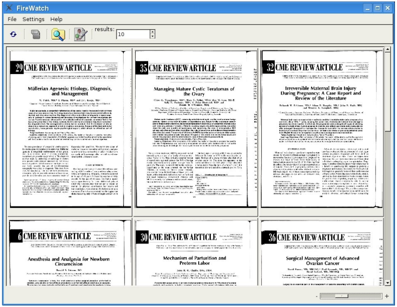
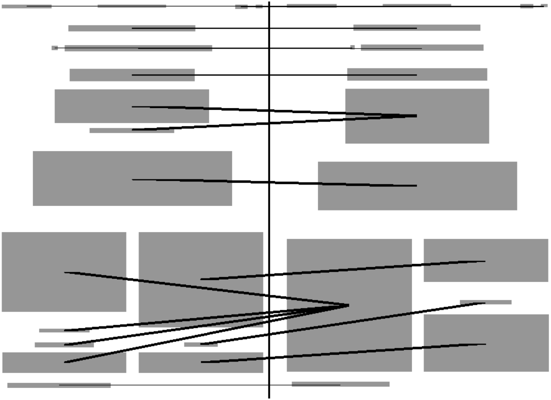
Visual Document Search




FireWatch
File Settings Help
results: 10
29 CME REVIEW ARTICLE
Müllerian Agenesis: Etiology, Diagnosis, and Management
35 CME REVIEW ARTICLE
Managing Mature Cystic Teratomas of the Ovary
32 CME REVIEW ARTICLE
Irreversible Maternal Brain Injury During Pregnancy: A Case Report and Review of the Literature
6 CME REVIEW ARTICLE
Anesthesia and Analgesia for Newborn Circumcision
30 CME REVIEW ARTICLE
Mechanism of Parturition and Preterm Labor
36 CME REVIEW ARTICLE
Surgical Management of Advanced Ovarian Cancer

- visual search feature complementing text-based search

Layout-Based Search

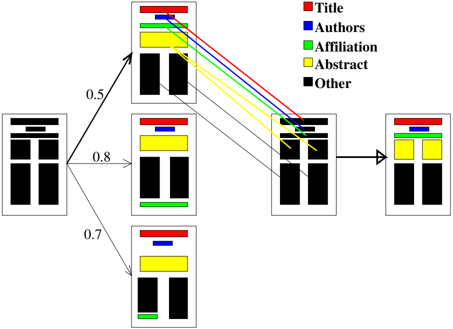


- edge cover distance measure for document images

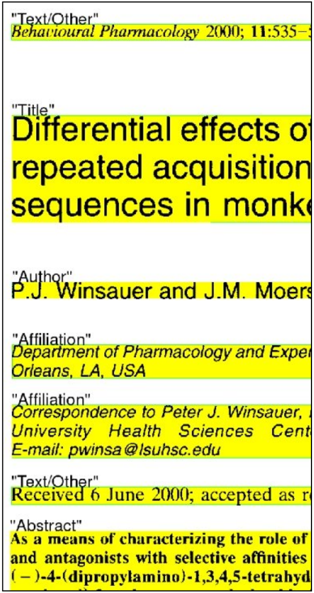
Example-Based Labeling of Title Page Images

- Labeling of title pages using similar labeled examples

1. Segment document image using layout analysis
2. Search for similar labeled documents in dataset using geometrical and textural features
3. Copy the labels from the best matching document



Example-based Logical Labeling



"Text/Other"
Behavioural Pharmacology 2000; **11**:535–

"Title"
Differential effects o
repeated acquisition
sequences in monke

"Author"
P.J. Winsauer and J.M. Moers

"Affiliation"
Department of Pharmacology and Exper
Orleans, LA, USA

"Affiliation"
Correspondence to Peter J. Winsauer,
University Health Sciences Cent
E-mail: pwinsa@lsuhsc.edu

"Text/Other"
Received 6 June 2000; accepted as r

"Abstract"
As a means of characterizing the role of
and antagonists with selective affinities
(−)-4-(dipropylamino)-1,3,4,5-tetrahyd

- automatic semantic labeling of page segmentations
- example-based approach: match blocks and transfer labels
- extend block distance using texture features
- accuracy on MARG:
  99.6% – unknown document
  98.9% – unknown journal
  94.8% – unknown journal type

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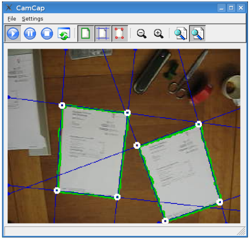
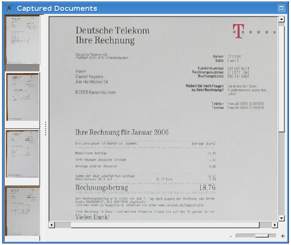
iDesk





Deutsche Telekom
Ihre Rechnung

Deutsche Telekom AG
Postfach 25 01, 67613 Kaiserslautern

Herrn
Daniel Keysers
Am Harzhübel 94

67663 Kaiserslautern

Datum	02.01.06
Seite	1 von 3
Kundennummer	154 061 6074
Rechnungsnummer	911 577 1063
Buchungskonto	560 341 5903
Haben Sie noch Fragen zu Ihrer Rechnung?	Sie erreichen Ihren Kundenservice kostenfrei unter:
Telefon	freecall 0800 33 01020
Telefax	freecall 0800 33 01029

Ihre Rechnung für Januar 2006

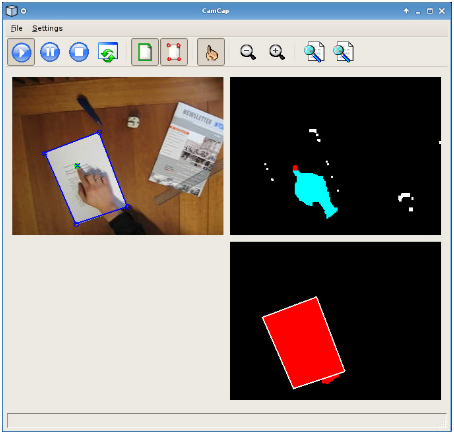
Die Leistungen im Überblick (Summen)		Beträge (Euro)
Monatliche Beträge		13,75
Verbindungen Deutsche Telekom		1,57
Beträge anderer Anbieter		0,85
Summe der oben angeführten Beträge		16,17
Umsatzsteuer 16 % auf ...	16,17 Euro	2,59
Rechnungsbetrag		18,76

Der Rechnungsbetrag wird nicht vor dem 7. Tag nach Zugang der Rechnung von Ihrem Konto 0009898537, BLZ 30070024 abgebucht.
Informationen zu HappyDigits erhalten Sie unter www.telekom.de/happydigits

Ihre Rechnung im Detail und weitere Hinweise finden Sie auf den folgenden Seiten.

Vielen Dank!

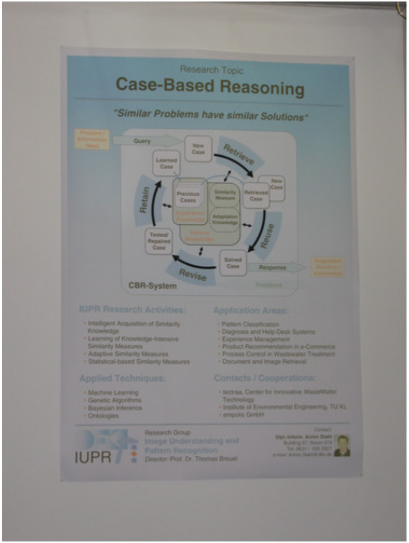
iDesk User Interaction



improved user experience:

- pointing at region of interest possible
- document detection improved
- works without separate calibration step
- zooming enabled

OSCAR - One Step Capture and Restoration



Research Topic

Case-Based Reasoning

"Similar Problems have similar Solutions"

IUPR Research Activities:

- Intelligent Acquisition of Similarity Knowledge
- Learning of Knowledge-Intensive Similarity Measures
- Adaptive Similarity Measures
- Statistical-based Similarity Measures

Application Areas:

- Pattern Classification
- Diagnosis and Help-Desk Systems
- Experience Management
- Product Recommendation in e-Commerce
- Process Control in Wastewater Treatment
- Document and Image Retrieval

Applied Techniques:

- Machine Learning
- Genetic Algorithms
- Bayesian Inference
- Ontologies

Contacts / Cooperations:

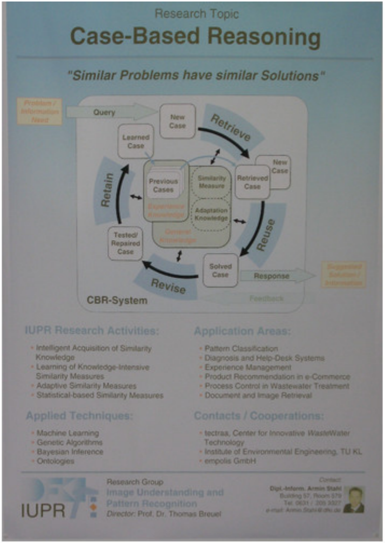
- tectraa, Center for Innovative WasteWater Technology
- Institute of Environmental Engineering, TU KL
- empolis GmbH

IUPR

Research Group
Image Understanding and
Pattern Recognition
Director: Prof. Dr. Thomas Breuel

Contact:
Dipl.-Inform. Armin Stahl
Building 57, Room 579
Tel. 0631 / 205 3327
e-mail: Armin.Stahl@dfki.de

input



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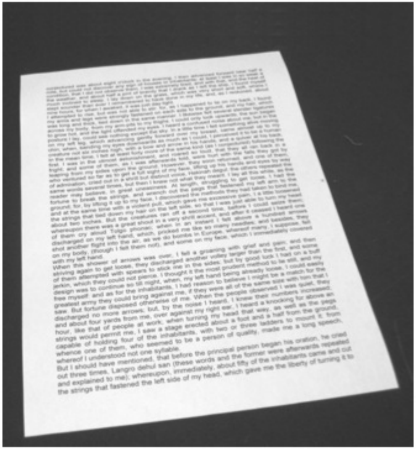
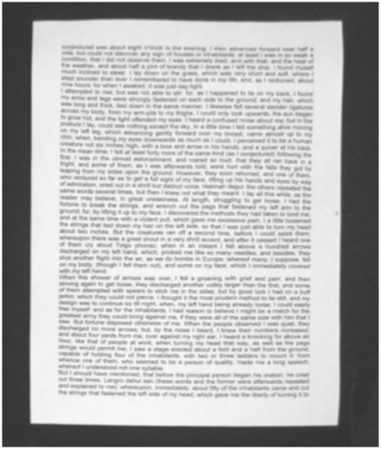
output

OSCAR - One Step Capture and Restoration





conjectured was about eight o'clock in the evening. I then advanced forward near half a mile, but could not discover any sign of houses or inhabitants; at least I was in so weak a condition, that I did not observe them. I was extremely tired, and with that, and the heat of the weather, and about half a pint of brandy that I drank as I left the ship, I found myself much inclined to sleep. I lay down on the grass, which was very short and soft, where I slept sounder than ever I remembered to have done in my life, and, as I reckoned, about nine hours; for when I awaked, it was just day-light.

I attempted to rise, but was not able to stir: for, as I happened to lie on my back, I found my arms and legs were strongly fastened on each side to the ground; and my hair, which was long and thick, tied down in the same manner. I likewise felt several slender ligatures across my body, from my arm-pits to my thighs. I could only look upwards; the sun began to grow hot, and the light offended my eyes. I heard a confused noise about me; but in the posture I lay, could see nothing except the sky. In a little time I felt something alive moving on my left leg, which advancing gently forward over my breast, came almost up to my chin; when, bending my eyes downwards as much as I could, I perceived it to be a human creature not six inches high, with a bow and arrow in his hands, and a quiver at his back. In the mean time, I felt at least forty more of the same kind (as I conjectured) following the first. I was in the utmost astonishment, and roared so loud, that they all ran back in a fright; and some of them, as I was afterwards told, were hurt with the falls they got by leaping from my sides upon the ground. However, they soon returned, and one of them, who ventured so far as to get a full sight of my face, lifting up his hands and eyes by way of admiration, cried out in a shrill but distinct voice, Hekinah degul: the others repeated the same words several times, but then I knew not what they meant. I lay all this while, as the reader may believe, in great uneasiness. At length, struggling to get loose, I had the fortune to break the strings, and wrench out the pegs that fastened my left arm to the ground; for, by lifting it up to my face, I discovered the methods they had taken to bind me, and at the same time with a violent pull, which gave me excessive pain, I a little loosened the strings that tied down my hair on the left side, so that I was just able to turn my head about two inches. But the creatures ran off a second time, before I could seize them; whereupon there was a great shout in a very shrill accent, and after it ceased I heard one of them cry aloud Tolgo phonac; when in an instant I felt above a hundred arrows discharged on my left hand, which, pricked me like so many needles; and besides, they shot another flight into the air, as we do bombs in Europe, whereof many, I suppose, fell on my body, (though I felt them not), and some on my face, which I immediately covered with my left hand.

When this shower of arrows was over, I fell a groaning with grief and pain; and then striving again to get loose, they discharged another volley larger than the first, and some of them attempted with spears to stick me in the sides; but by good luck I had on a buff jerkin, which they could not pierce. I thought it the most prudent method to lie still, and my design was to continue so till night, when, my left hand being already loose, I could easily free myself: and as for the inhabitants, I had reason to believe I might be a match for the greatest army they could bring against me, if they were all of the same size with him that I saw. But fortune disposed otherwise of me. When the people observed I was quiet, they discharged no more arrows; but, by the noise I heard, I knew their numbers increased; and about four yards from me, over against my right ear, I heard a knocking for above an hour, like that of people at work; when turning my head that way, as well as the pegs strings would permit me, I saw a stage erected about a foot and a half from the ground, capable of holding four of the inhabitants, with two or three ladders to mount it: from whence one of them, who seemed to be a person of quality, made me a long speech, whereof I understood not one syllable.

But I should have mentioned, that before the principal person began his oration, he cried out three times, Langro dehul san (these words and the former were afterwards repeated and explained to me); whereupon, immediately, about fifty of the inhabitants came and cut the strings that fastened the left side of my head, which gave me the liberty of turning it to

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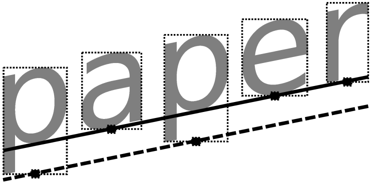
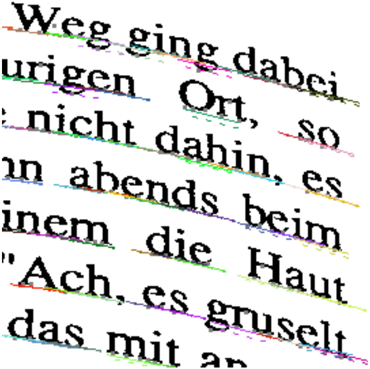
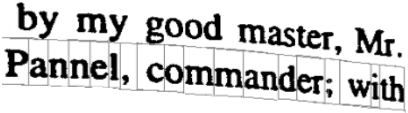
Page Surface Dewarping



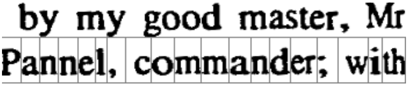


Weg ging dabei
urigen Ort, so
nicht dahin, es
n abends beim
inem die Haut
"Ach, es gruselt
das mit an

Page Surface Dewarping



by my good master, Mr.
Pannel, commander; with



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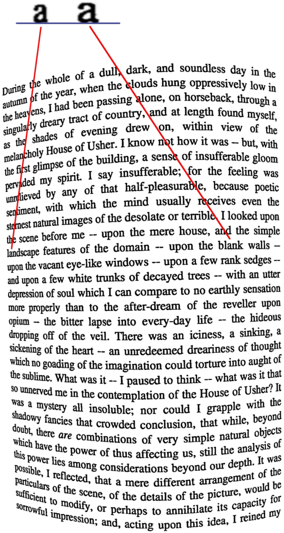
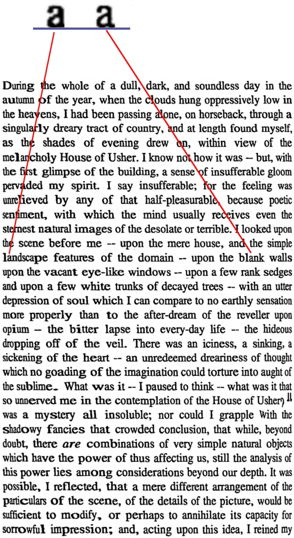


During the whole of a dull, dark, and soundless day in the autumn of the year, when the clouds hung oppressively low in the heavens, I had been passing alone, on horseback, through a singularly dreary tract of country, and at length found myself, as the shades of evening drew on, within view of the melancholy House of Usher. I know not how it was – but, with the first glimpse of the building, a sense of insufferable gloom pervaded my spirit. I say insufferable; for the feeling was unrelieved by any of that half-pleasurable, because poetic sentiment, with which the mind usually receives even the sternest natural images of the desolate or terrible. I looked upon the scene before me -- upon the mere house, and the simple landscape features of the domain -- upon the blank walls – upon the vacant eye-like windows -- upon a few rank sedges – and upon a few white trunks of decayed trees -- with an utter depression of soul which I can compare to no earthly sensation more properly than to the after-dream of the reveller upon opium – the bitter lapse into every-day life -- the hideous dropping off of the veil. There was an iciness, a sinking, a sickening of the heart -- an unredeemed dreariness of thought which no goading of the imagination could torture into aught of the sublime. What was it -- I paused to think -- what was it that so unnerved me in the contemplation of the House of Usher? It was a mystery all insoluble; nor could I grapple with the shadowy fancies that crowded conclusion, that while, beyond doubt, there *are* combinations of very simple natural objects which have the power of thus affecting us, still the analysis of this power lies among considerations beyond our depth. It was possible, I reflected, that a mere different arrangement of the particulars of the scene, of the details of the picture, would be sufficient to modify, or perhaps to annihilate its capacity for sorrowful impression; and, acting upon this idea, I reined my



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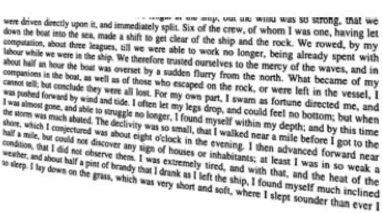
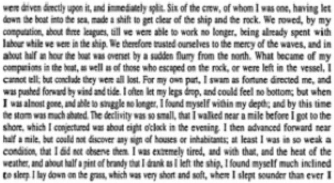


the ship, but the wind was so strong, that we were driven directly upon it, and immediately split. Six of the crew, of whom I was one, having let down the boat into the sea, made a shift to get clear of the ship and the rock. We rowed, by my computation, about three leagues, till we were able to work no longer, being already spent with labour while we were in the ship. We therefore trusted ourselves to the mercy of the waves, and in about half an hour the boat was overset by a sudden flurry from the north. What became of my companions in the boat, as well as of those who escaped on the rock, or were left in the vessel, I cannot tell; but conclude they were all lost. For my own part, I swam as fortune directed me, and was pushed forward by wind and tide. I often let my legs drop, and could feel no bottom; but when I was almost gone, and able to struggle no longer, I found myself within my depth; and by this time the storm was much abated. The declivity was so small, that I walked near a mile before I got to the shore, which I conjectured was about eight o'clock in the evening. I then advanced forward near half a mile, but could not discover any sign of houses or inhabitants; at least I was in so weak a condition, that I did not observe them. I was extremely tired, and with that, and the heat of the weather, and about half a pint of brandy that I drank as I left the ship, I found myself much inclined to sleep. I lay down on the grass, which was very short and soft, where I slept sounder than ever I



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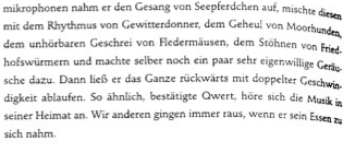
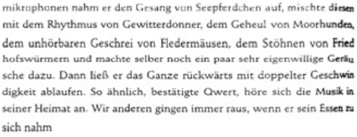


mikrophonen nahm er den Gesang von Seepferdchen auf, mischte diesen mit dem Rhythmus von Gewitterdonner, dem Geheul von Moorhunden, dem unhörbaren Geschrei von Fledermäusen, dem Stöhnen von Friedhofswürmern und machte selber noch ein paar sehr eigenwillige Geräusche dazu. Dann ließ er das Ganze rückwärts mit doppelter Geschwindigkeit ablaufen. So ähnlich, bestätigte Qwert, höre sich die Musik in seiner Heimat an. Wir anderen gingen immer raus, wenn er sein Essen zu sich nahm.



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- OCR error rates (commercial): 12.6% → 1.0%

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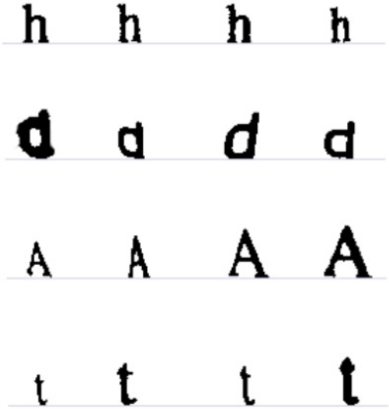
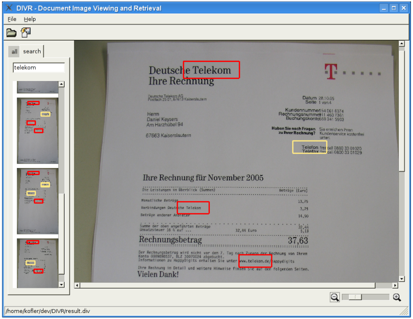
Document Image Viewing and Retrieval



- special OCR for captured documents

Document Image Viewing and Retrieval


DIVR - Document Image Viewing and Retrieval
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all search
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Verbindungen Deutsche Telekom		3,79
Beträge anderer Anbieter		14,90
Summe der oben angeführten Beträge		32,44
Umsatzsteuer 16 % auf ...	32,44 Euro	5,19
Rechnungsbetrag		37,63

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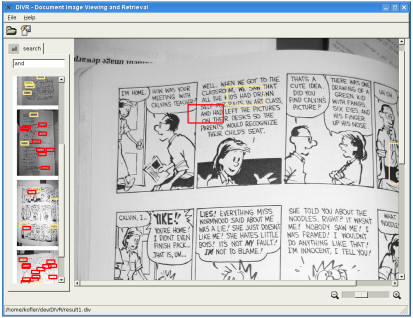
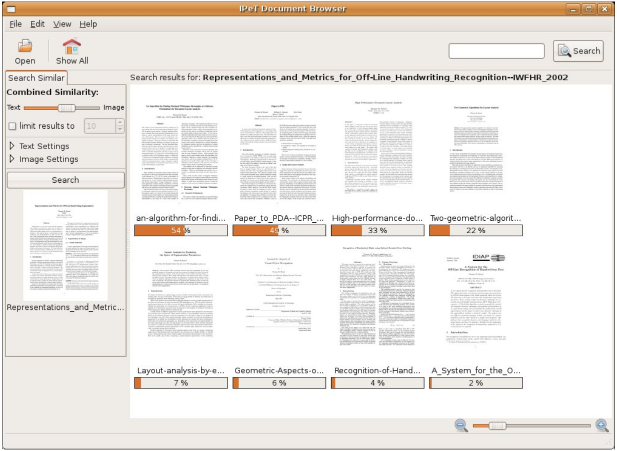

DIVR - Document Image Viewing and Retrieval
File Help
all search
and
I'M HOME.
HOW WAS YOUR MEETING WITH CALVIN'S TEACHER?
WELL, WHEN WE GOT TO THE CLASSROOM, WE SAW THAT ALL THE KIDS HAD DRAWN SELF-PORTRAITS IN ART CLASS, AND HAD LEFT THE PICTURES ON THEIR DESKS SO THE PARENTS WOULD RECOGNIZE THEIR CHILD'S SEAT.
THAT'S A CUTE IDEA. DID YOU FIND CALVIN'S PICTURE?
THERE WAS ONE DRAWING OF A GREEN KID WITH FANGS, SIX EYES, AND HIS FINGER UP HIS NOSE.
UH OH
CALVIN, I...
YIKE!! YOU'RE HOME! I DIDN'T EVEN FINISH PACK... THAT IS, UM...
LIES! EVERYTHING MISS WORMWOOD SAID ABOUT ME WAS A LIE! SHE JUST DOESN'T LIKE ME! SHE HATES LITTLE BOYS! IT'S NOT MY FAULT! I'M NOT TO BLAME!
SHE TOLD YOU ABOUT THE NOODLES, RIGHT? IT WASN'T ME! NOBODY SAW ME! I WAS FRAMED! I WOULDN'T DO ANYTHING LIKE THAT! I'M INNOCENT, I TELL YOU!
WHAT NOODLES
/home/kofler/dev/DIVR/result1.div

- special OCR for captured documents

Document Browser



Search results for: **Representations_and_Metrics_for_Off-Line_Handwriting_Recognition--IWFHR_2002**

Combined Similarity: Text — Image

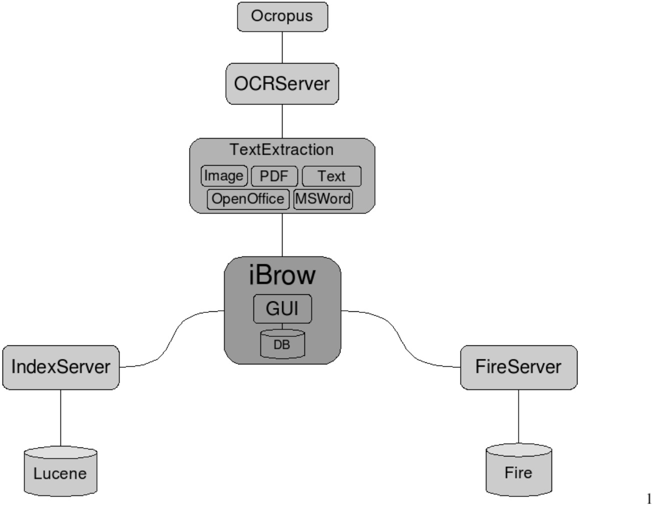
☐ limit results to 10

Representations_and_Metric...

an-algorithm-for-findi... 54 %
Paper_to_PDA--ICPR_... 49 %
High-performance-do... 33 %
Two-geometric-algorit... 22 %
Layout-analysis-by-e... 7 %
Geometric-Aspects-o... 6 %
Recognition-of-Hand... 4 %
A_System_for_the_O... 2 %

- stand-alone document browser
- server architecture for visual and textual search
- uses OCR server for scans and PDFs without included text

Architectural Overview



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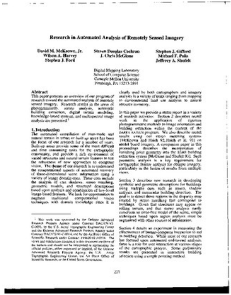
Document Image to HTML Conversion

- Put together components of a complete document analysis system
- Display the results of OCR and layout analysis for debugging purpose



Research in Automated Analysis of Remotely Sensed Imagery

David M. McKeown, Jr.
Wilson A. Harvey
Stephen J. Ford

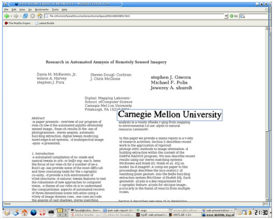
Steven Douglas Cochran
J. Chris McGlone

Stephen J. Gifford
Michael F. Polis
Jefferey A. Shufelt

Digital Mapping Laboratory
School of Computer Science
Carnegie Mellon University
Pittsburgh, PA 15213-3891

Abstract
This paper presents an overview of our program of research toward the automated analysis of remotely sensed imagery. Research results in the areas of photogrammetry, stereo analysis, automatic building extraction, digital terrain modeling, knowledge-based systems, and multispectral image analysis are presented.[1]

1. Introduction



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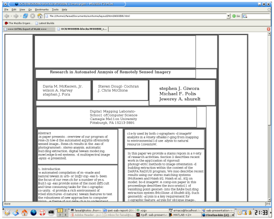
-e automated compilation of m--made and namral tewain in urb- or lmJjr-mp -eas h- been the focus of our rese-ch for a number of ye-s. Bui1t-up -eas provide some of the most diff1cult and time consumng tasks for the c-ographic co-unity, -d provide a rich environment of vGed stmctures -d natura1 tewain features to test the robustness of new approaches to computer vision. -e theme of our reSe-ch is to understand the compumtiona1 aspects of automated recove1 of three-dimenSional scene info-ation using a vGety of image dommn cues. -ese cues inc1ude the anaysis of cast shadows, stereo matching,

analysts in a vmety oftasks r-ging from mapping to environmental l-d use -alysis to natural resource 1nventoW.

In this paper we provide a stams repom in a v-iety of research activities. Section 2 descHbes recent work in the app1ication of rigorouS photogr-etHc methods to image oHentation -d building extraction within the context of the DARPA RADIUS program. We mso descHbe recent results using our stereo matching systems IMcKeown and Hsieh 92, Hsieh et a1. 92j on mode1 bo-d imageW. A comp-ion paper in this proceedings descHbes the inco-oratio11 of vanishing point geomet- into the BABe bui1ding extraction system fMcGlone -d Shufelt 93j. Such geometdc -a1ysis is a key requirement for c-ographic feature -a1ysis for ob1ique image-, p-icu1arly in the fusion of resu1ts from multiple v1ews.



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OCR/W00BIN-blocks/W00BIN_clean.pgm - Mozilla Firefox
File Edit View Go Bookmarks Tools Help
file:///home1/faisal/Documents/svnhome/layout2html/W00BIN.html
=== XHTML Export of MLAN ===
OCR/W00BIN-blocks/W00BIN_c...
Done
Firefox-bin [2]
21:33

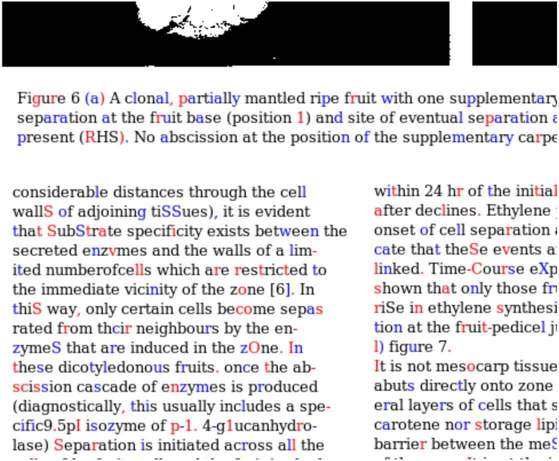


Figure 6 (a) A clonal, partially mantled ripe fruit with one supplementar
separation at the fruit base (position 1) and site of eventual separation a
present (RHS). No abscission at the position of the supplementary carpe

considerable distances through the cell wallS of adjoining tiSSues), it is evident that SubStrate specificity exists between the secreted enzvmes and the walls of a limited numberofcells which are restricted to the immediate vicinity of the zone [6]. In thiS way, only certain cells become sepas rated from thcir neighbours by the enzymeS that are induced in the zOne. In these dicotyledonous fruits. once the abscission cascade of enzymes is produced (diagnostically, this usually includes a specific9.5pI isozyme of p-1. 4-g1ucanhydrolase) Separation is initiated across all the

within 24 hr of the initial
after declines. Ethylene
onset of cell separation a
cate that theSe events a
linked. Time-Course eXp
shown that only those fr
riSe in ethylene synthesi
tion at the fruit-pedicel j
l) figure 7.
It is not mesocarp tissue
abuts directly onto zone
eral layers of cells that s
carotene nor storage lipi
barrier between the meS

classifier confidence information; black: high confidence, blue: medium confidence, red: low confidence; no language model used

Outline

Three More Layout Analysis Tasks

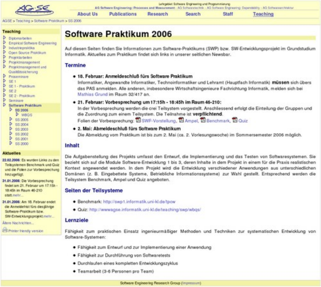
- Page Frame Detection
- Urdu/Arabic Document Analysis
- Block Type Classification

Applications

- Document Reflow
- Visual Document Search
- iDesk
- Dewarping
- Document Retrieval and Browsing
- Document Image to HTML Conversion
- HTML Layout Verification
- Bibliographic Meta-Data Extraction
- Arc and Line Detection
- More Applications of RAST

Image-Based HTML Layout Verification

- rendering of a web page to image
- layout analysis of the captured image
- verify the rendered layout of the webpage



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- Seminare
- Software Praktikum
  - SS 2006
    - WBQS
  - SS 2005
  - SS 2004
  - SS 2003
  - SS 2002
  - SS 2001
  - SS 2000

Aktuelles

22.02.2006: Es wurden Links zu den Teilsystemen Benchmark und Quiz und die Folien zur Vorbesprechung hinzugefügt.

31.01.2006: Die Vorbesprechung findet am 21. Februar um 17:15h - 18:45h im Raum 46-210 statt.mehr...

31.01.2006: Am 18. Februar endet die Anmeldefrist fürs diesjährige Software-Praktikum bzw. SW-Entwicklungsprojekt.mehr...

Ältere Nachrichten...

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Software Praktikum 2006

Auf diesen Seiten finden Sie Informationen zum Software-Praktikums (SWP) bzw. SW-Entwicklungsprojekt im Grundstudium Informatik. Aktuelles zum Praktikum findet sich links in unserer seitlichen Newsbar.

Termine

- **18. Februar: Anmeldeschluß fürs Software Praktikum**
  Informatiker, Angewandte Informatiker, Technoinformatiker und Lehramt (Hauptfach Informatik) **müssen** sich übers das PAS anmelden. Alle anderen, insbesondere Wirtschaftsingenieure Fachrichtung Informatik, melden sich bei Mathias Grund im Raum 32/417 an.
- **21. Februar: Vorbesprechung um 17:15h - 18:45h im Raum 46-210:**
  In der Vorbesprechung werden die crei Teilsystem vorgestellt. Anschliessend erfolgt die Einteilung der Gruppen und die Zuordnung zum einem Teilsystem. Die Teilnahme ist **verpflichtend**.
  Folien der Vorbesprechung: SWP-Vorstellung, Ampel, Benchmark, Quiz
- **2. Mai: Abmeldeschluß fürs Software Praktikum**
  Die Abmeldung vom Praktikum ist bis zum 2. Mai (ca. 2. Vorlesungswoche) im Sommersemester 2006 möglich.

Inhalt

Die Aufgabenstellung des Projekts umfasst den Entwurf, die Implementierung und das Testen von Softwaresystemen. Sie bezieht sich auf die Module Software-Entwicklung 1 bis 3, deren Inhalte in dem Projekt in einem für die Praxis realistischen Kontext angewendet werden. In dem Projekt wird die Entwicklung verschiedener Anwendungen aus unterschiedlichen Domänen (z. B. Eingebettete Systeme, Betriebliche Informationssysteme) zur Wahl gestellt. Entsprechend werden die Teilsystem Benchmark, Ampel und Quiz angeboten.

Seiten der Teilsysteme

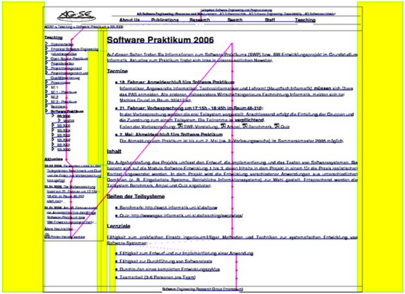
- Benchmark: http://swp1.informatik.uni-kl.de/tpcw
- Quiz: http://wwwagse.informatik.uni-kl.de/teaching/swp/wbqs/

Lernziele

Fähigkeit zum praktischen Einsatz ingenieurmäßiger Methoden und Techniken zur systematischen Entwicklung von Software-Systemen:

- Fähigkeit zum Entwurf und zur Implementierung einer Anwendung
- Fähigkeit zur Durchführung von Softwaretests
- Durchlaufen eines kompletten Entwicklungszyklus
- Teamarbeit (3-6 Personen pro Team)

Software Engineering Research Group (Impressum)



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Termine

Inhalt

Seiten der Teilsysteme

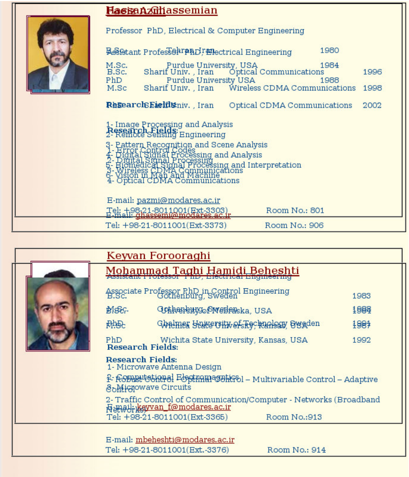
Lernziele

Software Engineering Research Group (Impressum)

Image-Based HTML Layout Verifier

Problems in web page rendering

- Browser incompatibilites



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B.Sc. Sharif Univ. , Iran Optical Communications 1996
PhD Purdue University USA 1988
M.Sc Sharif Univ. , Iran Wireless CDMA Communications 1998
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PhD Sharif Univ. , Iran Optical CDMA Communications 2002
1- Image Processing and Analysis
Research Fields:
2- Remote Sensing Engineering
3- Pattern Recognition and Scene Analysis
1- Error Control Codes
4- Digital Signal Processing and Analysis
2- Digital Signal Processing
5- Biomedical Signal Processing and Interpretation
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2- Computational Electromagntics
1- Robust Control – Optimal Control – Multivariable Control – Adaptive Control
3- Microwave Circuits
2- Traffic Control of Communication/Computer - Networks (Broadband Networks)
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Image-Based HTML Layout Verifier

Problems in web page rendering

- Browser incompatibilites
- Large fonts for visually impaired

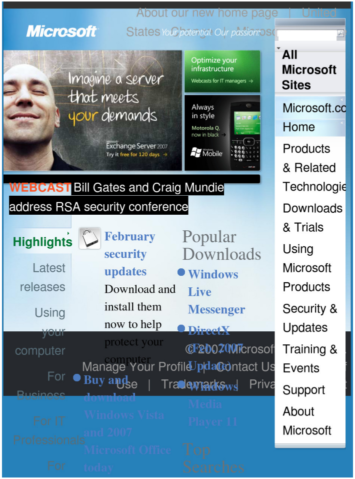
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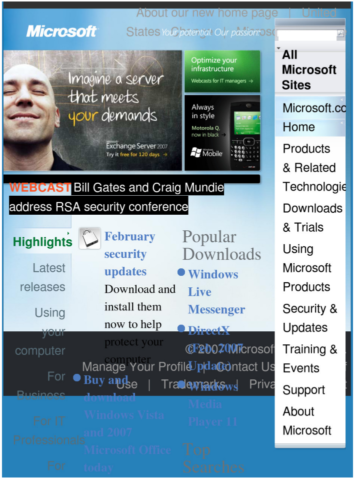
Image-Based HTML Layout Verifier

Problems in web page rendering

- Browser incompatibilites
- Large fonts for visually impaired

Solution: Image-based layout verification

- Rendering of a web page to image
- Layout analysis and OCR of the captured image
- Check for
  - Usable page layouts
  - Readability of the rendered text
  - Visibility of all textual contents



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Rendering a Web Page to Image

representative browsers

- Internet Explorer (Windows)
- Mozilla Firefox (Linux)
- Safari (MacOS)

Web Page Image Binarization

salient features of web page screenshots

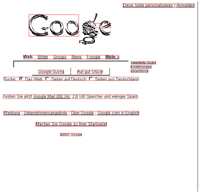
- Extensive use of colors
- Both normal and inverted text in the same image
- No noise
- No skew
- Perfectly rendered fonts

→ Seems to be a trivial problem, but

- Font anti-aliasing, colored non-uniform background, colored text, . . .

Text-Line Extraction

- goal: highlighting of differences in layouts of differently rendered webpages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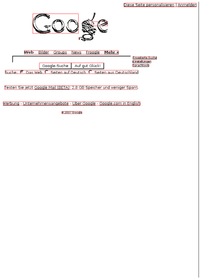
(a) Internet Explorer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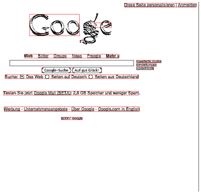
(b) Firefox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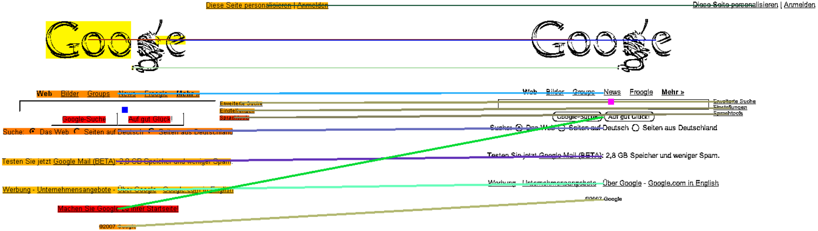
(c) Safari

Text-Line Matching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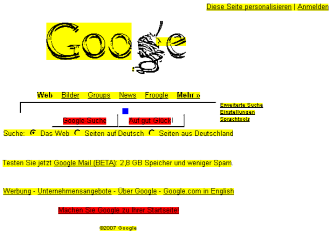
Layout Verification



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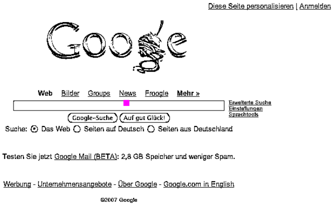

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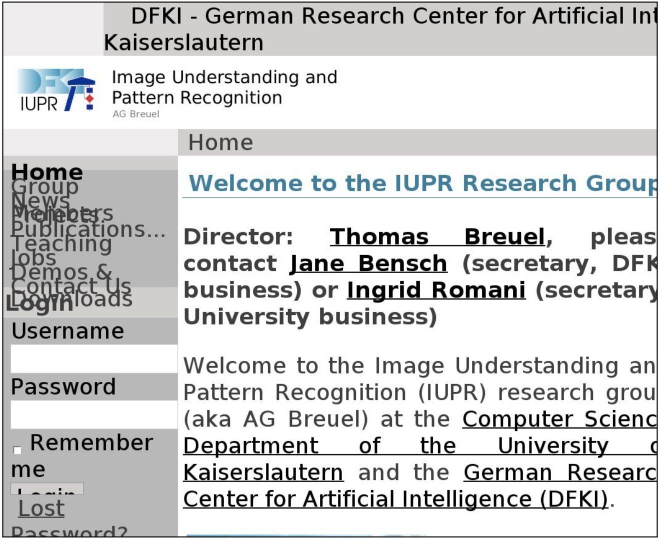
Content Verification

- goal:
  - identify incorrectly rendered and missing text
- problem:
  - low OCR accuracy on screenshots of webpages
- approach:
  - OCR on HTML page
  - highlight incorrectly rendered text

Image-Based HTML Layout Verifier



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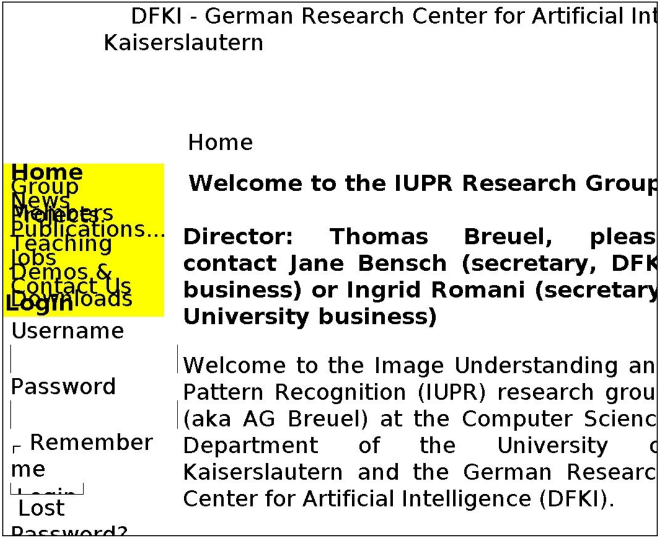

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- Page Frame Detection
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Applications

- Document Reflow
- Visual Document Search
- iDesk
- Dewarping
- Document Retrieval and Browsing
- Document Image to HTML Conversion
- HTML Layout Verification
- **Bibliographic Meta-Data Extraction**
- Arc and Line Detection
- More Applications of RAST

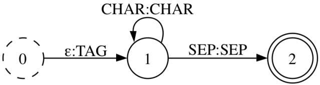
Bibliographic Meta-Data Extraction

- task: extract structured meta-data from references
- problem: strong variations across different reference styles
  - subfield ordering
  - partitioning symbols
  - spacing differences
  - content representation
- goal: retrieve labeling of reference according to semantics

- example:
  - input: (plain text)
    Davenport, T., D. DeLong and M. Beers, "Successful knowledge management projects," Sloan management review, 39, 2, (1998), 43–57.
  - output: (bibtex)
    author = "Davenport, T. and DeLong, D. and Beers, M."
    title = "Successful knowledge management projects"
    journal = "Sloan management review"
    volume = "39", number = "2", year = "1998", pages = "43–57"

probabilistic finite state transducers

- motivation:
  - modular and flexible
  - composition of complex models via abstract operations
  - training-based derivation of weights
  - intuitive illustration as directed graph
- model:
  - one PFST for each occuring subfield



  - language model is built as a closure of subfield bigrams
  - training on dataset yields probabilistically weighted PFST

performance evaluation of the system

- Cora dataset:
  - used for training and evaluation purposes
  - publicly available and most commonly applied
  - consists of 500 research paper citations
- Cora evaluation:

	word	field	instance
CRF (Peng et al.)	95.4		77.3
PFST	88.5	82.6	42.7
HMM (Seymore et al.)	85.1		10.0
INFOMAP (Day et al.)		73.3	

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Arc and Line Detection - Motivation

- analysis of scanned technical drawings
- reconstruction of CAD data
- use advantages of CAD storage for archives of drawings

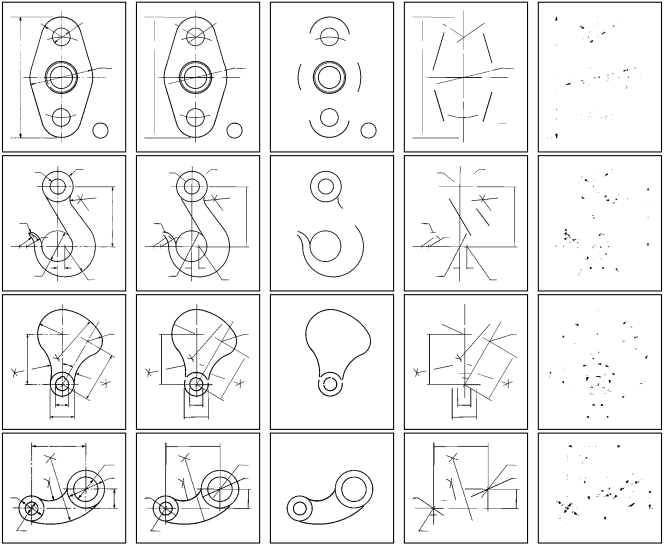
Arc and Line Detection - Method

- use runs of black pixels
- explicitly include line thickness
- no preprocessing like thinning, line adjacency graphs, . . .
- global optimization, no heuristics
- use quality function, branch-and-bound, interval arithmetic
  - keep priority queue of parameter regions
  - use upper bound of quality estimate for region
  - on best region:
    - stop?
    - output?
    - split and re-insert

$$q(\vartheta, (x_0, x_1, y)) \; = \; \max\left(0, \;\; d^{-\frac{1}{2}} \sum_{x=x_0}^{x_1} \operatorname{sgn}(\frac{d}{2} - d_\vartheta(x, y))\right)$$

$$q(\vartheta, (x_0, x_1, y)) \; = \; \max\left(0, \; 1 - \frac{|\frac{d}{2} - d_\vartheta(x_0, y)|}{\sigma^2}\right) + \max\left(0, \; 1 - \frac{|\frac{d}{2} - d_\vartheta(x_1, y)|}{\sigma^2}\right)$$

Arc and Line Detection - Examples



Arc and Line Detection - Summary

- globally optimal detection possible
- very exact results
- results (VRI-scores) on GREC 2003 contest images:

  0.757 our method (2005)
  0.609 S. JiQiang (2003)
  0.487 D. Elliman (2003)

- 2nd place in GREC2005 contest
- current implementation memory intensive (500M), takes some time (∼5min)

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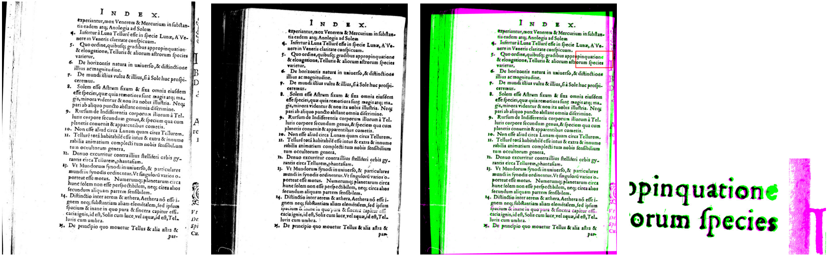
Historical Document Revision Detection



INDEX.

experiantur, mox Venerem & Mercurium in ſubſtantia eadem atq; Anologia ad Solem

4. Infertur à Luna Tellurē eſſe in ſpecie Lunæ, A Venere in Veneris claritate conſpicuam.

5. Quo ordine, quibuſq; gradibus appropinquation & elongatione, Telluris & aliorum aſtrorum ſpecies varietur.

6. De horizontis natura in uniuerſo, & diſtinctione illius ac magnitudine.

7. De mundi iſtius vultu & illius, ſi à Sole huc proſpiceremus.

8. Solem eſſe Aſtrum fixum & fixa omnia eiuſdem eſſe ſpeciei, quæ quia remotiora ſunt magis atq; magis, minora videntur & non ita nobis illuſtria. Neq; pari ab aliquo puncto abſtant omnia diſcrimine.

9. Rurſum de Indifferentia corporum iliorum à Telluris corpore ſecundum genus, & ſpeciem qua cum planetis conuenit & apparentibus cometis.

10. Non eſſe aliud circa Lunam quam circa Tellurem.

11. Tellurē totā habitabilē eſſe intus & extra & innumerabilia animatium complecti tum nobis ſenſibilium tum occultorum genera.

12. Denuo excurritur contraillius ſtelliferi orbis gyrantis circa Tellurem, phantaſiam.

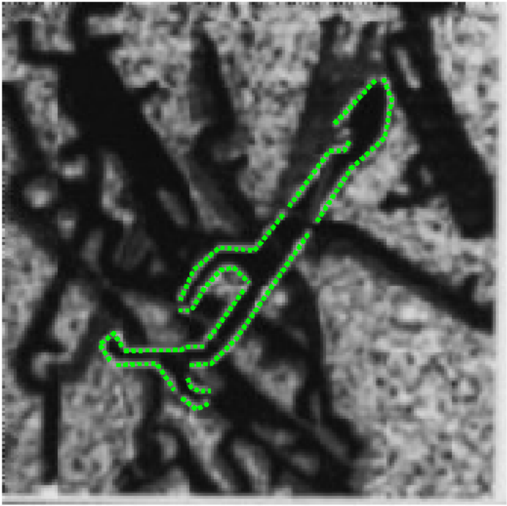
13. Vt Mundorum ſynodi in uniuerſo, & particulares mundi in ſynodis ordinentur. Vt ſingulorū varios oporteat eſſe motus. Numerumq; planetarum circa hunc ſolem non eſſe perſpectibilem, neq; circa alios ſecundum aliquam partem ſenſibilem.

14. Diſtinctio inter aerem & æthera, Aethera nō eſſe ignem neq; ſubſtantiam aliam elemētalem, ſed ipſum ſpacium & inane in quo pura & ſincera capitur efficacia ignis, id eſt, Solis cum luce, vel aquæ, id eſt, Telluris cum umbra.

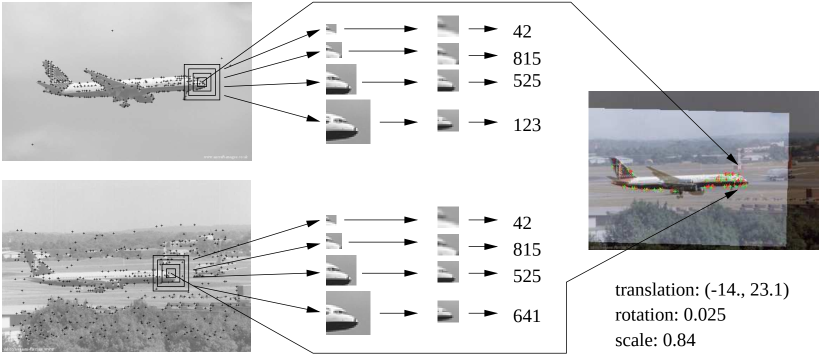
15. De principio quo mouetur Tellus & alia aſtra & par-

- robust document image matching for historical documents
- question:
  Which changes were made between different printings?
- uses geometric matching and Fourier contour descriptors

RAST: Application in Inspection

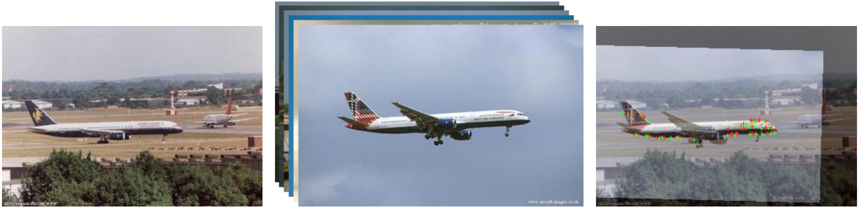


RAST for Object Matching



translation: (-14., 23.1)
rotation: 0.025
scale: 0.84

Object-Based Image Retrieval



- detect whether an image contains an object of a given class
- efficient matching for fully-connected patch-based model
- uses our RAST algorithm
- optimal, statistically well-founded

Object-Based Image Retrieval – Method

- match weakly annotated reference images, no segmentation
- patch-based approach (interest points, cluster descriptors)
- factor dependencies: x/y-translation, rotation, scale
- find optimal match using branch-and-bound approach
- set of reference patches R, test patches S

$$\begin{aligned}
\hat{\vartheta}(R,S) &:= \arg\max_{\vartheta \in T} Q(\vartheta, R, S) \\
Q(\vartheta, R, S) &:= \sum_{p \in R} q(\vartheta, p, S) \\
q(\vartheta, p, S) &:= \begin{cases} 1 & \text{if } \exists p' \in S: l_p = l_{p'} \wedge d(\vartheta, p, p') \leq d_0 \\ 0 & \text{otherwise} \end{cases}
\end{aligned}$$

Object-Based Image Retrieval – Results

method	airp.	faces	mot.
constellation model A	32.0	6.0	16.0
automatic segmentation	2.2	0.1	10.4
texture feature combination	0.8	1.6	8.5
constellation model B	9.8	3.6	7.5
PCA SIFT features	2.1	0.3	5.0
discriminative salient patches, SVM	7.0	2.8	3.8
spatial part-based model	6.7	1.8	3.0
constellation model C	6.3	9.7	2.7
patch histograms A	3.8	7.1	2.5
features inspired by visual cortex	3.3	1.8	2.0
patch histograms B	1.4	3.7	1.1
IPeT approach	4.8	2.8	1.3

- error rates [%] on Caltech data
- possible use in DIA → logo recognition

DFKI-IUPR Demos

http://demo.iupr.org/