Texture-based classification of forest types using high resolution aerial photographs

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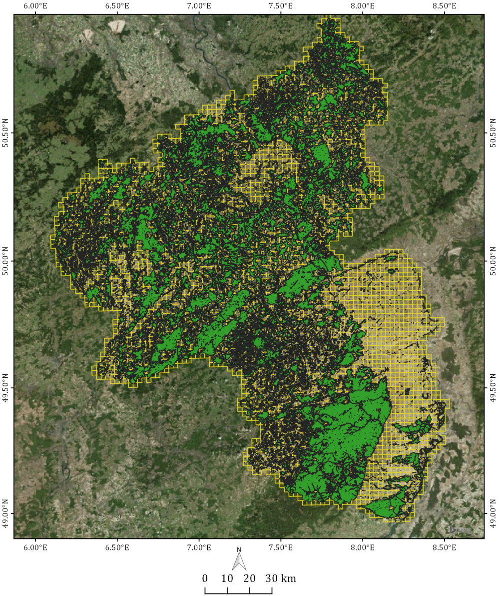
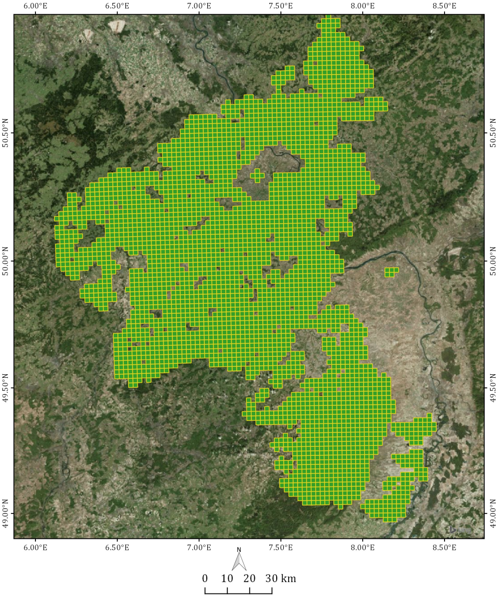
24./25. September 2015
Geozentrum der Universität Bonn

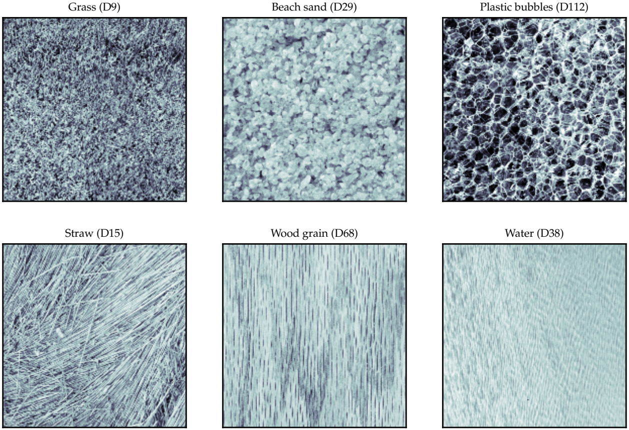


Coverage of high resoultion aerial images in RLP (5266 tiles)



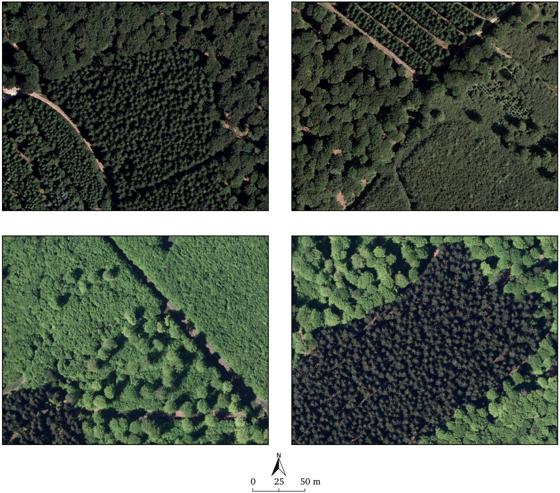
Coverage of tiles with at least 50% forest cover (3645 tiles)

Natural textures

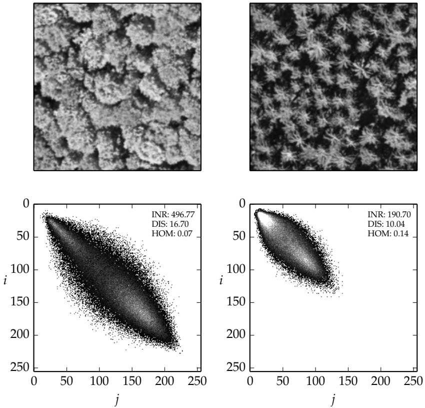


Brodatz library of natural textures [Weber, 1997]

Texture of forest types



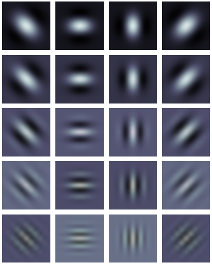
GLCM



Gray level co-occurrence texture features

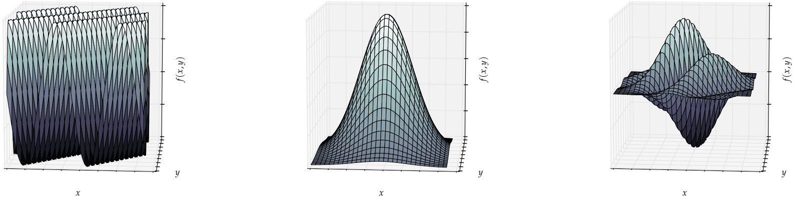
- spatial domain
- second-order statistics
- GLCM ($P(i, j|\theta, \delta)$)
- scalar texture descriptors

Gabor filter banks



Gabor filter implementations

- frequency domain
- windowed Fourier transform
- filter banks ($\Psi(x, y, f_l, \theta_k)$)
- Gabor energy feature



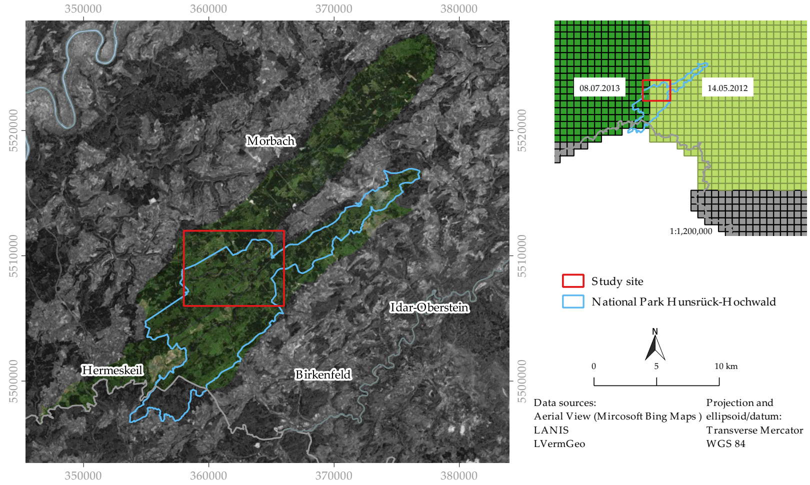
Research questions

main question

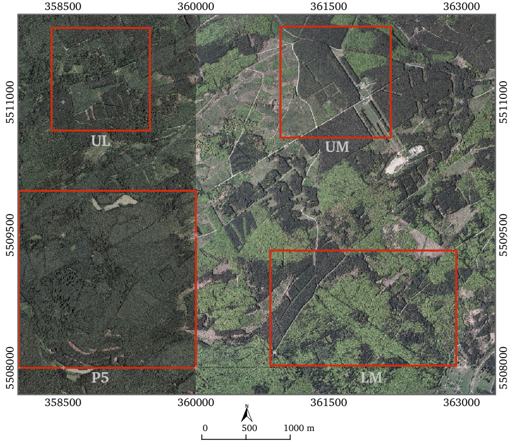
Is a texture-based classification of forest types possible?

secondary question

Which combination of parameters performs best?


350000
360000
370000
380000
5520000
5510000
5500000
Morbach
Idar-Oberstein
Hermeskeil
Birkenfeld
08.07.2013
14.05.2012
1:1,200,000
Study site
National Park Hunsrück-Hochwald
N
0
5
10 km
Data sources:
Aerial View (Mircosoft Bing Maps)
LANIS
LVermGeo
Projection and
ellipsoid/datum:
Transverse Mercator
WGS 84

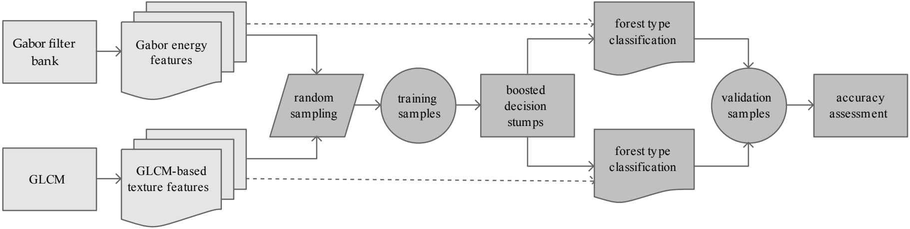
Setup



Texture processing

- R - G - B - NIR - Y
- window size
- spatial resolution
- orientation

Workflow

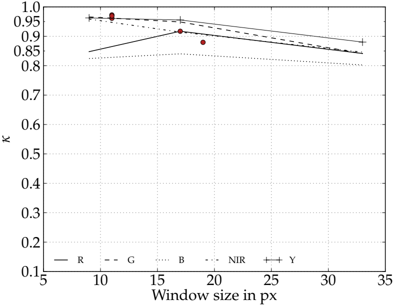

Gabor filter bank
Gabor energy features
GLCM
GLCM-based texture features
random sampling
training samples
boosted decision stumps
forest type classification
forest type classification
validation samples
accuracy assessment

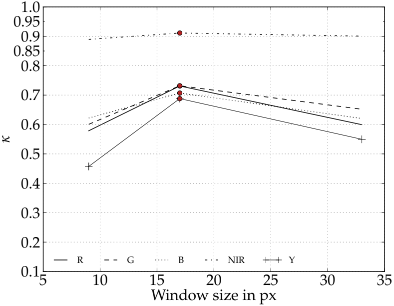
Classification accuracies

A selection of the highest achieved classification accuracies across all conducted texture-based classifications.

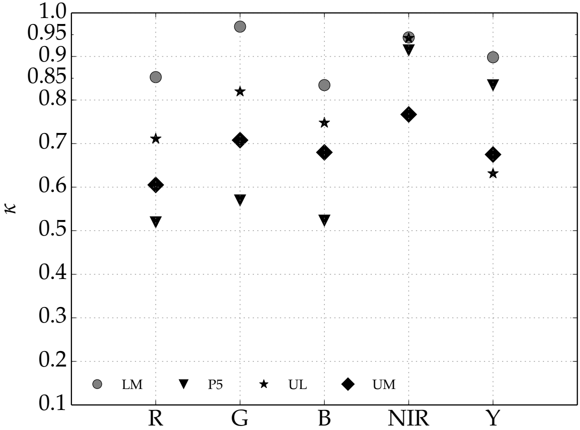
Setup	Subset	κ	σ
$GLCM_{Y-11}$	LM	0.97	0.01
$GLCM_{G-9}$	LM	0.97	0.02
$D1_{G}$	LM	0.97	0.03
$D2_{NIR}$	LM	0.95	0.02
$D1_{NIR}$	UL	0.94	0.04
$GLCM_{G}$	LM_{2m}	0.93	0.02
$D1_{NIR}$	P5	0.91	0.03
$GLCM_{NIR-17}$	P5	0.91	0.07
$GLCM_{NIR-9}$	UL	0.92	0.05
$GLCM_{Y-17}$	UM	0.86	0.08

GLCM-based classification (subset LM and P5)

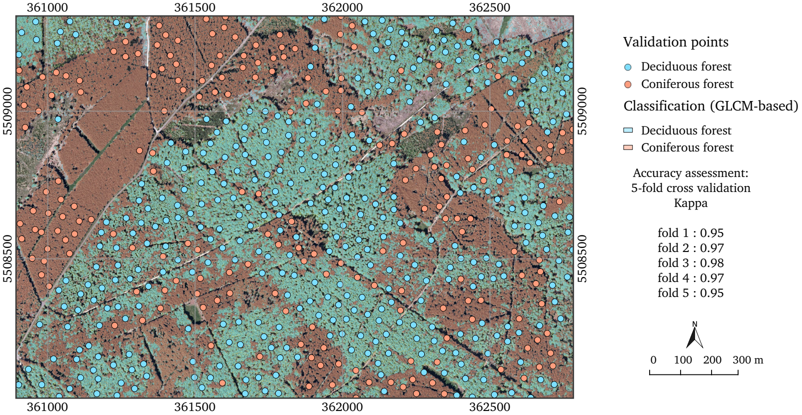




Gabor energy based classification



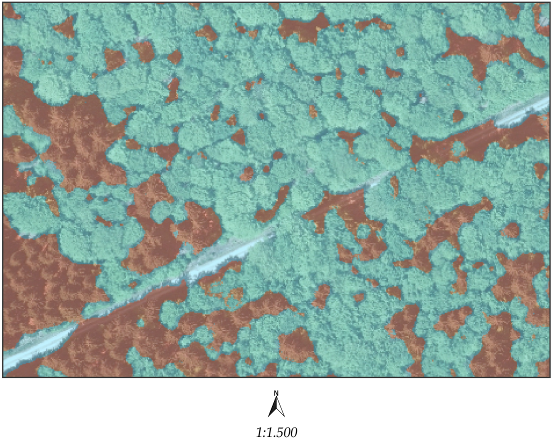
Subset LM


361000
361500
362000
362500
5509000
5508500
Validation points
Deciduous forest
Coniferous forest
Classification (GLCM-based)
Deciduous forest
Coniferous forest
Accuracy assessment:
5-fold cross validation
Kappa
fold 1 : 0.95
fold 2 : 0.97
fold 3 : 0.98
fold 4 : 0.97
fold 5 : 0.95
N
0 100 200 300 m

Subset LM

1:1.500

Subset LM

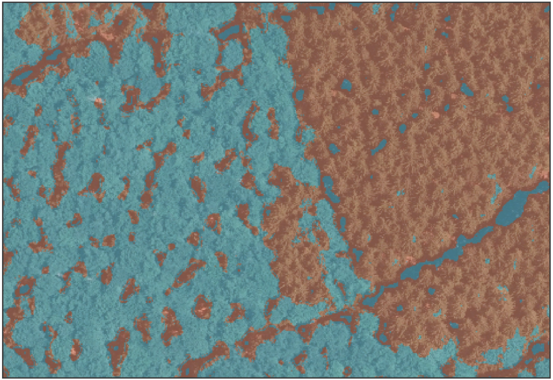


Subset P5

N

1:1.500

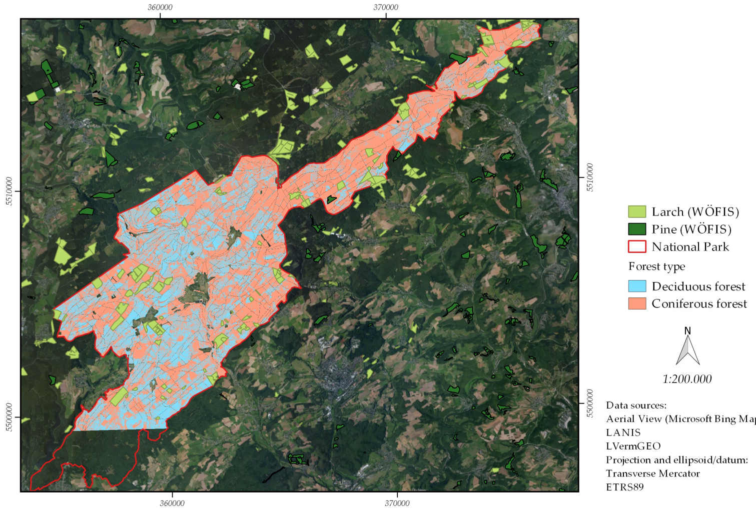
Subset P5



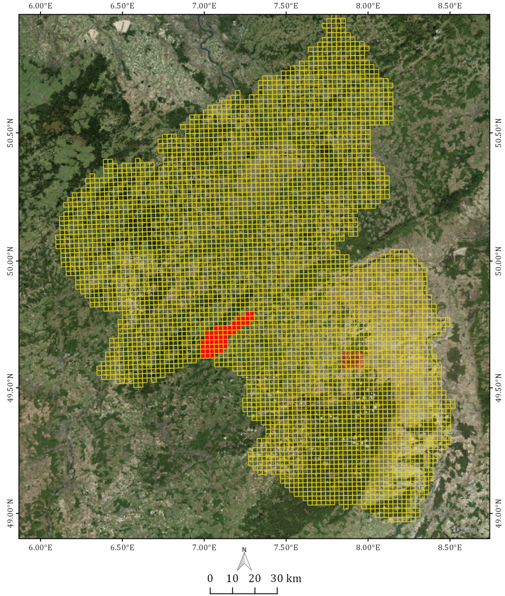
N

1:1.500

Hunsrück-Hochwald National Park

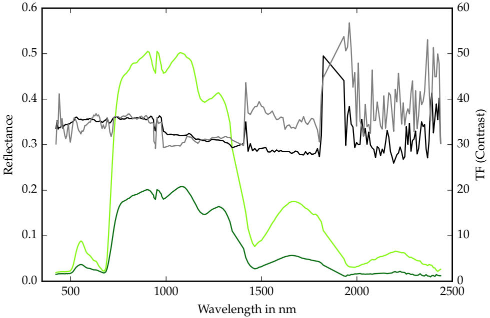


Data sources:
Aerial View (Microsoft Bing Maps)
LANIS
LVermGEO
Projection and ellipsoid/datum:
Transverse Mercator
ETRS89



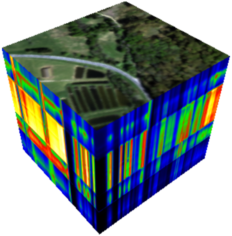
Coverage of generated forest type maps (48 tiles)

Focus areas



GLCM in 3D

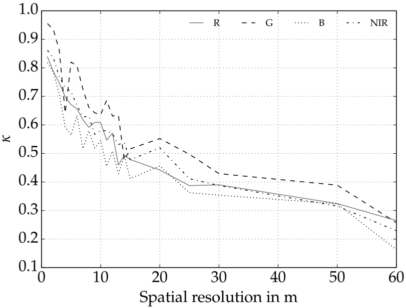
- texture of hyperspectral images
- volumetric texture features
- VGLCM [Tsai et al., 2007]



Focus areas

Topics

- spectral and textural information
- change in scale
- texture features based on geomertic properties of the GLCM
- image segmentation



References

Tsai, F., Chang, C. K., Rau, J. Y., Lin, T. H. and Liu, G. R. (2007)
3D computation of gray level co-occurrence in hyperspectral image cubes.
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