Hyperspectral imaging technology

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The optical windows

![Graph showing atmospheric transmittance and wavelength regions for UV, Vis, NIR, SWIR, MWIR, and LWIR domains.]

- **Wavelength [µm]**
  - UV Vis NIR: 0-1.5
  - SWIR: 1.5-3
  - MWIR: 3-5
  - LWIR: 5-15

- **Atmospheric transmittance**

- **Reflective domain**

- **Thermal domain**
Categories of imaging systems

- Broadband (panchromatic)
- Multispectral
- Hyperspectral
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Spectral imaging technologies

Filter-based

Dispersive

Interferometric

Snapshot (non-scanning)
Spectral signatures and fingerprints

Material classification:
The possibility to distinguish a tree pixel from a camouflage pixel!
Principles for spectral target detection

**Spectral matching** (signature based detection)
- Requires a priori knowledge of spectral target signatures

**Anomaly detection**
- Does not require a priori knowledge of spectral target signatures
Example: Camouflage detection
DUCAS 2009-2013

Main objective:
Investigate the benefit in a complex urban environment of hyperspectral imaging in combination with high spatial resolution (broadband) imaging

Detection in Urban scenario using Combined Airborne imaging Sensors
EDA project with seven contributing nations (Sweden leading)
**Clear** operative use of HSI:

- Automatic target detection, recognition and tracking
- Detection of small targets
- Efficient mapping for mission planning

Detection in **Urban** scenario using **Combined Airborne imaging Sensors**

**EDA** project with seven contributing nations (Sweden lead)

Continued development desirable in:

- Higher HSI spatial resolution
- Data management and compression
- Efficient working methods and routines for human operators & image analysts
## Examples of applications

<table>
<thead>
<tr>
<th>Military</th>
<th>Civilian</th>
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<tbody>
<tr>
<td>• Battlespace information collection and exploitation</td>
<td>• Crise and disaster management</td>
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<td>• Target and false target discrimination</td>
<td>• Infrastructure monitoring</td>
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<tr>
<td>• Detection of camouflage</td>
<td>• Biological and chemical detection</td>
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<tr>
<td>• Detection of surface land mines and disturbed earth</td>
<td>• Environmental monitoring</td>
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<tr>
<td>• Early warning of intercontinental ballistic missiles (ICBMs)</td>
<td>• Climate research</td>
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<td>• Space surveillance</td>
<td>• Geological surveys</td>
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<td>• etc.</td>
<td>• Crop characterization</td>
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<td>• QC in food industry</td>
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