Automated feature extraction from airborne SAR data for security
EARTHemes Deutschland

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DEFINIENS + Intermap
Introduction in DEFINIENS technology
Data acquisition & principle workflow
Ruleset description
Results & validation
Outlook
Conclusion
Definiens Enterprise Image Intelligence is the only technology that understands images similar to the human mind.

Definiens provides breakthrough Enterprise Image Intelligence to customers like NGA, Lockheed Martin, DigitalGlobe, European Commission, Saudi Aramco etc.

Other technologies are still focused on single PC performance and pixel based image analysis, whereas Definiens uses object and context based technology.

Definiens Image Intelligence provides scalable solutions from laptop to production centre and thus guarantees maximum performance.
Automated basic landcover

- Can be used as GIS layer
- Basis for further analysis
- Standardized product for large areas
- Up-to-date land cover information
- High level of automation
- Processed in client-server system within days for whole Germany
  - Ideal for time critical security applications

- Product downloadable from beginning of 2007
- Shows the potential of Definiens technology
Definiens Enterprise Image Intelligence Suite (EII)

- Definiens Developer
- Definiens Architect
- Definiens Analyst
- Definiens Viewer

- Ruleware development based on Cognition Network Technology
- Tune Ruleware
- Execute Ruleware
- Review Results
- Exchange Results

- Definiens eCognition Server

- High throughput batch processing
- Parallel processing
- Standard Interfaces
- Runs on Windows and Linux
Workflow In New Client – Server Architecture

Lab 1
Rule set and application development
EO Expert with CNL* eCognition knowledge

Lab 2
Adjust classification + manual editing
Image Analyst, no specific eCognition know-how necessary

*CNL = Cognition Network Language
for rule set development in Definiens Developer

Definiens eCognition Server
Server Room
Parallel processing
eCognition Server – Tiling and Stitching

Tiling of full scenes

Parallel processing of tiles

Stitching of tiles

Definiens Analyst/Architect

Definiens eCognition Server

Definiens Analyst/Architect
System Setup

Definiens Analyst

Data Storage

Ruleware

eCognition Server

Vector Results

Data Acquisition
Data Acquisition:
Intermap Technologies, Inc.
InterFerometric Synthetic Aperture Radar (IFSAR)
coverage: 2006 Germany
2007 Europe

**DSM**
Digital Surface Model

**ORI**
Orthorectified Radar Imagery

- resolution: 5 m x 5 m
- 1.25 m x 1.25 m
Definiens Ruleset

- The Process Tree
- Cognition Network Language (CNL)

Cognition Network Language (CNL) – A powerful language for developing image analysis formulas. A single process is the elementary unit of a rule set providing a solution to a specific image analysis problem. Processes are the main working tools for developing rulesets.
Basic steps

basic land-cover:
- Built-Up Area
- Water
- Smooth Surface
- Thicket/Wood

Requirements:
Minimum area size:
15.625 m² (125 m x 125 m)
Features extracted:

- **Water**
  1. homogeneity properties are used to detect water seeds
  2. grow algorithm adds water objects using relational features
  3. DSM used to distinguish between shadow and water

- **Smooth surface**
  1. Edge detection filters slope
  2. Combined with texture features homogeneous areas are extracted

- **Urban**
  1. Growing algorithm starting from seeds with high intensity
  2. Separation between urban and wood using texture and context (in line seeds \( \rightarrow \) urban, random distributed \( \rightarrow \) wood)

- **Wood** (see above)

- **Post-processing**
  - Area filter, smoothing, clutter removal
Performance

Processing Times:
Complete Scene: 120min (1CPU)

Disc Space:
Result files per scene: 35mb

Processing whole Germany in 8* days

* (on 20 Servers)
## Performance

<table>
<thead>
<tr>
<th>NEXTMap Deutschland</th>
<th></th>
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<tbody>
<tr>
<td>Project Area</td>
<td>360000 km²</td>
</tr>
<tr>
<td>Scene Area</td>
<td>180 km²</td>
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<tr>
<td>Scenes</td>
<td>2000</td>
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### Processing stats

<table>
<thead>
<tr>
<th>Dataset Processing Time (min)</th>
<th>2 hour</th>
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<tr>
<td>CPUs Available</td>
<td>20</td>
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<tr>
<td>Processing Time</td>
<td>8.3 Days</td>
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### Data Storage

<table>
<thead>
<tr>
<th>Export file size</th>
<th>35 mb</th>
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<tr>
<td>Storage Requirement</td>
<td>70,0 gb</td>
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Results
Comparison with manual extraction
Results – Overview 9 Scenes
Results – Overview 9 Scenes
Preliminary validation based on a grid pattern with visual interpretation (144 samples):

<table>
<thead>
<tr>
<th></th>
<th>Built-Up</th>
<th>Wood/Thicket</th>
<th>Lakes</th>
<th>Stream</th>
<th>Rural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-Up</td>
<td>95.33</td>
<td>10.81</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>Wood</td>
<td>3.74</td>
<td>87.84</td>
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<td>0.00</td>
<td>5.41</td>
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<tr>
<td>Lakes</td>
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<td>0.00</td>
<td>100.00</td>
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<tr>
<td>Stream</td>
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<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
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<tr>
<td>Rural</td>
<td>0.93</td>
<td>1.35</td>
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<td>91.89</td>
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<tr>
<td>Sum</td>
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<td>100.00</td>
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Weighted Overall: 92.40
Current Status

Ruleset development for Germany finished for test area. Initial accuracy assessment for Germany available.

**Development dataset:**

Germany: 94 Datasets (12000 x 12000 pixel), over Stuttgart part of the NEXTMap Deutschland campaign

**Features extracted:**

- Built-Up Area
- Water
- Smooth Surface
- Wood/Thicket
Outlook
Outlook

Process whole Germany
This year

Feasibility study to derive more classes (e.g. distinguish between lakes/tidal water, rivers, …)

At the moment

On demand we process whole Europe
2007

On demand we process other regions (e.g. Asia, USA, …)
Conclusions

- New functionalities in Definiens Enterprise Image Technology (like variables, loops, …) allow development of transferable rulesets for segmentation and classification.
- Very high level of automation allows processing of large areas within days.
- Ideal for time critical security applications.
- Can also be elaborated for optical data.
- New standardized up to date level in information extraction from EO data.
Thanks for your attention!

For further information please contact:

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Once you have used eCognition and comparing to pixel based analysis - there is no going back »
Thank you!

www.definiens.com