

Recognition of Character Strings in Low-quality Images Using Inter-character Features

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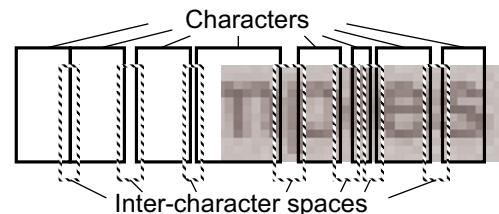
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 (ii) í:w“Rüx “ r w(zq°~'oM }
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2.1 °A S

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 ~ç ϕ^{jl} r w(zw ^Ôx~ç ϕ^(rj) Ÿf
 = 'h wqsloM } o p\ h ^ (i),(ii)
 x| “ Ÿfæí “tdŁ'hÔx~çwÔt
 O b wp|\ f g OA;OB qflb}^
 t ^ (iii) x| “ Ÿfæí “tdŁ'hÔx~
 ç w V fl'oM wp|\ sin∠AOB qfl
 b}\ w°A wux

$$OA \times OB \times \sin \angle AOB \quad (1)$$

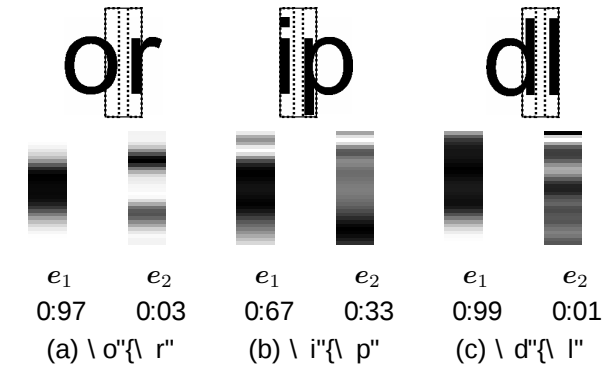
qs }\ x|Ôx~çU sbØw [q° b }
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2.2 “ Ÿfæí w^R

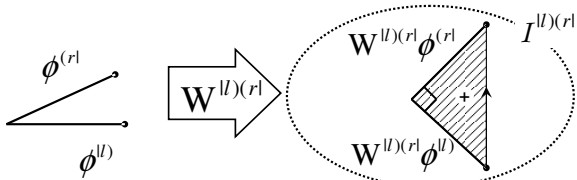
(w “U I| “w “U r pK “ í:w
 Ÿfæí T^{jl}(rj) qfl' | T^{jl}(rj) wøŁæ
 W^{jl}(rj) qb } W^{jl}(rj) x <wrgt lo~R^
 }
 c/š'°æ ctmV|:w¶6-ĩÔçw É
 q \qt |(z ϕ^(cj) q~z ϕ^(jc)

O|°çÜW 1qs OtYF=b wqb
 } W^{jl}(rj) ~Rb h tx| ϕ^{jl} ϕ^(rj) ;M|
 <wì æ P

$$P = \frac{1}{2} \phi^{jl} \phi^{jl} + \phi^{(rj)} \phi^{(rj)} \quad (2)$$



\$ 2 æí w { Õ ~ ç } < w : " x { Õ }



\$ 3 æí I^(l)(rj) " to Y F = ^ h ¶ 6 Õ ~ ç

\ w P 2 p { | f
g (, 1;, 2); (e1; e2) q b } { Õ ~ ç w « \$
2 t \$ Õ } ø £ æ W^(l)(rj) x < t lo { }

$$W^{(l)(rj)} = \frac{1}{\sqrt{2}} \begin{bmatrix} 1 & 1/2 \\ 1 & 1/2 \end{bmatrix} B^> \quad (3)$$

$$/ i 1/2 = \text{diag} \begin{bmatrix} 1 & 1/2 \\ 1 & 1/2 \end{bmatrix} \quad (4)$$

$$B = [e_1 \ e_2] \quad (5)$$

\ w â ^ t | < w Q í U < h ^ }

$$\|W^{(l)(rj)} \phi^{(jl)}\| = \|W^{(l)(rj)} \phi^{(rj)}\| = 1 \quad (6)$$

$$W^{(l)(rj)} \phi^{(jl)} \perp W^{(l)(rj)} \phi^{(rj)} \quad (7)$$

\ x | æ W^(l)(rj) t lo ^ Õ ~ ç φ^(jl); φ^(rj) U
Ú f = ^ h \ q fl b } ^ t | æ Ü < w
O t Y t s \ q -, b w q b }

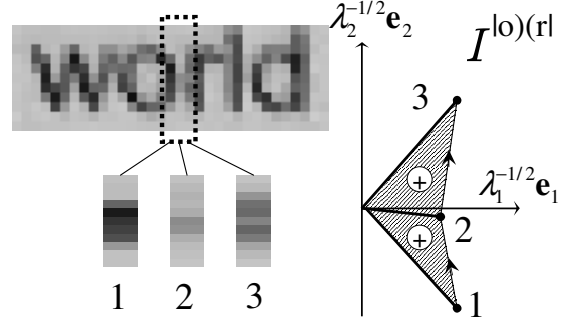
$$\det \|W^{(l)(rj)} \phi^{(jl)}\| \|W^{(l)(rj)} \phi^{(rj)}\| > 0 \quad (8)$$

\ x | Õ ~ ç W^(l)(rj) φ^(jl); W^(l)(rj) φ^(rj) U s b ø U
Y q s \ q fl b } ' \ U R q h s M Õ
t x | Õ ~ ç e2

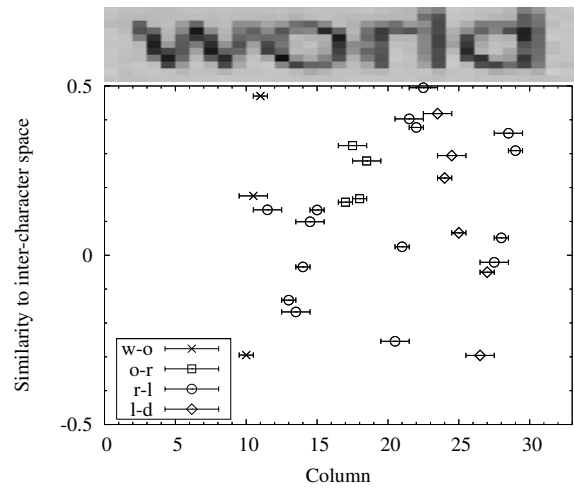
t Õ }

2.3 " í : w Ý

" » h p / p n » £ T m » £ p "
í : < t 0 ' | " Ú f æ í I^(l)(rj) q w « -
S - b M O \ }



\$ 4 æí S - w \$ } " Ú f æ í w « S x d
£ Õ ~ ç U s b ø U £ q ' o ^ A }



\$ 5 " í : w " Ú f æ í t 0 b « S }
" Ú f æ í "w" - "o", "o" - "r", "r" - "l", "l" - "d" t 0 b
S n p h

i » £ (n ≤ i ≤ m) w < £ µ ç h Õ
~ ç y_i 0 | ° ç Ü 1 q s
O t Y F = b } \ w Õ ~ ç I^(l)(rj) t d £ ' |
Õ ~ ç W^(l)(rj) y_i (n ≤ i ≤ m)
q I^(l)(rj) q w « S x | \ w Õ ~ ç U s b ~ fl
w ø w £ q s } ' h U l o | < w Ü p fl ^ }

$$s_{(n,m)}^{(l)(rj)} = \frac{1}{2} \frac{\det \|W^{(l)(rj)} y_i\| \|W^{(l)(rj)} y_{i+1}\|}{i=n} \quad (9)$$

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" í : q | \ o" \ r" w " Ú f æ í q w «
- S ø - t lo { o M } \ w O s « - S
" » h p / w : w " í : t 0 ' o { h A L
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b V Õ p ô M Õ o M }

2.4 { Õ ~ ç U 2

2 { Õ ~ ç U O b Õ w r g
\ h } ' T ' | φ^(jl) φ^(rj) U x t « - ' o M Õ
t x | { Õ ~ ç U 1 m ' T s M h | " p

2 w(c) Ufw« Ô
oM }fw Os°t0'ox|aü' Z h
t 0 w«S)Q wqb }

$$s_{(n,m)}^{(l)(rj)} = 0 \quad (, 2 < t) \quad (10)$$

\\p| t xGü ^s qb }

3 "»h p w ÝÝ

"»w ÝÝw h | Øp x'4 "å' µO
[4, 7] ; MoU' b } } q "w«S°Ax|ÿ
...í "t0'o fiQU<Ý^ oM [8] æí
O [5] t } HRO [4, 7] p x| } q "°At l
o h'4 " T \$ 6 tÔb Os> <åÑ
(hypothesis graph)[9] ~ ' | \$-hOt lo
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;b \qt |ÝÝp t" \$ }

3.1 æí Ot x w "w ÝÝ

æí Ot "w«S°AMOW t \
} "»h p/w m »tT n »t p
" < Ô«~ç= ' | z(m,n)
O|°çÜW 1 qs OtYF=b w
qb }/S'°æ c wæí S(c)
(PCA) t ^R'oSV|fw{ Ô«
~ç e_r(c) ∈ S(c) z(m,n)
c q w«S x <wÜp) Q }

$$s_{(m,n)}^{(c)} = \sum_{r=1}^R \frac{X^R}{e_r^{(c)}} z_{(m,n)}^{(c)} \quad (11)$$

R x ; b { Ô«~çw"i:pK } (m;n)
tmV|«SU" "U'4 "qs }
"»w#i W qb q|Úw m;n (1 ≤ m <
n ≤ W) t0''4 " { }

3.2 «S w w Ø

> <åÑw'4 "U> y|f A &
~w/p«S tU7Gqs w sgb \qt
lo| "»w ÝÝALU }
&~/p j j t (1 ≤ j ≤ J) w "S'°æ c_j
J xfw&~tSZ " :pK } \\p|

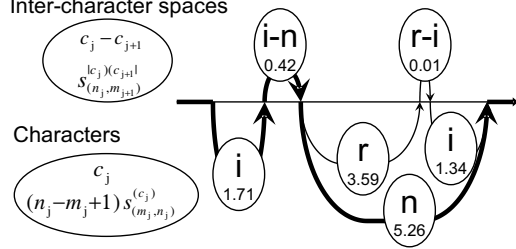
$$m_1 < n_1 < m_2 < n_2 < \dots < m_J < n_J \quad (12)$$

pK } "w«S t S_1

$$S_1 = \sum_{j=1}^J (n_j - m_j + 1) s_{(m_j, n_j)}^{(c_j)} \quad (13)$$



Inter-character spaces



\$ 6 Ö " "in" t0oRh

wx4fwSbwzz

w4wt0b:wSb

"xwS (0 ≤ s_{(m_j, n_j)}^{(c_j)} ≤ 1) | "
<w#i pO 'Zh t q s loM }°M| " í
:w«S t S_2

$$S_2 = (n_J - m_1 + 1) \sum_{j=1}^J \frac{1}{s_{(m_j, m_{j+1})}^{(c_j)} - 1} \quad (14)$$

\w S_2

S x O k ; Mo~Üp) Q

}

$$S = S_1 + kS_2: \quad (15)$$

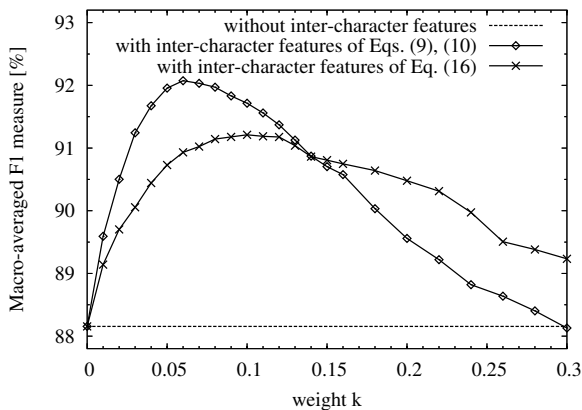
ÝÝALw "» (c_1; c_2; ; ; c_J) x | \w S 7 G qb
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4 îg

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») B ' h } S ' °æ x ó : " 62 " (A{Z, a{z,
0{9: Ariel Ñi~) q ' h } ' µ ^ » w " » h
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t 0 b h | / S ' °æ m V | " + M t S
| (ÜM t t ^ d h 625 x w ¶ 6 ^ » (32 × 32
pixel) \ R ' h | \ w ¶ 6 ^ » T | 2.1 p \
h " w (z φ^{(c_j)} q " z φ^{(c)})

3.1 p \ h { Ô«~ç e_r(c) (1 ≤ r ≤ R = 5)
{ | " í : w Úf æí T^{l)(rj)} q " w æí
S(c) (10) tSZ t x 0:02 q
'h }

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A L w " » w « \$ 8 t Ô } ÝÝ S w f " q ' o |



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Y [11] to"p^ oM Úk Ø É F₁

p q 6 q p r T F₁ (F₁ = 2pr/(p+r)) - ' | ¶

ʹµ~ "»t h lo É h w p K } A L t

q | k < 0:06 w c p x | k ʹC ^ d] q t ʹʹ

^ S w ~ ‡ U h } \ x | " í : ^ b ;

b \ q p | i l h • < ʹí' ‡ a ʹ U H M ^ h h

q B Q } ' T ' | k > 0:06 w c p x ʹʹ^ S

U ʹ < ' | k ≥ 0:3 p x " í : ^ s M Ō

(k=0) w ^ S < s l h } \ x | " í : ^ w

ô T S U " ^ r ô X s M \ q Ō & ' o M }

" | " í : ^ w b ; x f i p K U | " w

α - S q ° ø d q V w z p & ~ t b A

U K \ q U ì T t s l h }

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ü i ~ w Ø p x s X | o m t ϕ^(l) ϕ^(rj) q w

Y F = ì t l o l h Ō w ^ S ° A ' h } \ w

Ō | 2. t S Z ^ (i), (ii) w ° A ' o M \ q

t s } α - S w ° A Ü k ~ Ü p f l ^ }

$$s_{(n,m)}^{(l)(rj)} = \frac{1}{2} \left(\phi^{(l)} y_n + \phi^{(rj)} y_m \right) \quad (16)$$

A L \$ 7 / t Ō } Ü (16) ; M o " í : w α -

S - ' h Ō ~ ‡ U h U | O q z -

b q ʹʹ^ S w — « U ʹ X s l o M } Ü (9)

q Ü (16) w S M x | y_n y_m

(16) x | y_n y_m

s_(n,m)^{(l)(rj)}

5 S t

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x (16) p S A h A L b

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TRfw

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SwUDpK“hh

dMwzptloxMpUh

xwdMwUoM

ːwSd“U

oM

wx[J4

wth

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