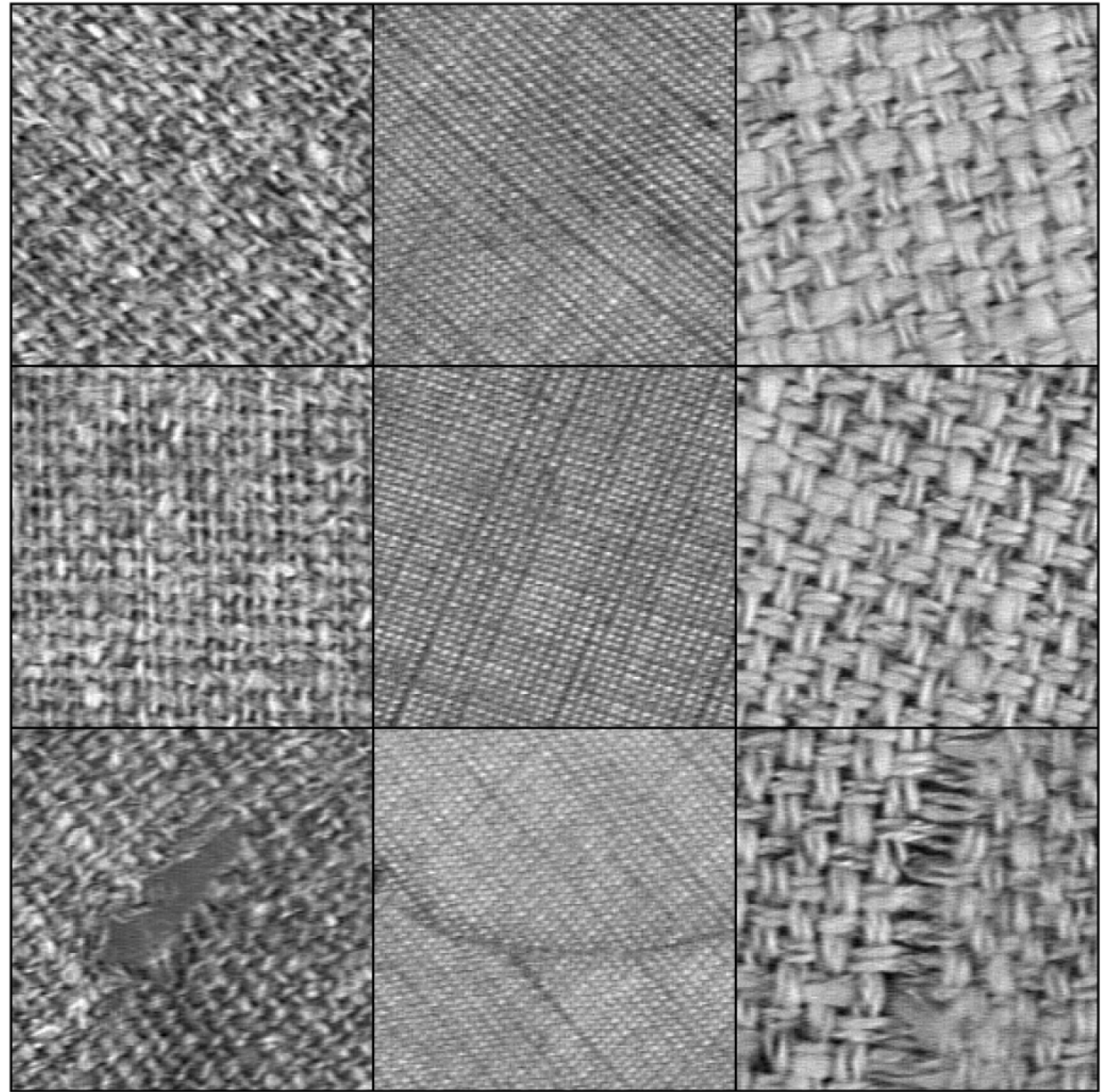
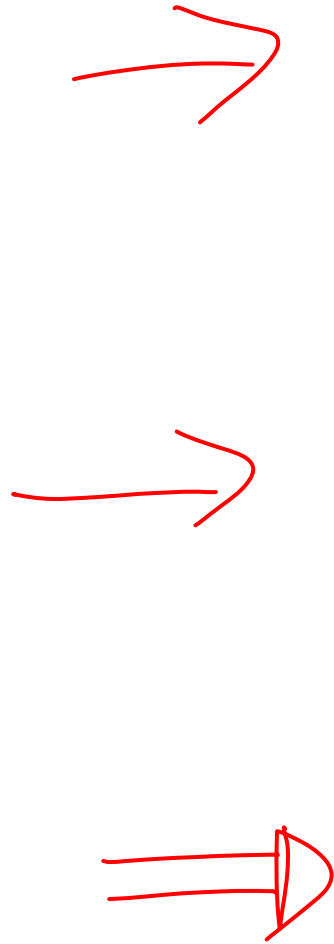


Anwendungen:

Invarianten über Gruppenmittel

- Sichtprüfungsaufgaben (Textilien)
- Bildsuchmaschinen (query by example)
SIMBA und MICHELSCOPE
- Automatische Klassifikation von Blütenpollen

Visual inspection of textiles with anisotropic texture



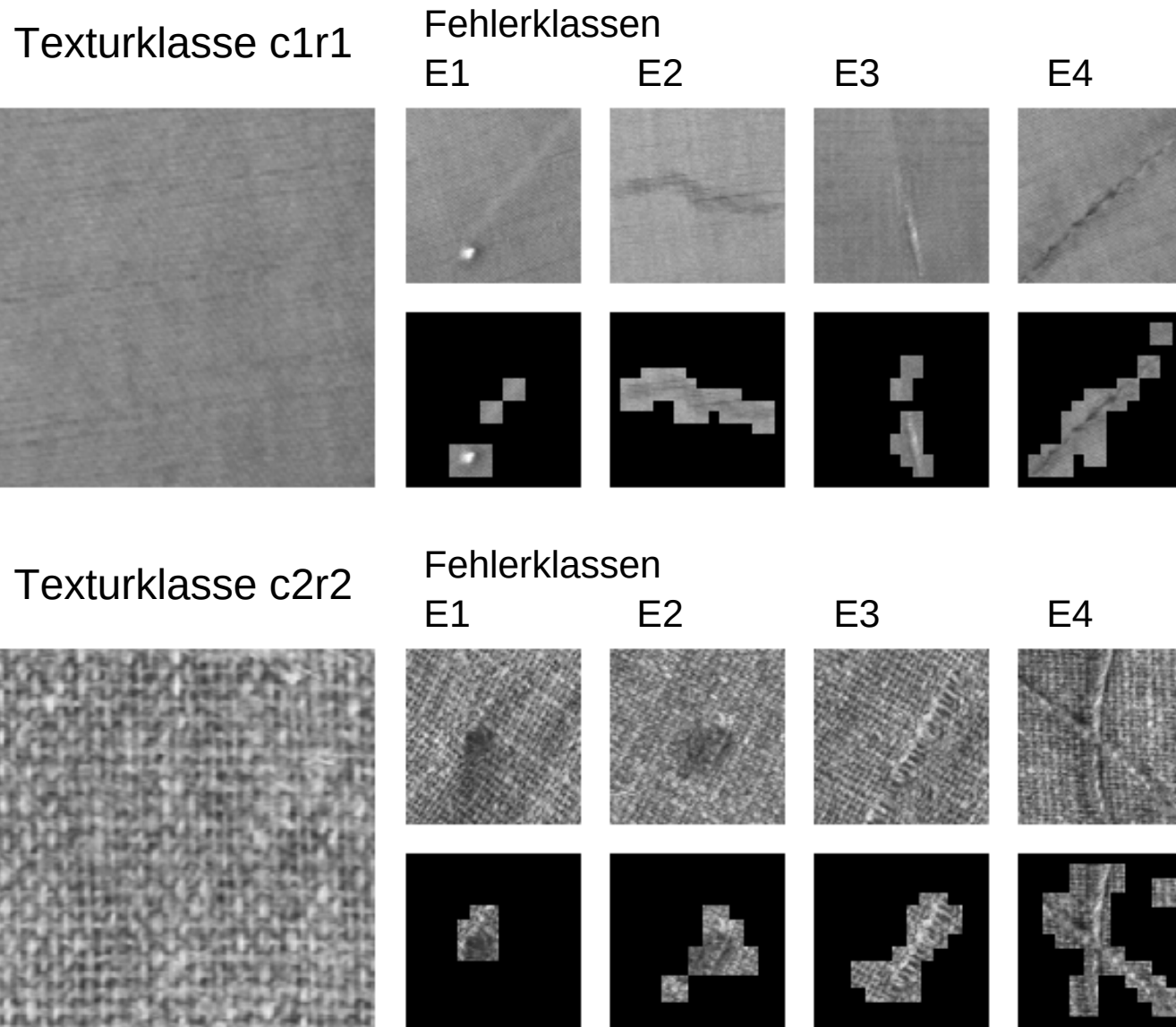
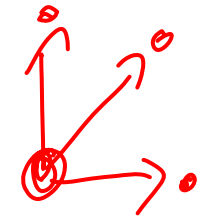
Textildatenbank TILDA

<http://www.informatik.uni-freiburg.de/~lmb/tilda> (ca. 3200 images)



Texturdefektdetektion bei Textilstoffen

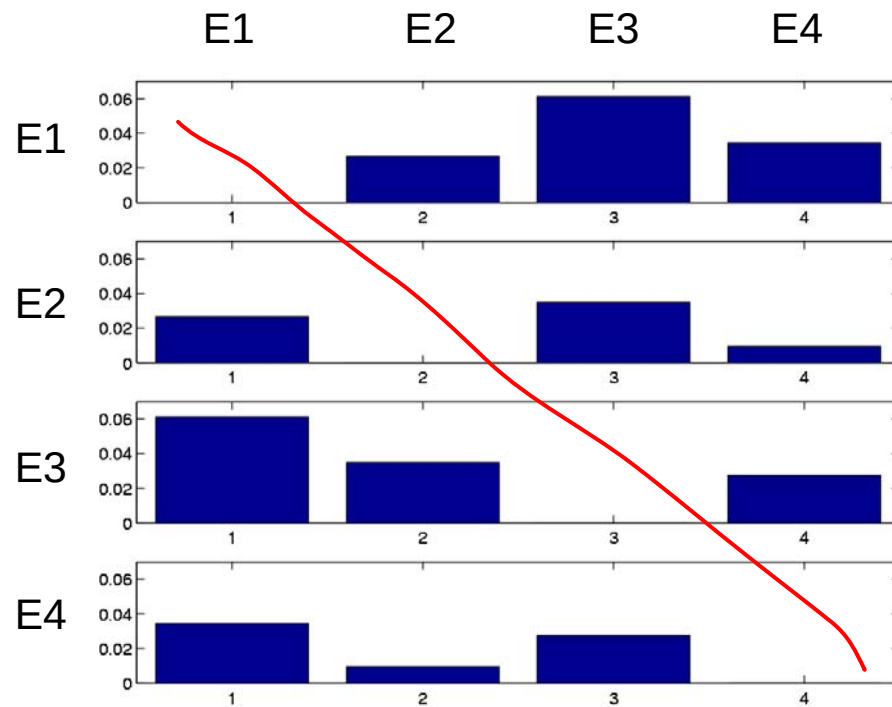
Segmentierung der Defekte



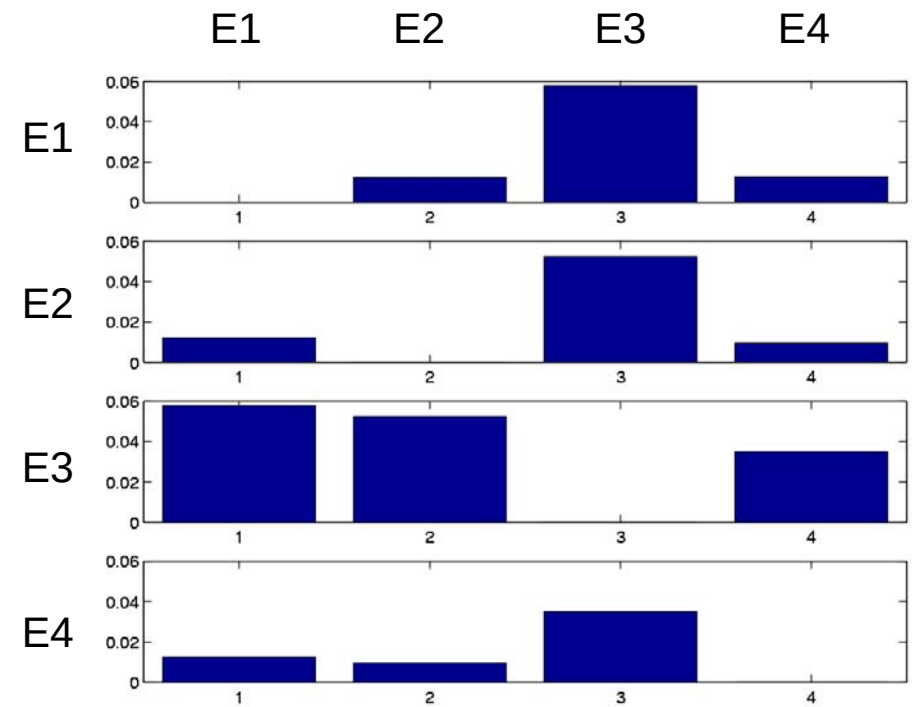
Texturdefektdetektion bei Textilstoffen

Diskriminierung der Defektklassen

Klassendistanzen Texturklasse c1r1

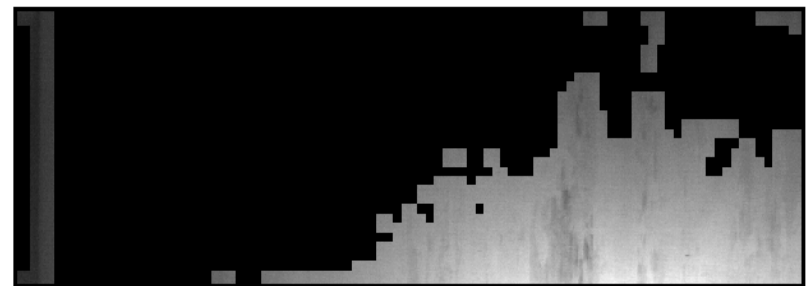
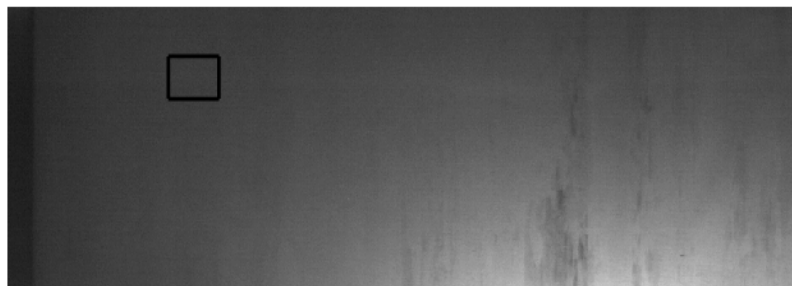
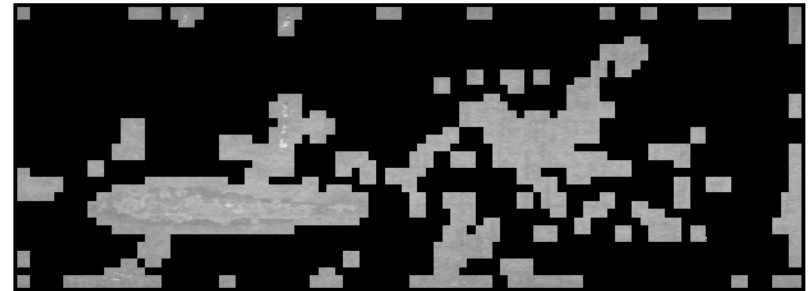
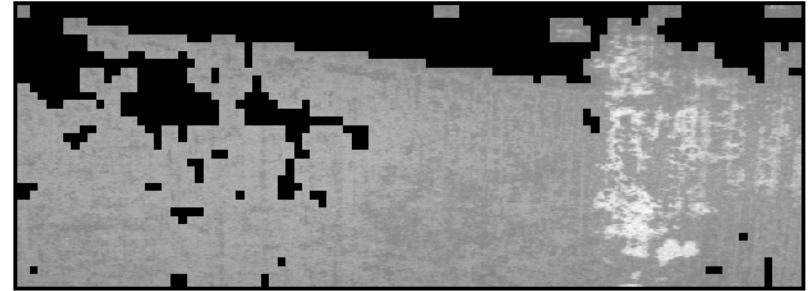
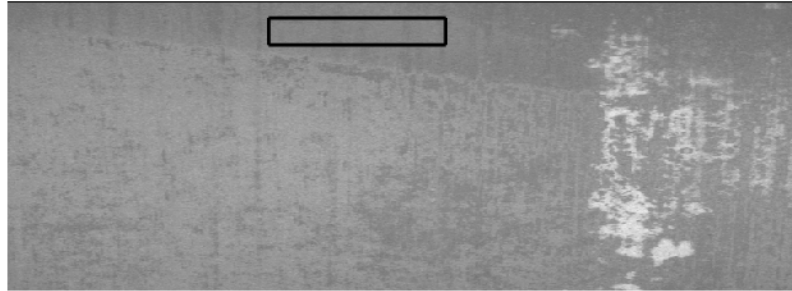


Klassendistanzen Texturklasse c2r2

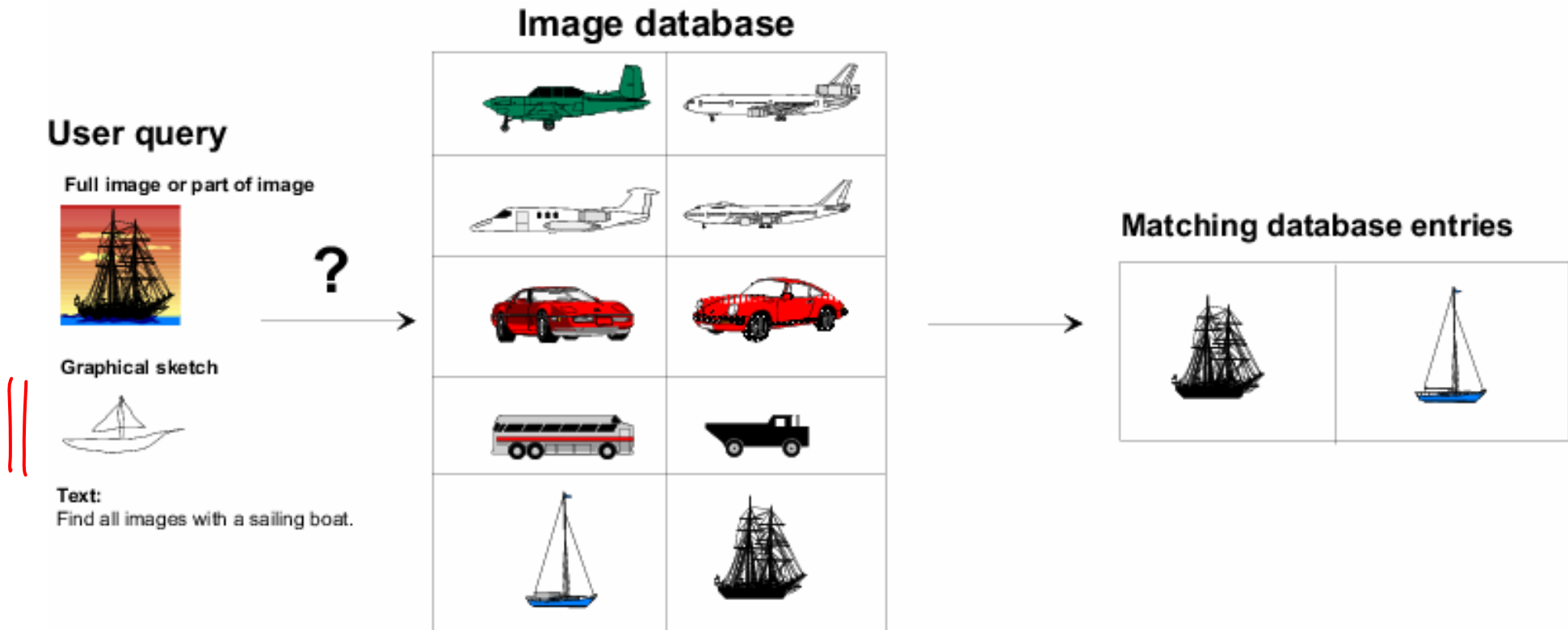


Texturdefektdetektion auf Stahloberflächen

Segmentierung der Defekte



Content based image retrieval



<http://simba.informatik.uni-freiburg.de/>



Query image



0.978



0.828



0.792



0.686



0.674



0.649



0.630



0.595



Query image



0.98



0.82



0.81



0.79



0.78



0.78



0.77



0.76



Query image



0.99



0.79



0.77



0.68



0.68



0.66



0.66



0.66



Query image



0.98



0.82



0.79



0.77



0.74



0.73



0.71



0.71





Query image



0.98



0.79



0.77



0.68



0.68

X



0.65

X



0.65

↑



0.63

X



Query image



0.98



0.80



0.78



0.74



0.70



0.60



0.59



0.57

SIMBA – Search IMages By Appearance

COLOR only



Search template



96827



63939.4



62383.7



60840.3



59997.4



59316.6



59061



58323.8

SIMBA – Search IMages By Appearance



Search template



87948.7



85491.7



85163



84896.4



84603.2



84379.5



84065.4



83475.7

SIMBA – Search IMages By Appearance



Search template



96689.4



81479.3



77883.8



71489.1



70400.4



67864.2



66298.7



66249.5



SIMBA – Search IMages By Appearance

COLOR RELATIONSHIP



Search template



92393.05



81203.6



77685.85



75091.55



71376.85



70761.3



69292.6



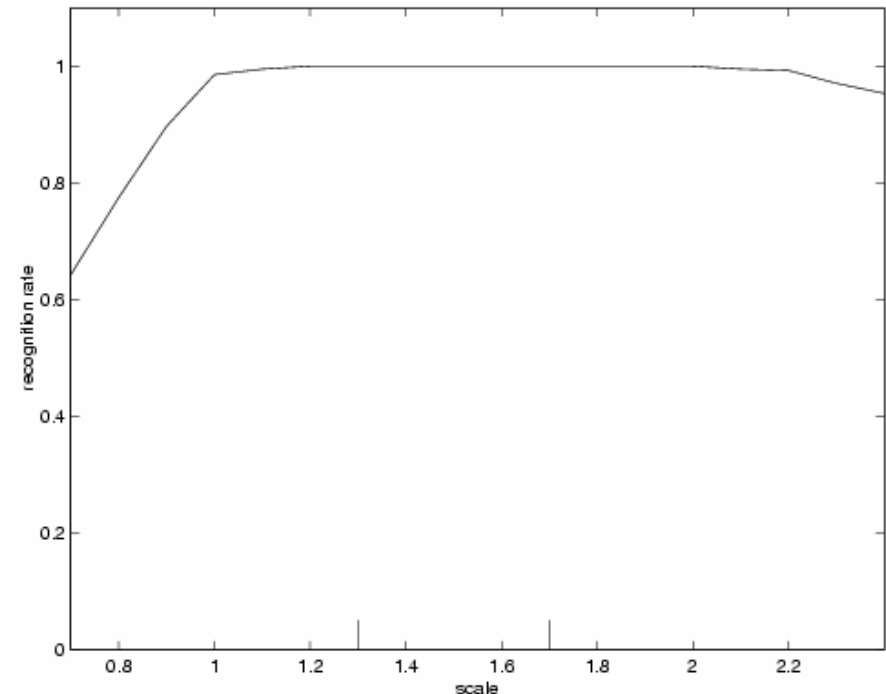
68030.95

Experiments



Robustness to scaling

- Database as before, grayvalue features only
- Kernels $\mathbf{M}(1,0)\mathbf{M}(0,2)$, $\mathbf{M}(2,0)\mathbf{M}(0,4)$
- Images reduced/zoomed (bilinear interpolation) to scales from 0.7 to 2.4
- Database contains scales 1.3 and 1.7 only



→ Good recognition from scale 1 to 2.2, i.e. scale 4.8 in area

SIMBA

Searching Images by Appearance

<http://simba.informatik.uni-freiburg.de/>

Suchbild



Suchmethode

Farbe

Textur



☒ Motiv

☒ Größe

☒ Seitenverhältnis

Datenbank

BRD

Suche starten

Ergebnisse



Brd0644



Brd0638



Brd0732



Brd0689



Brd0729



Brd0636



Brd0727



Brd0637



Brd0645



Brd0640



Brd0642



Brd0635



Brd0691



Brd0730



Brd0639



Brd0643

Suchbild



Suchmethode

Farbe

Textur



☒ Motiv

☒ Größe

☒ Seitenverhältnis

Datenbank

BRD

Suche starten

Ergebnisse



Brd0644



Brd0637



Brd0689



Brd0636



Brd1138



Brd0489



Brd0727



Brd0502



Brd0494



Brd0854



Brd0193



Brd0492



Brd0191



Brd0635



Brd0168



Brd0857

Suchbild



Suchmethode

Farbe

Textur



☒ Motiv

☒ Größe

☒ Seitenverhältnis

Datenbank

BRD

Suche starten

Ergebnisse



Brd0523



Brd0485



Brd0538



Brd0232



Brd0408



Brd0409



Brd0486



Brd0447



Brd0540



Brd0164



Brd0449



Brd0266



Brd0386



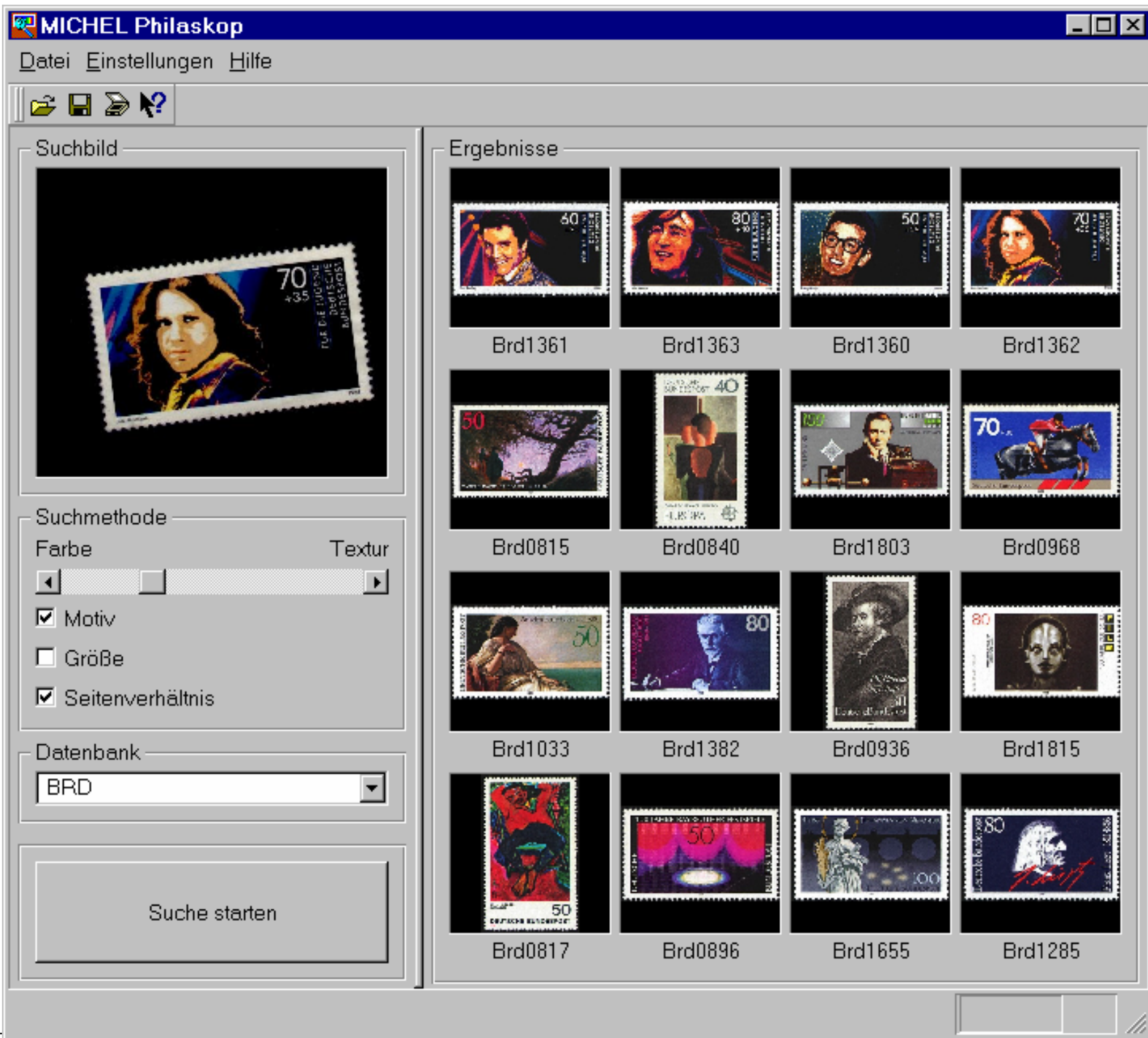
Brd0173

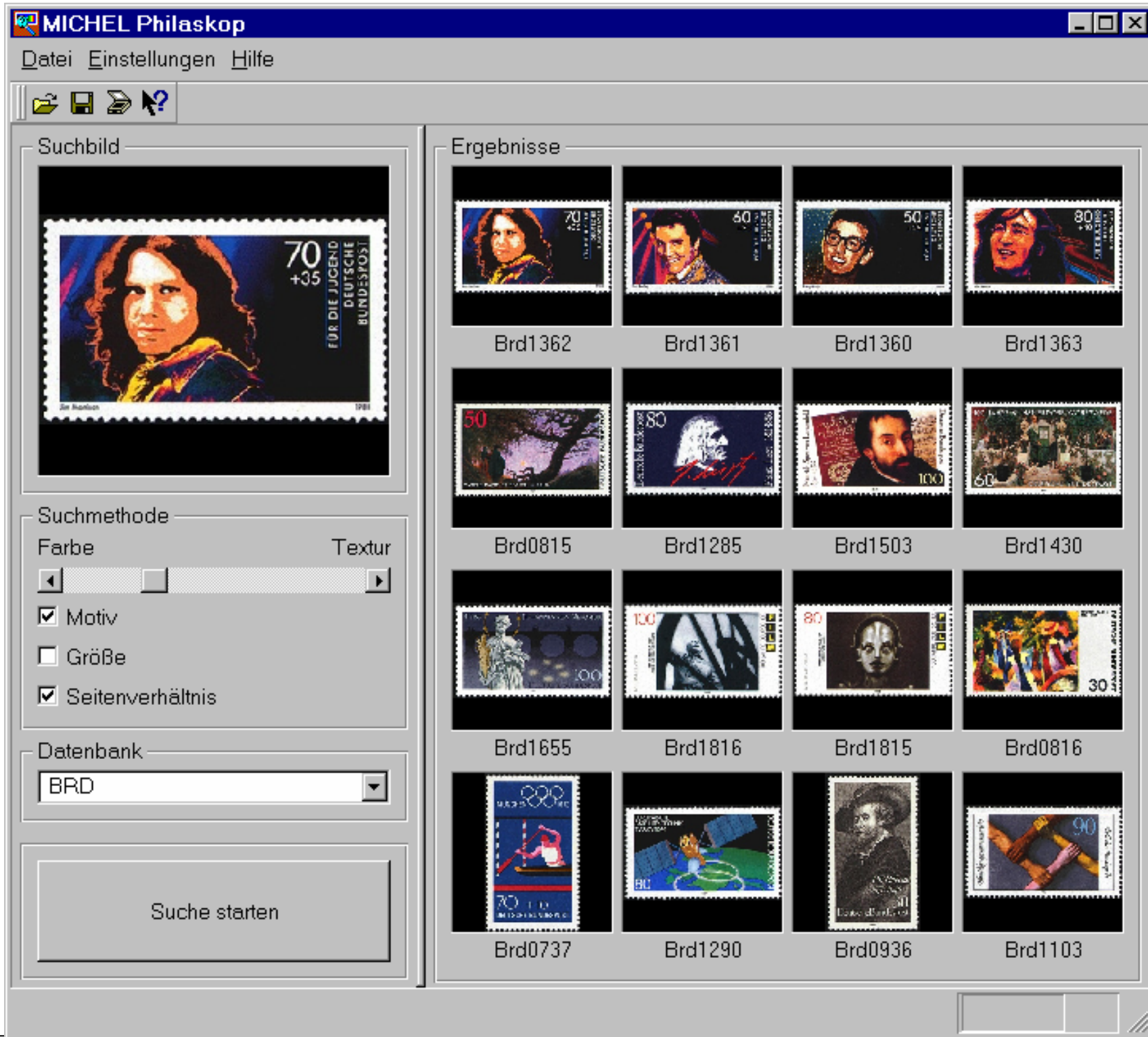


Brd1610



Brd0487





Suchbild



Suchmethode

Farbe

Textur



☒ Motiv

☒ Größe

☒ Seitenverhältnis

Datenbank

BRD

Suche starten

Ergebnisse



Brd0700



Brd0694



Brd0697



Brd0773



Brd0703



Brd0702



Brd0698



Brd0696



Brd0701



Brd1623



Brd1140



Brd0695



Brd1379



Brd1137



Brd0699



Brd1038



Automated Pollen Recognition in Air Samples by Digital Microscopy

O. Ronneberger, U. Heilmann, V. Dietze, E. Schultz

► Motivation

- Time-consuming, but still inaccurate visual pollen counting

► Demand

- Reliable pollen data for pollen forecast

► Approach

- 3D fluorescence imaging (tomography) instead of 2D conventional translucent microscopy
- Image recognition based on general »grey scale invariants«, instead of traditional object specific features

► First results (see table on the right)

- »Grey scale invariants« have characteristic shapes for different pollen species
- Recognition rate of 82% already in a first run

► Outlook

- Employment of digital microscopy for automated particle analysis in general.

Pollen species	Grey Scale Invariants	No.	Mis-classifications
Maple		5	1 () → Goose.
Birch		8	3 (r1) → Alder (r3) → Alder (s1) → Alder
Yew		2	—
Alder		10	2 (u3) → Birch (v3) → Birch
Goosefoot		7	—
Hornbeam		2	—
Hazel		10	2 (p2) → Goose. (p4) → Alder

Collaborating
institutions



Deutscher
Wetter
Dienst

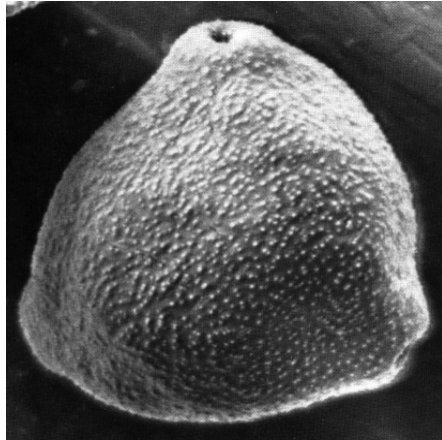


MeteoSchweiz

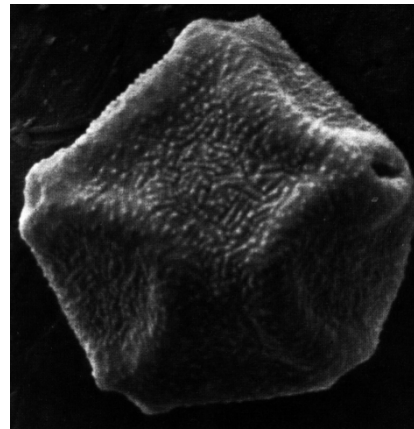


ALBERT-LUDWIGS-
UNIVERSITÄT VON FREIBURG

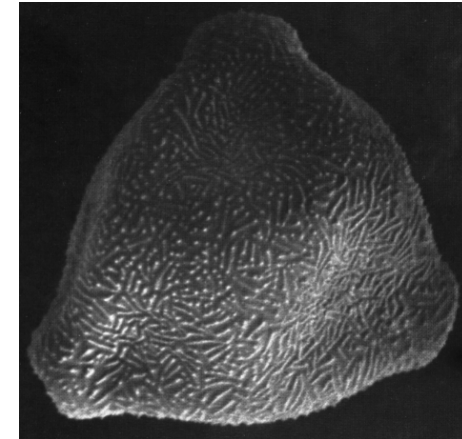
Pollen examples



Hasel



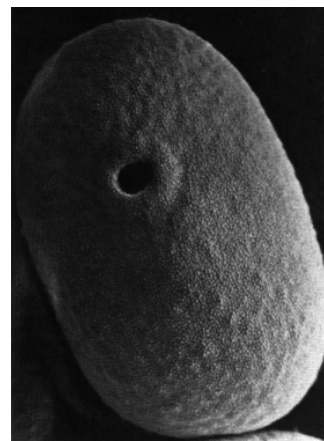
Erle



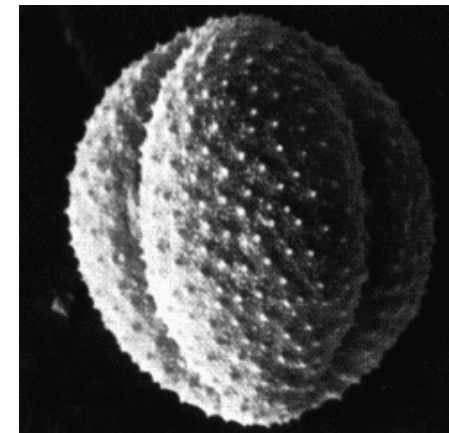
Birke



Gräser



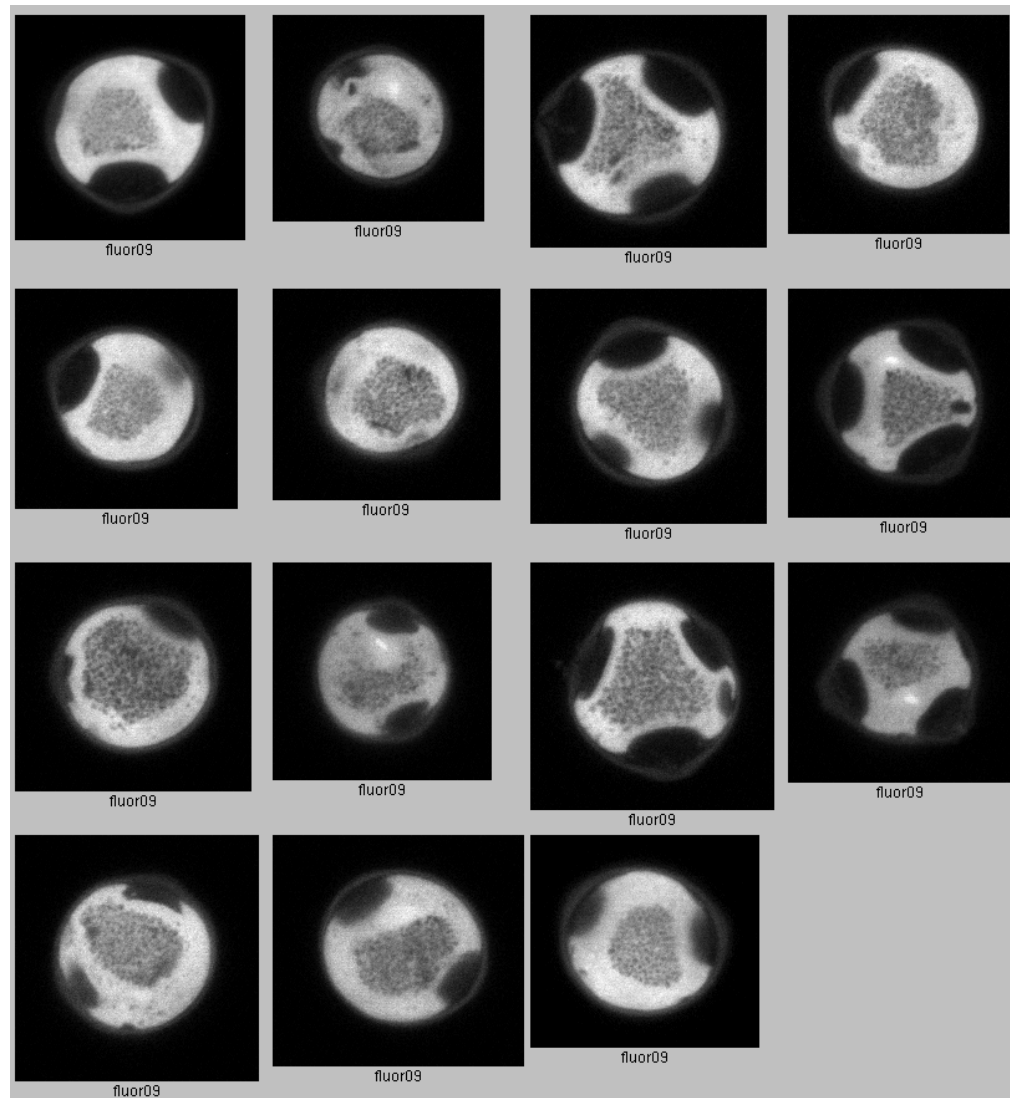
Roggen



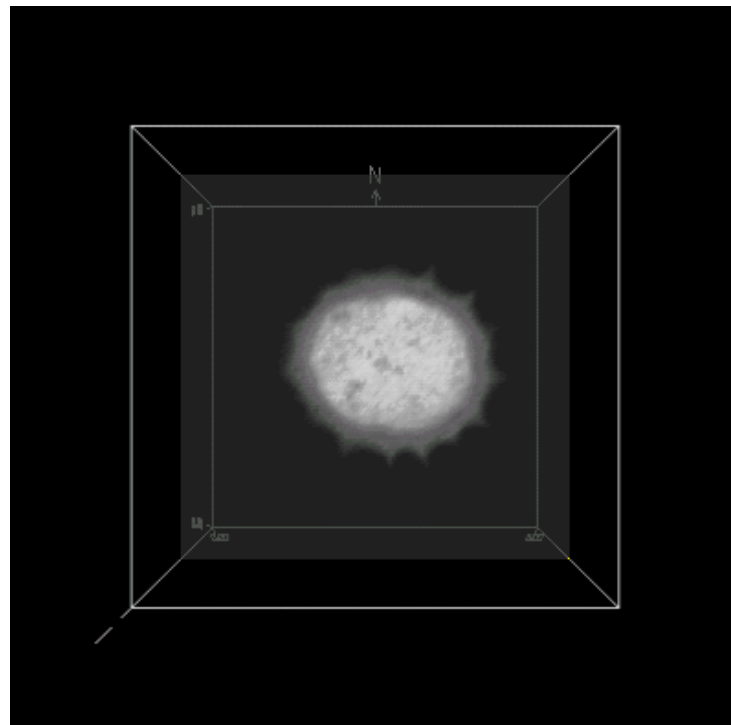
Beifuß

+ 33 further species (not relevant for allergies)

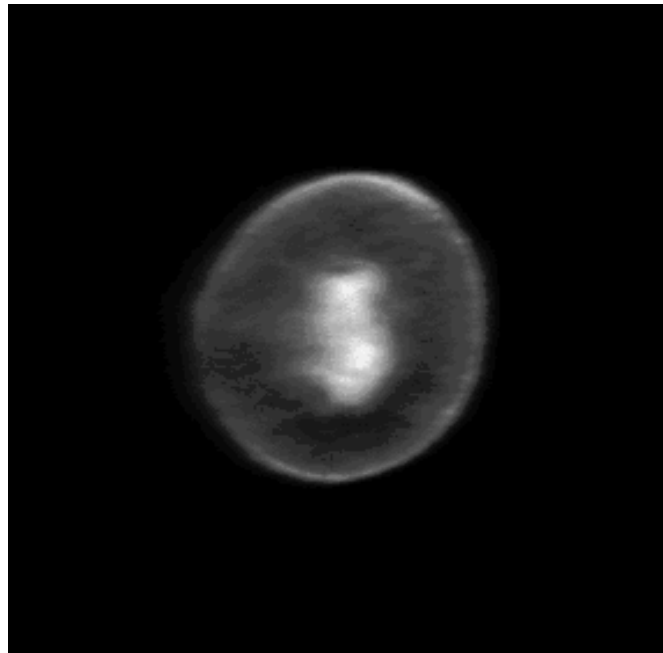
Haselpollen



Gänseblümchen/daisy pollen grain



Eibe/Taxus



Reference Data Base Description

- 26 pollen species directly sampled from the plants
 - Correctly assigned species
 - Maybe less variation in size and shape compared to airborne pollen (no different sub-species, no regional variation)
 - No deformation or contamination or agglomeration
- Recording 3D volumes of about 15 samples of each species with a Confocal Laser Scanning Microscope
 - No distortions of the data due to imperfect imaging of a usual microscope

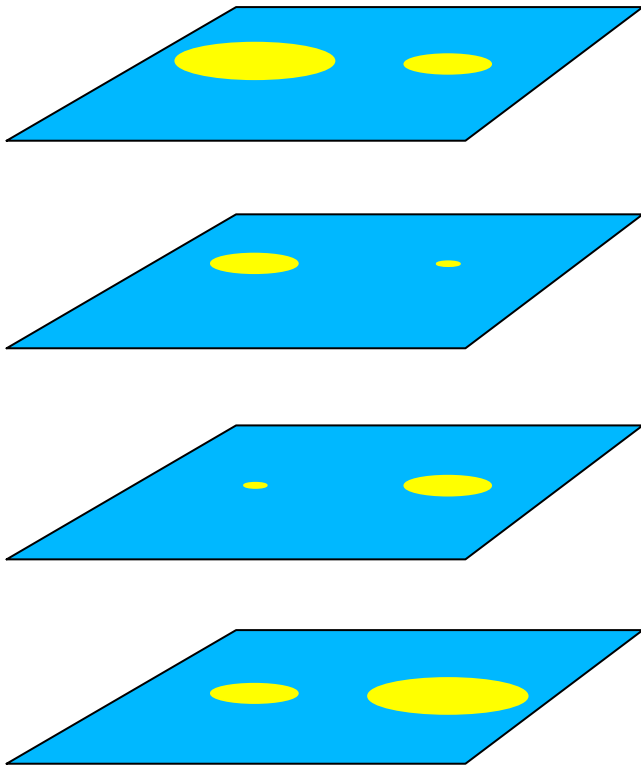
Classification Results using 3D LSM Data

(leave-one-out Classification)

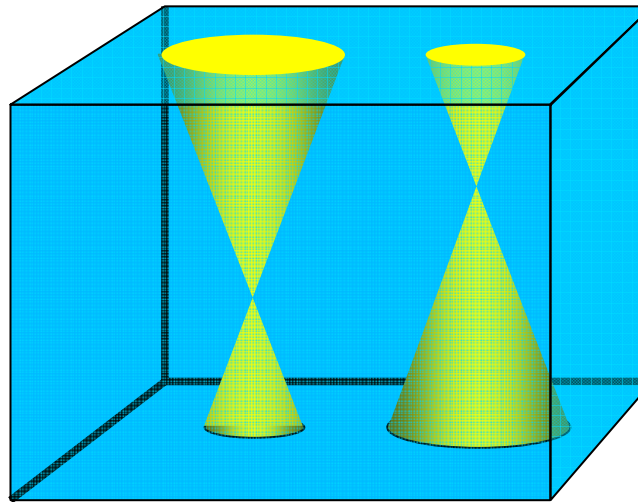
	Correct	Wrong classifications
<i>Artemisia:</i>	13	1 -> <i>Compositae</i> , 1 -> <i>Platanus</i>
<i>Alnus:</i>	15	-
<i>Alnus viridis:</i>	12	-
<i>Betula:</i>	13	2 -> <i>Plantago</i>
<i>Corylus:</i>	13	1 -> <i>Alnus</i>
<i>Gramineae/Poaceae:</i>	15	-
<i>Secale:</i>	11	3 -> <i>Fagus</i> , 1 -> <i>Tilia</i>
Allergolocial irrelevant*:	282	2 -> <i>Gramineae</i>
Total:	97.4%	2.6%

* *Acer*, *Carpinus*, *Chenopodium*, *Compositae*, *Cruciferae*, *Fagus*, *Quercus*, *Aesculus*, *Juglans*, *Fraxinus*, *Plantago*, *Platanus*, *Rumex*, *Populus*, *Salix*, *Taxus*, *Tilia*, *Ulmus*, *Urtica*

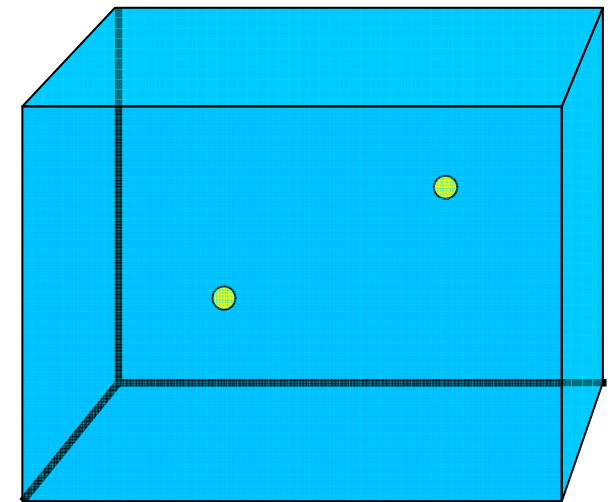
Gewinnung von tomographischen 3D-Daten mit einem normalen Fluoreszenz-Mikroskop



Aufnahme eines
Bildstapels mit einem
normalen Mikroskop

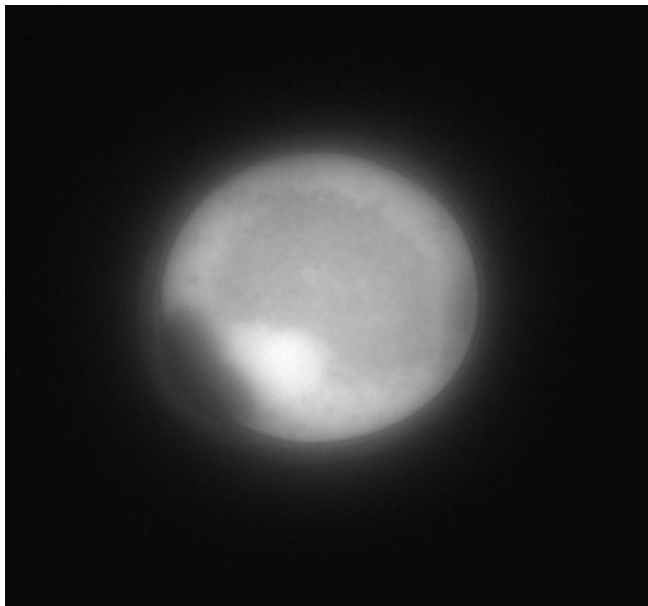


Zusammensetzen der
Bilder im Computer zu
einem Volumen

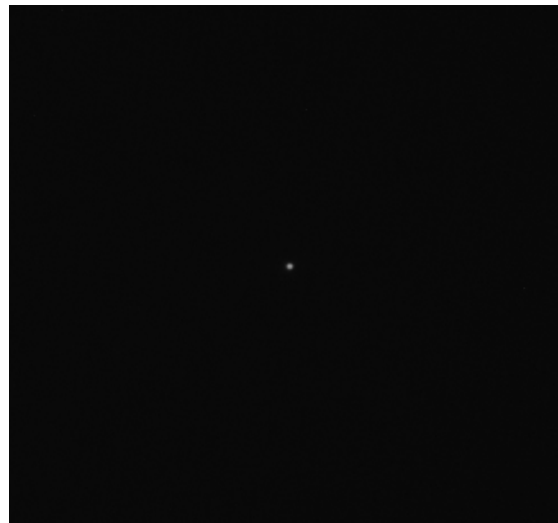


Nach Entfaltung mit der
Punktbildfunktion sind
alle unscharfen
Bereiche entfernt

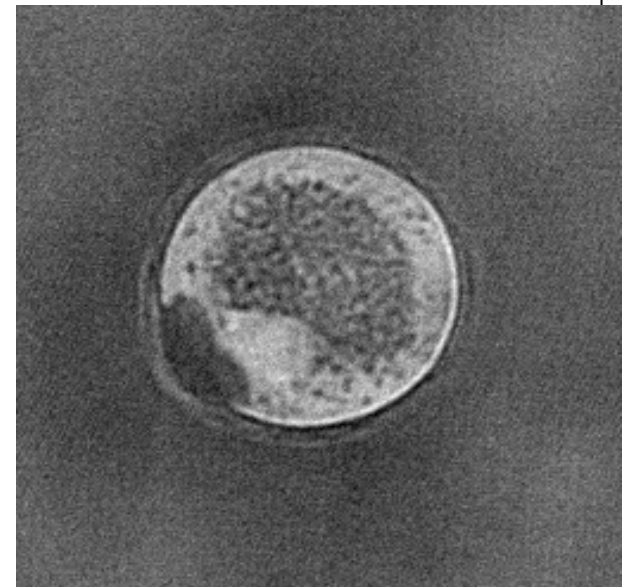
Deconvolution of a Pollen (Hasel/Corylus)



volume



point-spread
function



deconvolved volume