Diplomarbeitspräsentation

FAKULTÄT FÜR !NFORMATIK
Faculty of Informatics

Efficient Layout Analysis of Ancient Manuscripts Using Local Features

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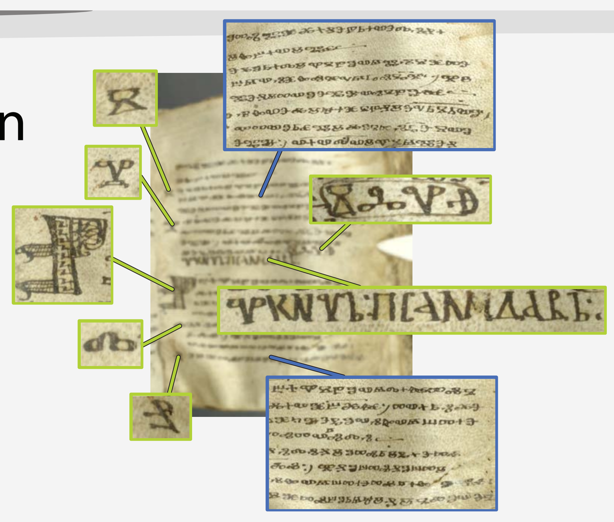
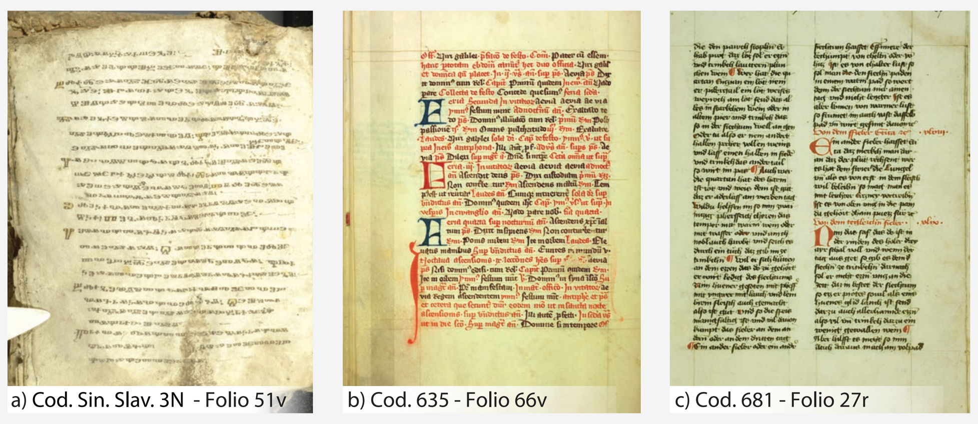
Introduction

- **Layout analysis** of ancient handwritten documents
  - Glagolitic, 11th century (a)
  - Latin, 14th century (b)
  - German, Latin, 1396 (c)



- Challenges
  - Heterogeneously textured, stained
  - Corrugated writing support
  - Faded-out ink
  - Fluctuating text lines
  - Different writing styles
  - Varying layouts



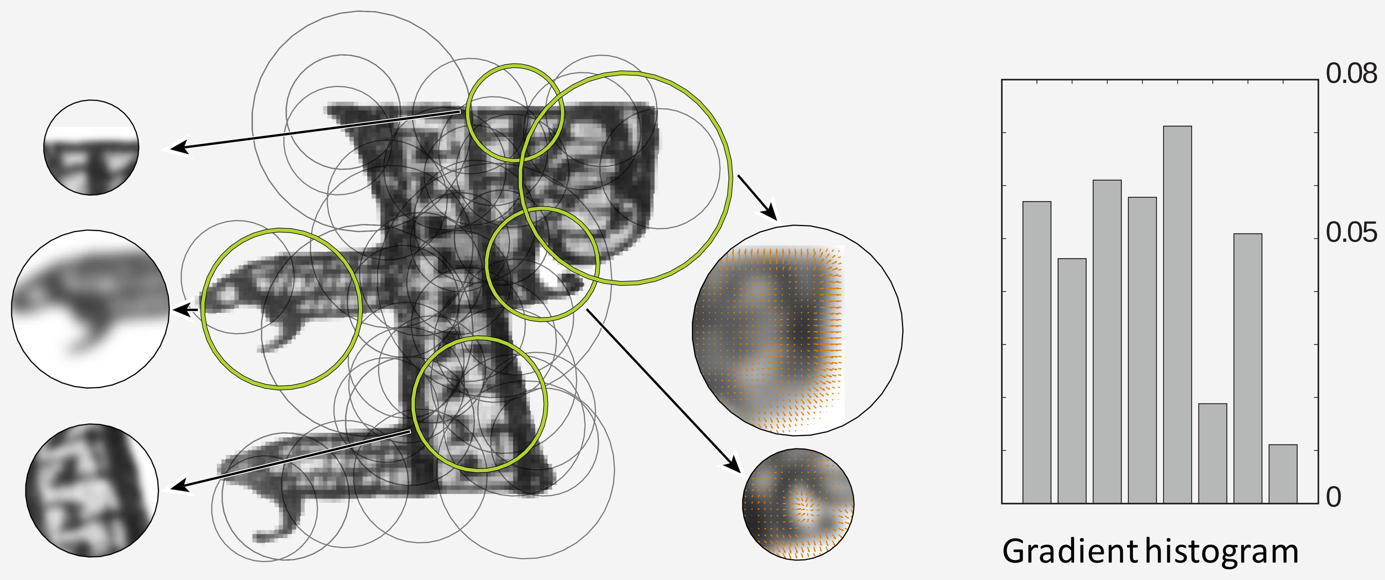
a) Cod. Sin. Slav. 3N - Folio 51v   b) Cod. 635 - Folio 66v   c) Cod. 681 - Folio 27r

- Layout elements have structural similarities on the local level
  - Outlines, hachure, elongated strokes, angular/round shapes

Glagolitic characters O and N as decorative initial, small initial, headline and character in regular text.

Methodology

- Describing layout elements (junctions, endings, corners, circles)
  - Interest Points (IP) by means of Difference of Gaussian (**DoG**)
    - 2nd order derivative scale-space
    - Detecting blob like regions at local extrema
  - Scale Invariant Feature Transform (**SIFT**)
    - Gradient magnitude and gradient orientation
    - Gradient histograms of local patches



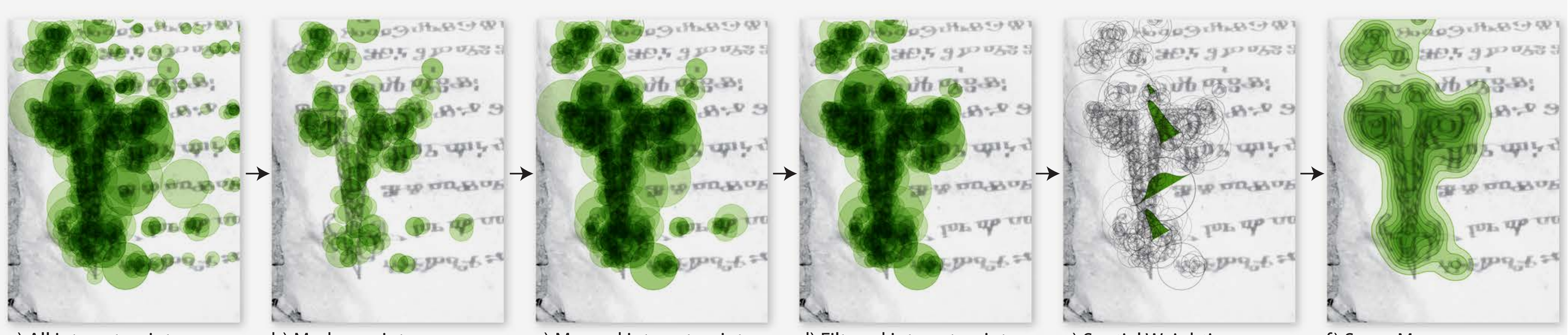
Gradient histogram

- Supervised Classification (**SVM**)
  - Classes: regular text, embellishments
    - Headlines and initials belong to the same class
    - Similar characteristics of local structure

Methodology - Localization

Cascading localization algorithm exploiting DoG IP

- Scale-based weighting
  - Penalizing diminutive and large scales
  - small: background clutter, dots, small structures, speckles
  - large: whole decorative initials, spots, stains, ripples
- Marker points (b)
  - IP of a specific size are most reliable
- Joining with IP overlapping with markers (c)
- Region-based processing (d)
  - Rejecting small, sparse and unreliable object candidates
- Score maps (e, f)

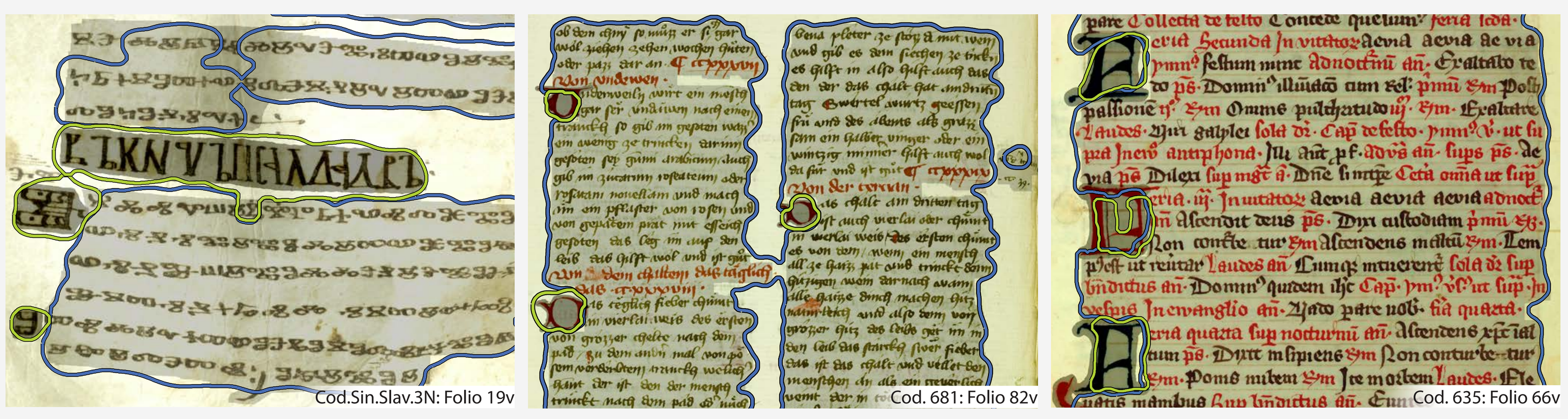


a) All interest points   b) Marker points   c) Merged interest points   d) Filtered interest points   e) Spatial Weighting   f) Score Map

[1] of the decorative element class

Results

System evaluation
- Random sample of 100 pages per manuscript
- Varying layouts and writing styles
- Trained with image patches containing layout elements
- Manually labeled ground truth



Cod.Sin.Slav.3N: Folio 19v   Cod. 681: Folio 82v   Cod. 635: Folio 66v

per pixel evaluation	Cod.Sin.Slav.3N Rec.	Prec.	$F_{0.5}$	Cod. 635 Rec.	Prec.	$F_{0.5}$	Cod. 681 Rec.	Prec.	$F_{0.5}$
all classes[1]	0.873	0.924	**0.914**	0.984	0.969	**0.972**	0.977	0.974	**0.975**
main body text	0.899	0.939	0.930	0.995	0.974	0.978	0.981	0.979	0.979
DE[2]	0.513	0.667	0.629	0.634	0.765	0.735	0.566	0.712	0.677

Recall, Precision and $F_{0.5}$-score for the manuscripts

[1] 92 % of the classified pixels belong to the regular text
[2] decorative elements

Conclusion

- System handles degraded manuscript images (no binarization)
- Exploiting the local structure similarity of the elements
  - Local descriptors at dedicated positions
- Cascading localization algorithm based on reliable interest points

Future work

- Distinction between decorative initials, plain initials, headings
- Text line extraction method
  - Following the highest density of interest points
  - Density Based Clustering

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