

# Automatic writer identification: the paleographer's new best friend?

Jinna Smit

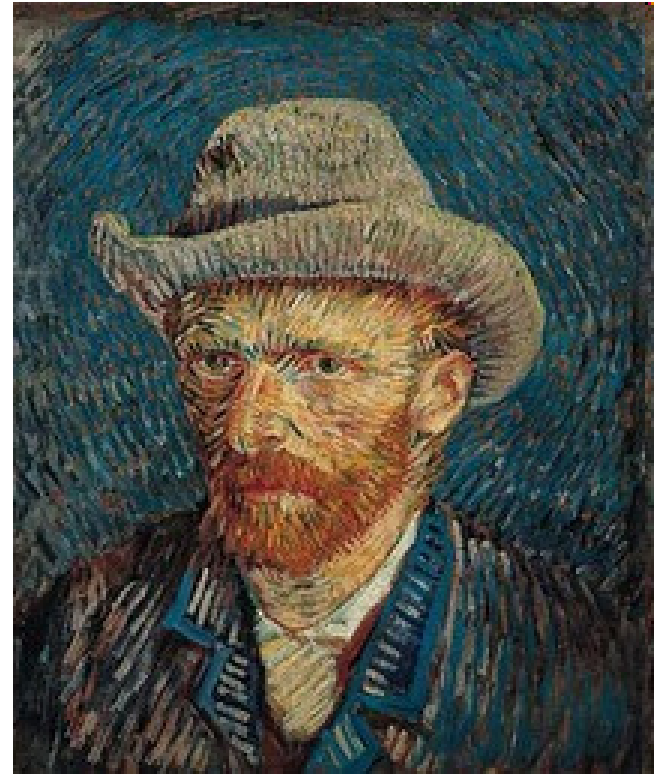
University of Amsterdam/Nationaal Archief

“Thinking of meat makes people less social and lonely”.

Article in Dutch newspapers on an experiment of three psychologists

# Le Blute-Fin Mill





# Axel Brink

## Designer of GIWIS:

- writer identification program combining
- preprocessing steps and feature extraction methods
- requiring minimal user interaction
- visualizing the inner workings

## Designer of the Quill feature:

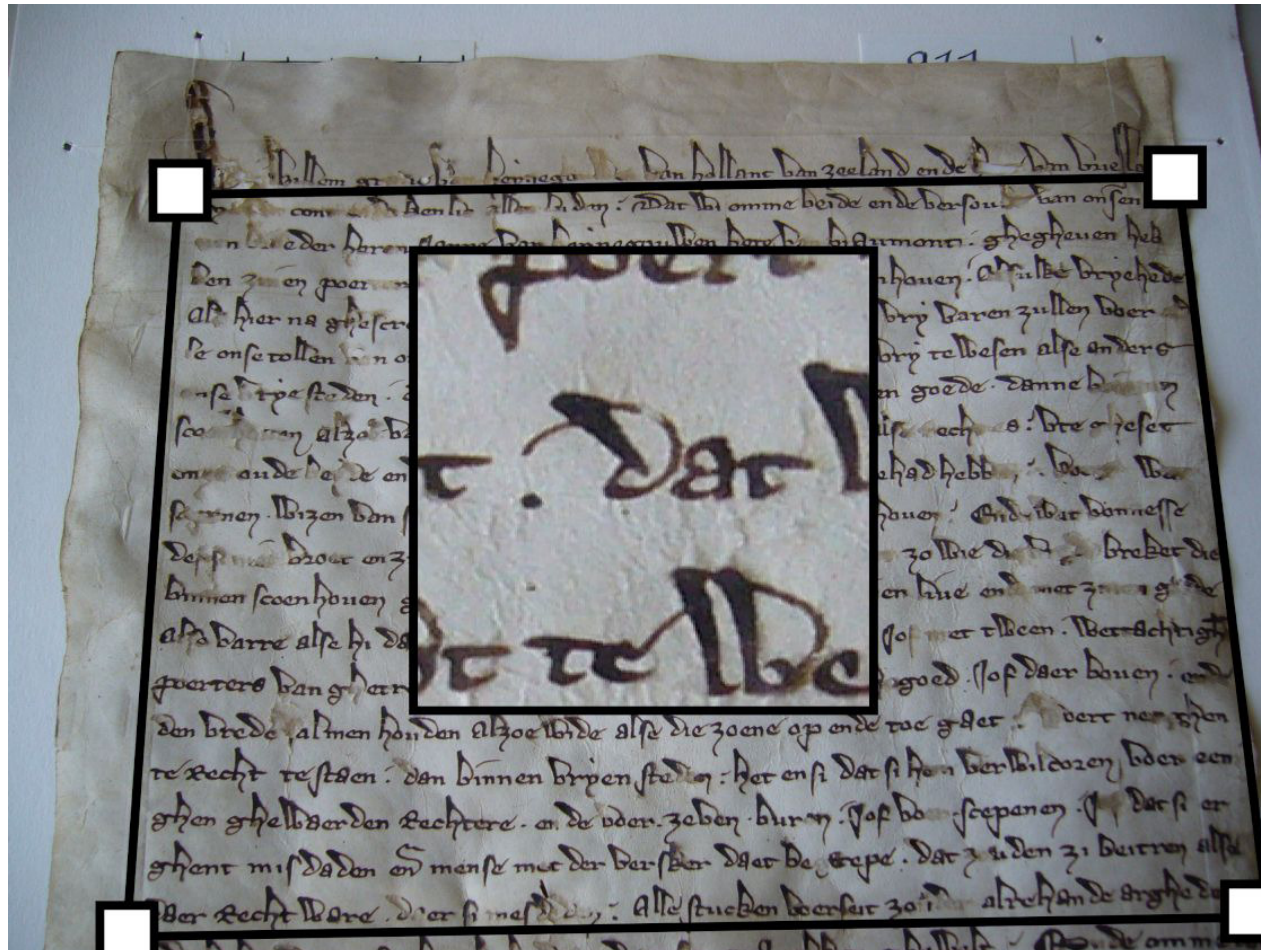
- one of the feature extraction methods of GIWIS
- measures width and direction of the ink trace
- performance rate of 92% and more

Research topic:  
**chancery of the count of Holland**

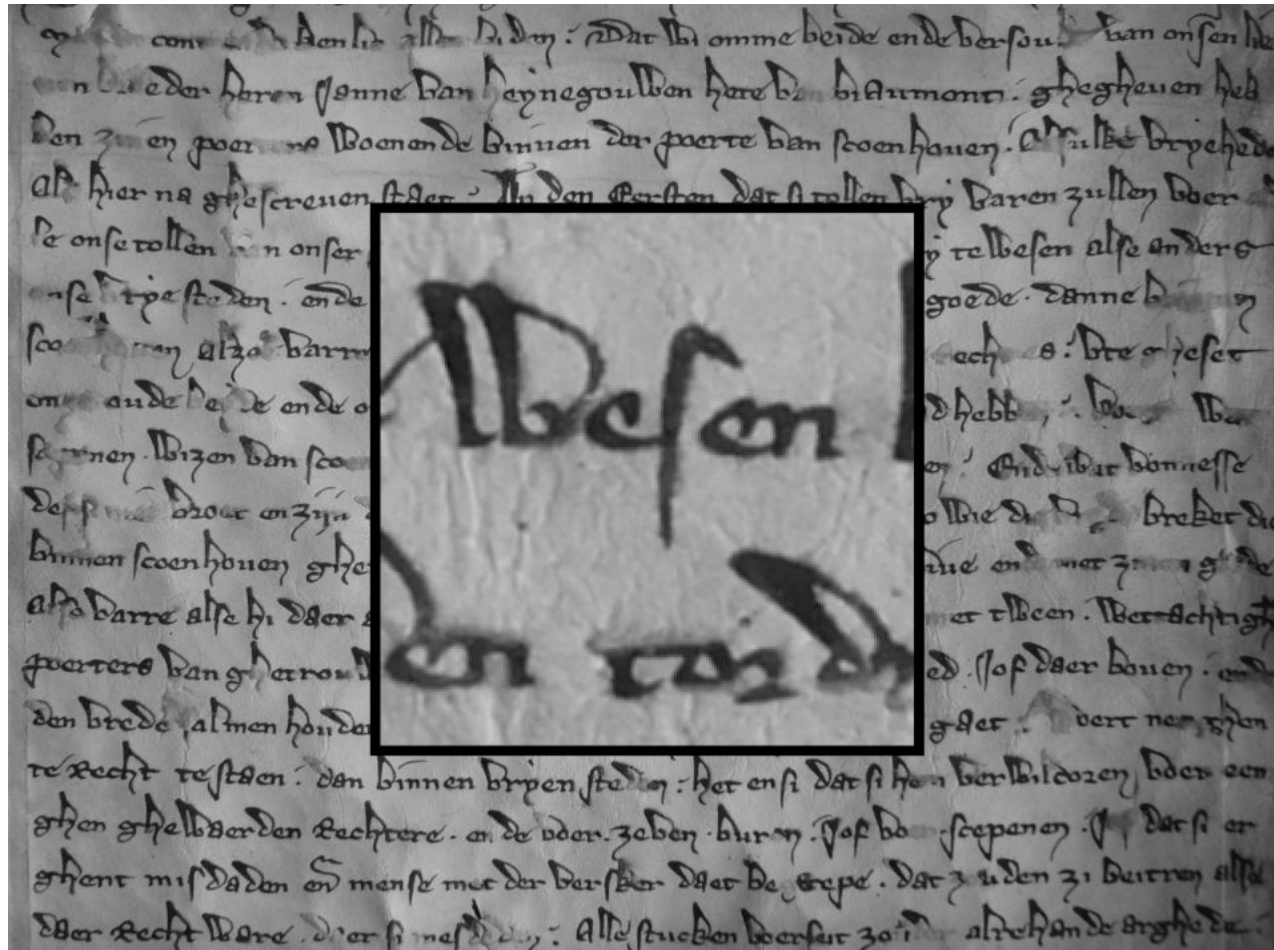
- Period 1299 until 1345
- County of Holland unified with county of Hainault
- Sources: output of the chancery
- Approach: paleographical method



# Manual text region selection:

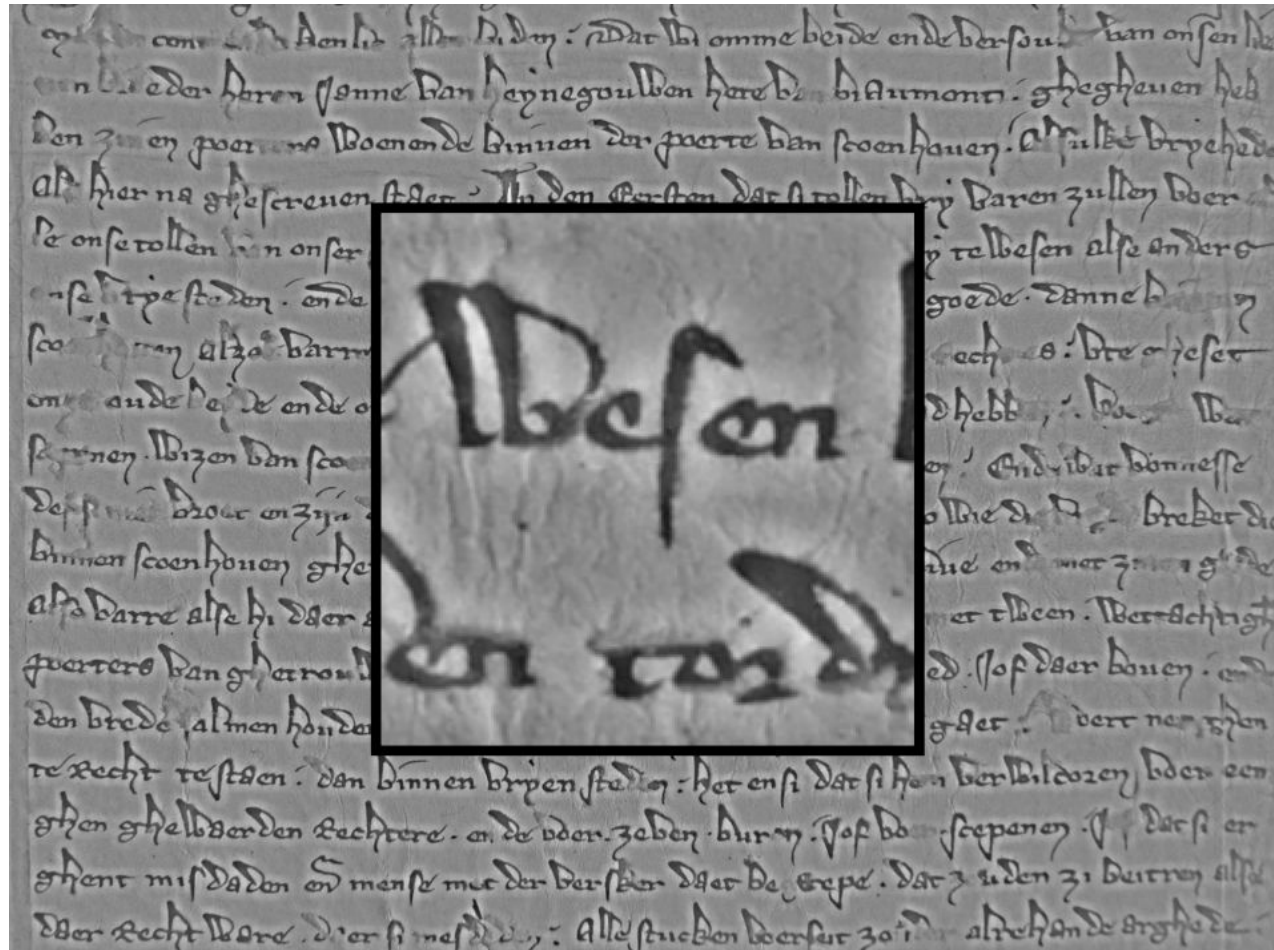


# Grayscale conversion, perspective correction and scaling:






# Removal of stains and equalizing of color variations by highpass filtering



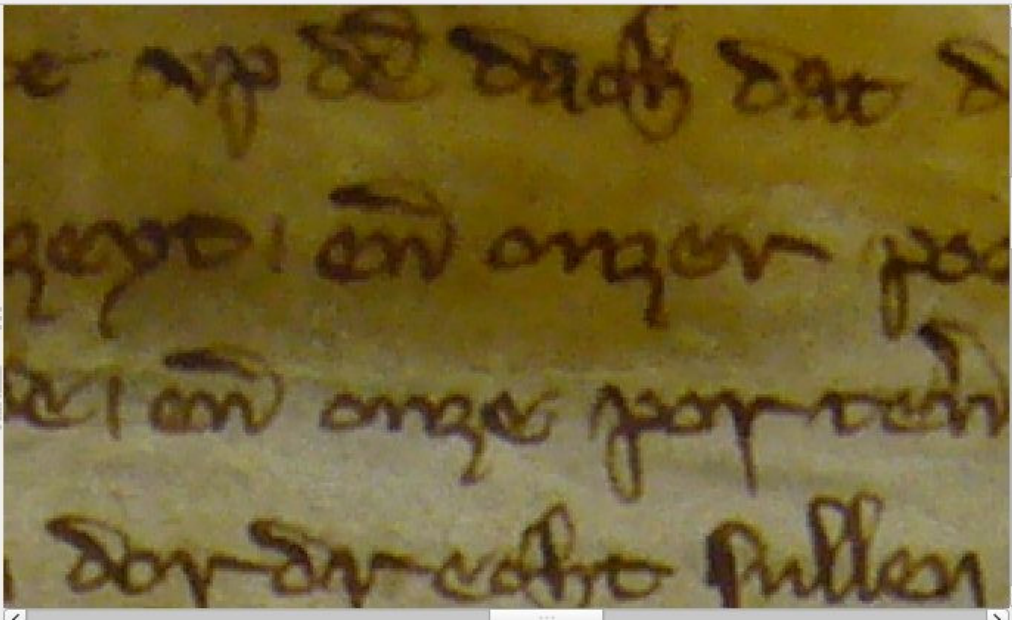


GIWIS - oorkondes.corpus

Corpus Image Help

 university of groningen  
Artificial Intelligence

Object: 1299j04a  
Image id: P1020844  
Writer: KaV  
Genuine: Unknown



Dataset Prepro Features Search Compare Performance test Clustering

Quality: Acceptable

Select text

Region of interest type  
 Perspective

Operations  
Backcorrect(35.0)

Backcorrect Crossed words  
Remove step View

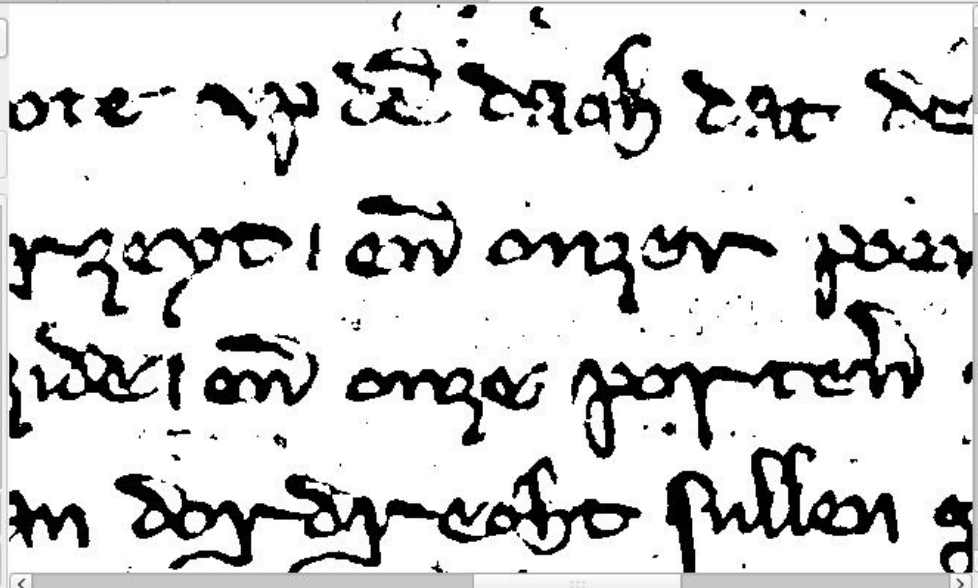


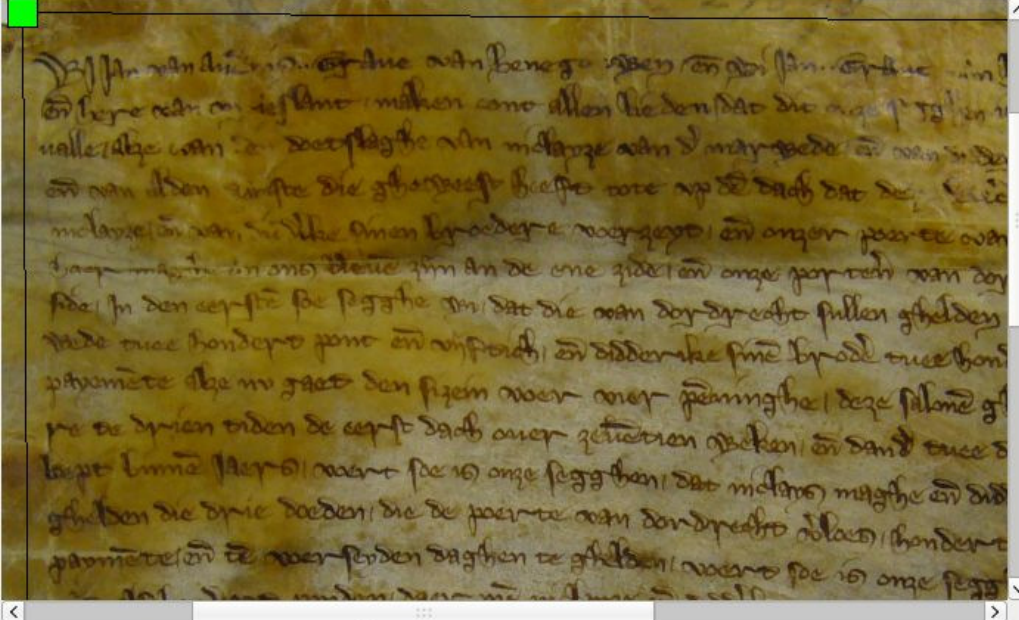
Image loaded.

GIWIS - oorkondes.corpus

Corpus Image Help

university of groningen  
Artificial Intelligence

Object: 1299j04a  
Image id: P1020844  
Writer: KaV  
Genuine: Unknown



Dataset Prepro Features Search Compare Performance test Clustering

Actions

- Random
- Runlength
- Brush
- Fraglets
- Hinge
- Hinge2
- Directions
- Inkwidth
- Quill
- QuillHinge

Compute  
Compute for all  
Remove all...

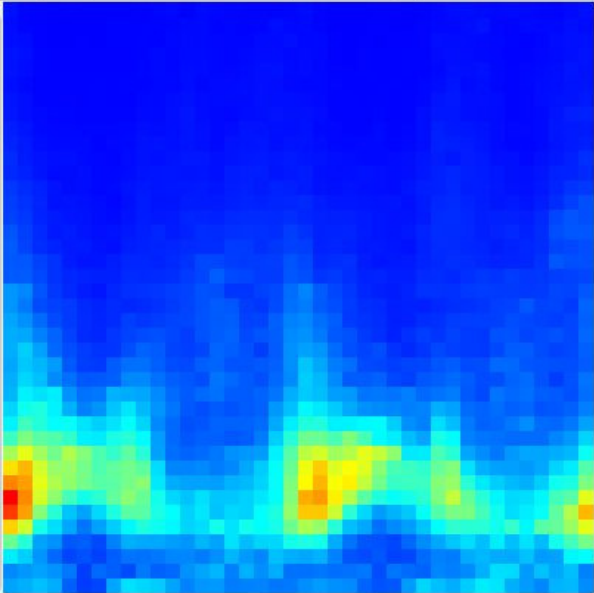



Image loaded.

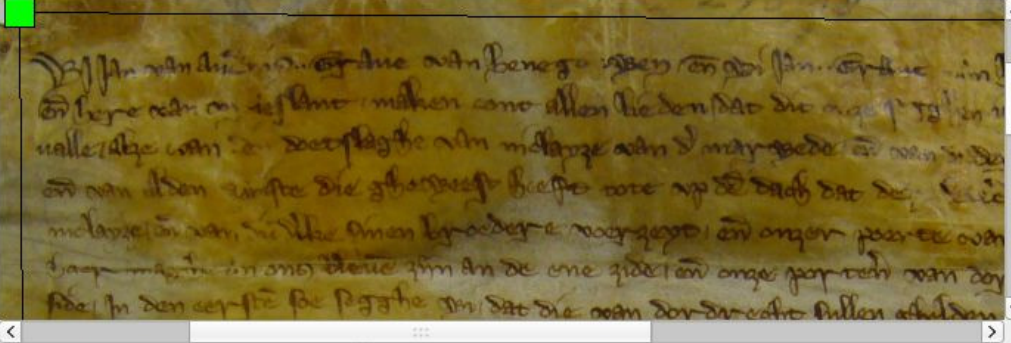


GIWIS - oorkondes.corpus

Corpus Image Help


**university of groningen**  
 Artificial Intelligence

Object:   
 Image id:   
 Writer:   
 Genuine:



Dataset Prepro Features **Search** Compare Performance test Clustering

Feature(s) used: Quill

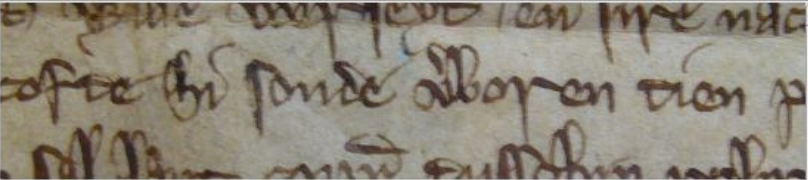
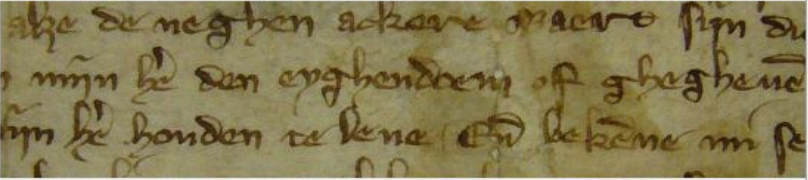
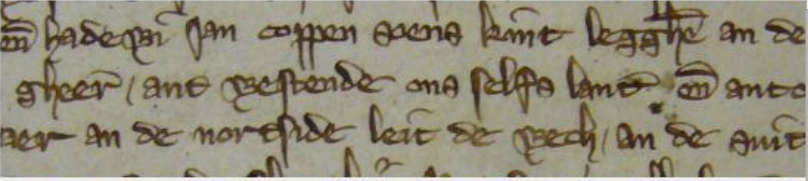
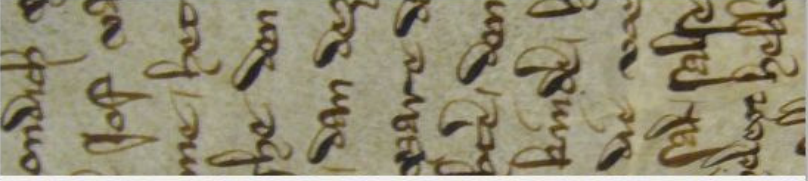
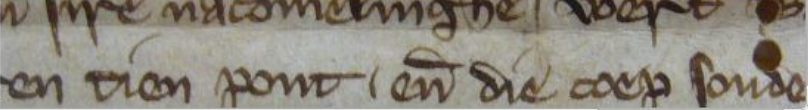
1	1299k24a Writer: KaV Distance: 0.03	
2	1301h05a Writer: KaV Distance: 0.04	
3	1313e14a Writer: KaV Distance: 0.04	
4	1303k11a Writer: KaV Distance: 0.04	
5	1299k24a Writer: KaV Distance: 0.04	

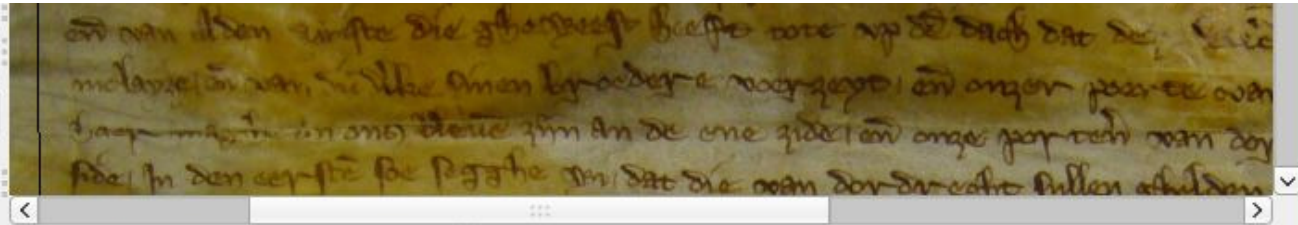
Image loaded.



Image id: P1020844

Writer: KaV

Genuine: Unknown

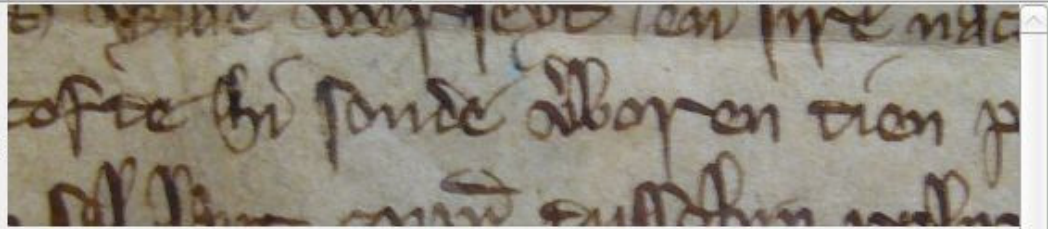


Dataset Prepro Features Search Compare Performance test Clustering

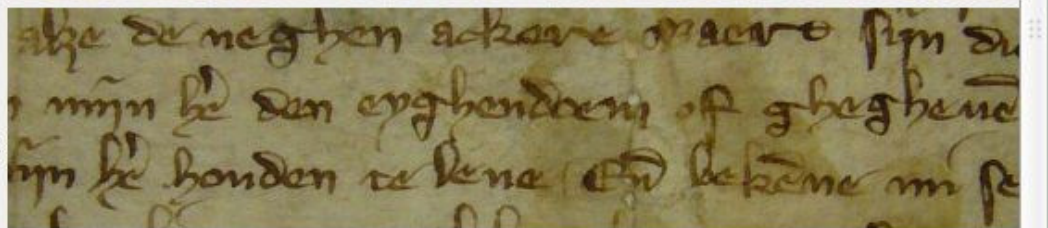
Feature(s) used: Quill

Search

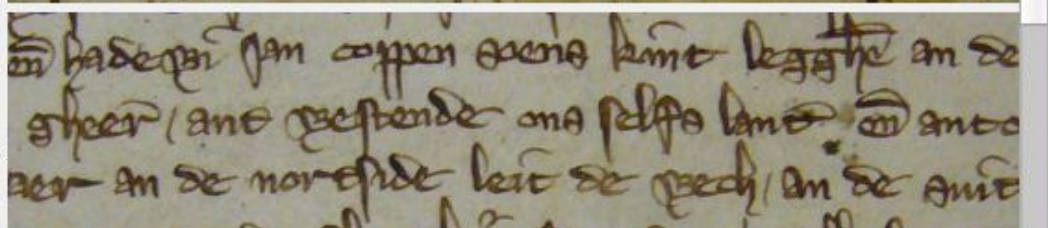
1 1299k24a  
Writer: KaV  
Distance: 0.03



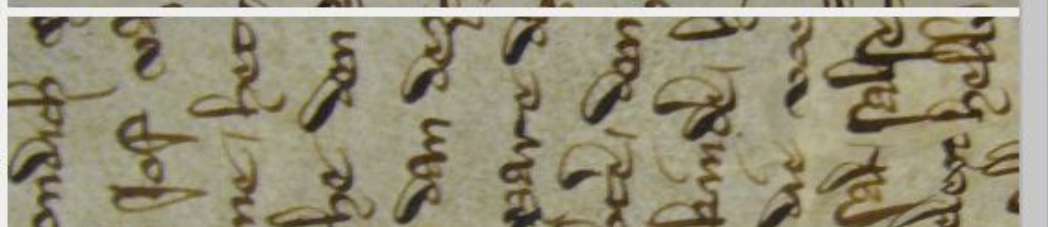
2 1301h05a  
Writer: KaV  
Distance: 0.04



3 1313e14a  
Writer: KaV  
Distance: 0.04



4 1303k11a  
Writer: KaV  
Distance: 0.04



5 1299k24a  
Writer: KaV  
Distance: 0.04

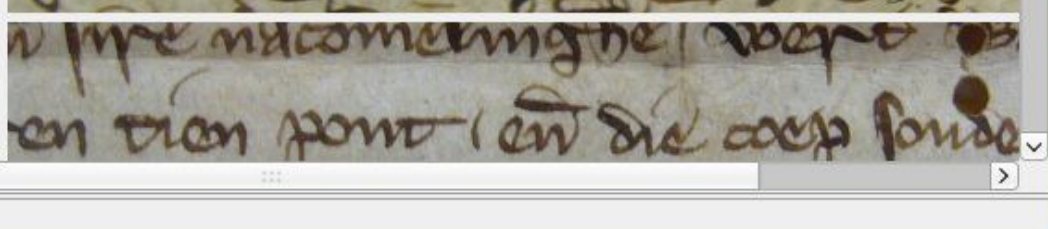


Image loaded.

# Charter written by chancery clerk Richard Vlec

**XXI.** 37

**W**illems Graue van hant van holl van zeelant Ende he van vure stane. daken ont allen luden. Want vor ons comen sin onse lieue ende ghebrauwe lude van onser part van quere die nu ghevoe het hebben sy met wel recht hebben en moeghen dueren hare part van stunde die men hem dan sculdich was Ende dan sy ons toegeden hare roe are are die sy van onsen van uader ende van ons hebben die handen die nement van buten somes noch oronde over han luden zegghe ach. Want onse wille es Ende wy hem gheorduen, die sy als alle stou als men hem woister stele In zeelant sculdich es, of sculdich worden sal. Winnen moeghen en dan onse dinsten en hare rechte dan of veruolghen vor den deken of promson. In quere die nu es of hier na wesen sal, als zedelyc en custumelyc was en als sy plaghien te dene bi onsen voruade en bi ons vor die zeuen jaer. Eer die melde core In zeelant ghemact was. Ende om die wy willen die vast en ghesteude handen en doen houde hebben wy desen brief beghelt met onsen zeghele. Behanghende. Ghelyken core teynor op sinter jans auond bypasta midden zoms. Inc. Jaer ons her. wy. at. vuf en dor. rich.





# RV: identification nos. 1-11 by m.i. & GIWIS

*Testcharter*

*Identification writing hand*

## GIWIS top 3

		m.i.	<b>1</b>	m.i.		<b>2</b>	m.i.		<b>3</b>	m.i.	
1	1334f18	RV	1338i10	RV	0.09	1343a12	RV	0.09	1342l20a	RV	0.10
2	1334h27	RV	1337h27a	RV	0.10	1338i10	RV	0.10	1334f18	RV	0.10
3	1335d02a1	RV	B1338g31	RV	0.08	1335d02a3	RV	0.09	1338l09a	RV	0.09
4	1335d02a3	RV	1338l09a	RV	0.08	1340i29	RV	0.08	1335d02a1	RV	0.09
5	1335f23a	RV	1340i29	RV	0.10	1335d02a1	RV	0.10	1337k10	RV	0.10
6	1335k19	RV	1342a12	RV	0.08	1342l20a	RV	0.10	1338i10	RV	0.10
7	1335l03	RV	1342a12	RV	0.06	1338j09a	RV	0.09	1335k19	RV	0.11
8	1336b2a	RV	1337h22a	RV	0.10	1337k30a	RV	0.10	1342a12	RV	0.10
9	1336d08	RV	1342l20a	RV	0.10	1335k19	RV	0.11	1337h27a	RV	0.11
10	1336e26	RV	1337h27a	RV	0.14	1342a12	RV	0.14	1335k19	RV	0.15
11	1337a25	RV	1335d02a3	RV	0.09	1338l09a	RV	0.10	1335d02a1	RV	0.11

# RV: identification nos. 12-23 by m.i. & GIWIS

*Testcharter*

*Identification writing hand*

## GIWIS top 3

		m.i.	1	m.i.		2	m.i.		3	m.i.	
12	1337e16	RV	1338e06	RV	0.07	1335d02a4	RV	0.11	B1338g31	RV	0.11
13	1337gx	RV	B1338g31	RV	0.09	1338l09a	RV	0.12	1338e06	RV	0.12
14	1337h22a	RV	1336b2a	RV	0.10	1338l09	RV	0.10	1337k30a	RV	0.10
15	1337h27a	RV	1338i10	RV	0.09	1334h27	RV	0.10	1342l20a	RV	0.10
16	1337i04a	RV	1337h27a	RV	0.09	<b>1335d02a2</b>	<b>n.i.</b>	<b>0.11</b>	<b>1326j05</b>	<b>JvL</b>	<b>0.12</b>
17	1337k10	RV	1338e06	RV	0.08	1340j06a	RV	0.09	B1338g31	RV	0.10
18	1337k30a	RV	1342a12	RV	0.08	1342l20a	RV	0.09	1338a12	RV	0.09
19	1338a12	RV	1342a12	RV	0.07	1337k30a	RV	0.09	1338j09a	RV	0.10
20	1338c17	RV	1338j09a	RV	0.09	1338l09	RV	0.09	1342a12	RV	0.10
21	1338e06	RV	1337e16	RV	0.07	1337k10	RV	0.08	1344d22a	RV	0.09
22	1338f19	RV	1338j09a	RV	0.10	1342l20a	RV	0.11	1342a12	RV	0.11
23	1338g08a	RV	<b>1303k06a</b>	<b>T</b>	<b>0.11</b>	1337h27a	RV	0.12	1337e16	RV	0.12



# RV: identification nos. 24-33 by m.i. & GIWIS

*Testcharter*

*Identification writing hand*

## GIWIS top 3

		m.i.	<b>1</b>	m.i.		<b>2</b>	m.i.		<b>3</b>	m.i.	
24	B1338g31	RV	1335d02a1	RV	0.08	1338l09a	RV	0.09	1337gx	RV	0.09
25	1338h22a	RV	1338i10	RV	0.09	1342a12	RV	0.09	1340f07a	RV	0.10
26	1338i10	RV	1342a12	RV	0.08	1338h22a	RV	0.09	1334f18	RV	0.09
27	1338j09a	RV	1342a12	RV	0.07	1338c17	RV	0.09	1335l03	RV	0.09
28	1338l09	RV	1338c17	RV	0.09	1342a12	RV	0.10	1337h22a	RV	0.10
29	1338l09a	RV	1335d02a3	RV	0.08	B1338g31	RV	0.09	1339c10	RV	0.09
30	1339c10	RV	1340j06a	RV	0.06	1340i29	RV	0.07	1338l09a	RV	0.09
31	1339c20	RV	1335d02a3	RV	0.09	1338l09a	RV	0.11	1340i29	RV	0.11
32	1339f17	RV	1335d02a3	RV	0.11	1338l09a	RV	0.11	1339c10	RV	0.12
33	1339g20	RV	1340j06a	RV	0.09	1340i29	RV	0.09	<b>1308k05a</b>	<b>V</b>	<b>0.11</b>

# RV: identification nos. 34-43 by m.i. & GIWIS

*Testcharter*

*Identification writing hand*

## GIWIS top 3

		m.i.	<b>1</b>	m.i.		<b>2</b>	m.i.		<b>3</b>	m.i.	
34	B340e12	RV	1340i29	RV	0.13	1338l09a	RV	0.14	<b>1309a05a</b>	<b>n.i.</b>	<b>0.14</b>
35	1340f07a	RV	1342a12	RV	0.07	<b>1310g08f</b>	<b>S</b>	<b>0.09</b>	1342l20a	RV	0.09
36	1340f09a	RV	1339g20	RV	0.12	1340j06a	RV	0.13	1340i29	RV	0.14
37	1340i29	RV	1340j06a	RV	0.05	1339c10	RV	0.07	1335d02a3	RV	0.08
38	1340j06a	RV	1340i29	RV	0.05	1339c10	RV	0.06	1339g20	RV	0.09
39	1341c29a	RV	1340i29	RV	0.12	1339c10	RV	0.12	<b>1301c08a</b>	<b>n.i.</b>	<b>0.12</b>
40	1342a12	RV	1335l03	RV	0.06	1338a12	RV	0.07	1340f07a	RV	0.07
41	1342a26	RV	1342a12	RV	0.09	1337h27a	RV	0.12	1338a12	RV	0.12
42	1342l20a	RV	1342a12	RV	0.08	1337k30a	RV	0.09	1338i10	RV	0.09
43	1344d22a	RV	1338e06	RV	0.09	1337e16	RV	0.11	1335d02a4	RV	0.11

# Usual procedure: subscription hand ≠ charter hand

Willelmus... Graue van heymd van holland van zeland en hie van orichtland. gaken ons allen lude dat nu hem mitsse p...  
ghenomen hebben en nemen omc dien st die hi ons gheden heu...  
ghedeffen es binne onsen...  
soute en rechtveren die...  
es binne onsen lande...  
zake dat yement op hem...  
noven doen alle onsen...  
wonschaft waren ju...  
dichtes na onsen...  
Jussu dno. curat ad...  
dno. by. de...  
f. de...  
[A. de...]

Jussu dno. curat ad...  
dno. by. de...  
f. de...  
[A. de...]

mer at sven...  
ubieden at onsen...  
goed de...  
ten an...  
soudes hi...  
dier hi...  
waer...  
f. de...  
de...  
de...

Willelmus... Graue van heymd van holland van zeland en hie van...  
ghenomen hebben en nemen omc dien st die hi ons gheden heu...  
ghedeffen es binne onsen lande...  
soute en rechtveren die nu sien of namels wesen...  
sullen...



# Charter written and signed by Richard Vlec

Willems... Graue van Breyne van holl om ge  
dat ghi onder goet en verheid als van  
toe ghehouden souden hebben. dat hi hem schrey  
en e heid Janne heid Simon van benchey en de  
ken deuste als hi van ons gheuen hebben he  
trich van onser vesten met desen briene beze  
pnce araryen ay dalene dach. mo. jor.  
p dmy  
Frans. Dub. de bellomote. a falcomote / a alys de gfilw  
.. Richard Vlec

Polland en vullen den  
ans zome en hessel dat p  
te bedraghen. Vore  
vullen en van hessle corf  
helden. En des maken  
i. sandey tgho pomand  
E an de saure

*Testcharter*

*Identification writing hand*

**GIWIS top 3**

			<b>1</b>				<b>2</b>				<b>3</b>
1	<b>1337h27a</b>	<b>RV</b>	1338i10	rv	0.09	1334h27	rv	0.10	<b>1342l20a</b>	<b>RV</b>	<b>0.10</b>
2	<b>1337k10</b>	<b>RV</b>	<b>1338eo6</b>	<b>RV</b>	<b>0.08</b>	<b>1340j06a</b>	<b>RV</b>	<b>0.09</b>	B1338g31	rv	0.10
3	<b>1337k30a</b>	<b>RV</b>	1342a12	rv	0.08	<b>1342l20a</b>	<b>RV</b>	<b>0.09</b>	<b>1338a12</b>	<b>RV</b>	<b>0.09</b>
4	<b>1338a12</b>	<b>RV</b>	1342a12	rv	0.07	<b>1337k30a</b>	<b>RV</b>	<b>0.09</b>	<b>1338j09a</b>	<b>RV</b>	<b>0.10</b>
5	<b>1338c17</b>	<b>RV</b>	<b>1338j09a</b>	<b>RV</b>	<b>0.09</b>	<b>1338l09</b>	<b>RV</b>	<b>0.09</b>	1342a12	rv	0.10
6	<b>1338e06</b>	<b>RV</b>	1337e16	rv	0.07	<b>1337k10</b>	<b>RV</b>	<b>0.08</b>	1344d22a	rv	0.09
7	<b>1338f19</b>	<b>RV</b>	<b>1338j09a</b>	<b>RV</b>	<b>0.10</b>	<b>1342l20a</b>	<b>RV</b>	<b>0.11</b>	1342a12	rv	0.11
8	<b>1338h22a</b>	<b>RV</b>	1338i10	rv	0.09	1342a12	rv	0.09	<b>1340f07a</b>	<b>RV</b>	<b>0.10</b>
9	<b>1338j09a</b>	<b>RV</b>	1342a12	rv	0.07	<b>1338c17</b>	<b>RV</b>	<b>0.09</b>	1335l03	rv	0.09
10	<b>1338l09</b>	<b>RV</b>	<b>1338c17</b>	<b>RV</b>	<b>0.09</b>	1342a12	rv	0.10	1337h22a	rv	0.10
11	<b>1338l09a</b>	<b>RV</b>	1335d02a3	rv	0.08	B1338g31	rv	0.09	<b>1339c10</b>	<b>RV</b>	<b>0.09</b>
12	<b>1339c10</b>	<b>RV</b>	<b>1340j06a</b>	<b>RV</b>	<b>0.06</b>	<b>1340i29</b>	<b>RV</b>	<b>0.07</b>	<b>1338l09a</b>	<b>RV</b>	<b>0.09</b>
13	<b>1339f17</b>	<b>RV</b>	1335d02a3	rv	0.11	<b>1338l09a</b>	<b>RV</b>	<b>0.11</b>	<b>1339c10</b>	<b>RV</b>	<b>0.12</b>
14	<b>1339g20</b>	<b>RV</b>	<b>1340j06a</b>	<b>RV</b>	<b>0.09</b>	<b>1340i29</b>	<b>RV</b>	<b>0.09</b>	1308k05a	V	0.11
15	<b>1340f07a</b>	<b>RV</b>	1342a12	rv	0.07	1310g08f	S	0.09	<b>1342l20a</b>	<b>RV</b>	<b>0.09</b>
16	<b>1340f09a</b>	<b>RV</b>	<b>1339g20</b>	<b>RV</b>	<b>0.12</b>	<b>1340j06a</b>	<b>RV</b>	<b>0.13</b>	<b>1340i29</b>	<b>RV</b>	<b>0.14</b>
17	<b>1340i29</b>	<b>RV</b>	<b>1340j06a</b>	<b>RV</b>	<b>0.05</b>	<b>1339c10</b>	<b>RV</b>	<b>0.07</b>	1335d02a3	rv	0.08
18	<b>1340j06a</b>	<b>RV</b>	<b>1340i29</b>	<b>RV</b>	<b>0.05</b>	<b>1339c10</b>	<b>RV</b>	<b>0.06</b>	<b>1339g20</b>	<b>RV</b>	<b>0.09</b>
19	<b>1342l20a</b>	<b>RV</b>	1335d02a3	rv	0.08	<b>1337k30a</b>	<b>RV</b>	<b>0.09</b>	1335d02a1	rv	0.09



Writing samples Richard Vlec  
GIWIS: distance = 0.05

Willem.. Graue van Hevyn van Hollant van gelant en he van  
stadeloed te quiten onsen heven en gheculden. Scyden Baed-  
ghelofcen als zij son ons ghelofte hebben hem Willem van  
palanen sines newe Janne Eriere. Willem Berremay en  
zestien stelinghe en neghen penninghe groter conen al

Willem.. Graue van Hevyn van Hollant van gelant en he van  
dreche alsulke gracie ghedien hebben omme dienst die hi on  
dan toe behore en die visten te doughten also groot al  
maers die gheloghen sijn west waerds van loememere g  
die en gaertu dan up hebben wort omme honden sal van  
misen zeshel - gheghene to



1st = RV: 1339 July 20

2nd = V: 1308 November 5

GIWIS: distance = 0.11

Willems... Graue van Heneg van holt van gelame en here van  
dat ghi onderzouet om waerheid als van dat just  
toe ghehouden souden hebben. dat hi hem seluen dierfom be  
en e here Janne here Simon van benchey en Willem den en  
ken dienste als hi van ons gheuen hebben. hoe dat hi he  
trich van onsen vanden van Heneg van gelame

Willems Graue van Heneg van holt van gelame en here van  
singe onze baem van middelborch, dat ghi der abdissen van  
van den goede daer haer de abbe van middelborch onbesreit of  
haer in besreit of ghesceeft heeft, is dat sake dat de abbe  
die hare hem of ghesceeft hebben, en die mee en toe ghegheue



Writing samples Richard Vlec  
GIWIS: distance = 0.14

Willems.. Graue van heym van holl van zelanc en he van  
goede vrede van eiser porcen van roddanc. dat hebben me open  
sac de den edem dat sijn beghen saken en ghesaet sijn op h  
hem dat den hebben op v zeyden en op v godesinken. dat  
en ont sulle is dat sijn hebben in den manieren condranc

Willems.. Graue van heym van hollanc van zelanc en he van  
drecht alsulke gracie ghedien hebben omme dienst die hi on  
dan toe behoort en die wiskene te doughten. also groot al  
maers die ghelegghen sijn west waerds van loememere g  
die ou gaer te dan up hebben. wort omme houden sal van  
die ou gaer te dan up hebben. wort omme houden sal van  
die ou gaer te dan up hebben. wort omme houden sal van

# More about GIWIS and the Quill feature:

- Axel Brink, *Robust and applicable handwriting biometrics* [PhD thesis University of Groningen, December 2011].
- A. Brink, J. Smit, M. Bulacu, and L. Schomaker, “Writer identification using directional ink-trace width measurements.” *Pattern Recognition*, (45):162-171, 2012.  
doi: 10.1016/j.patcog.2011.07.005
- J. Smit, “The death of the palaeographer? Experiences with the Groningen Intelligent Writer Identification System (GIWIS)” [*Archiv für Diplomatik*]