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Use of ADS40 pushbroom imagery for tree species classification in Finland

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About the project

- Idea of testing the ADS40 in Scandinavian forests (2007)

  RGBNIR: ADS40 4 km $\Rightarrow$ 40 cm GSD, UCD $\Rightarrow$ 112 cm

  Spectral bands: ADS40 narrow, UCD overlapping

  Calibration: ADS40 absolute, UCD relative
- Qs:

  1) **Gain from using reflectance images for tree SP?**
  - Separation of effects by GSD and medium
  - Effects of tree age / site fertility in spectra

  2) Gain from adding LiDAR data and image features?
  - Birch problematic in LiDAR intensity, in NIR?
  - Orthogonality LiDAR and image data

  3) Comparison of different digital airborne sensors?

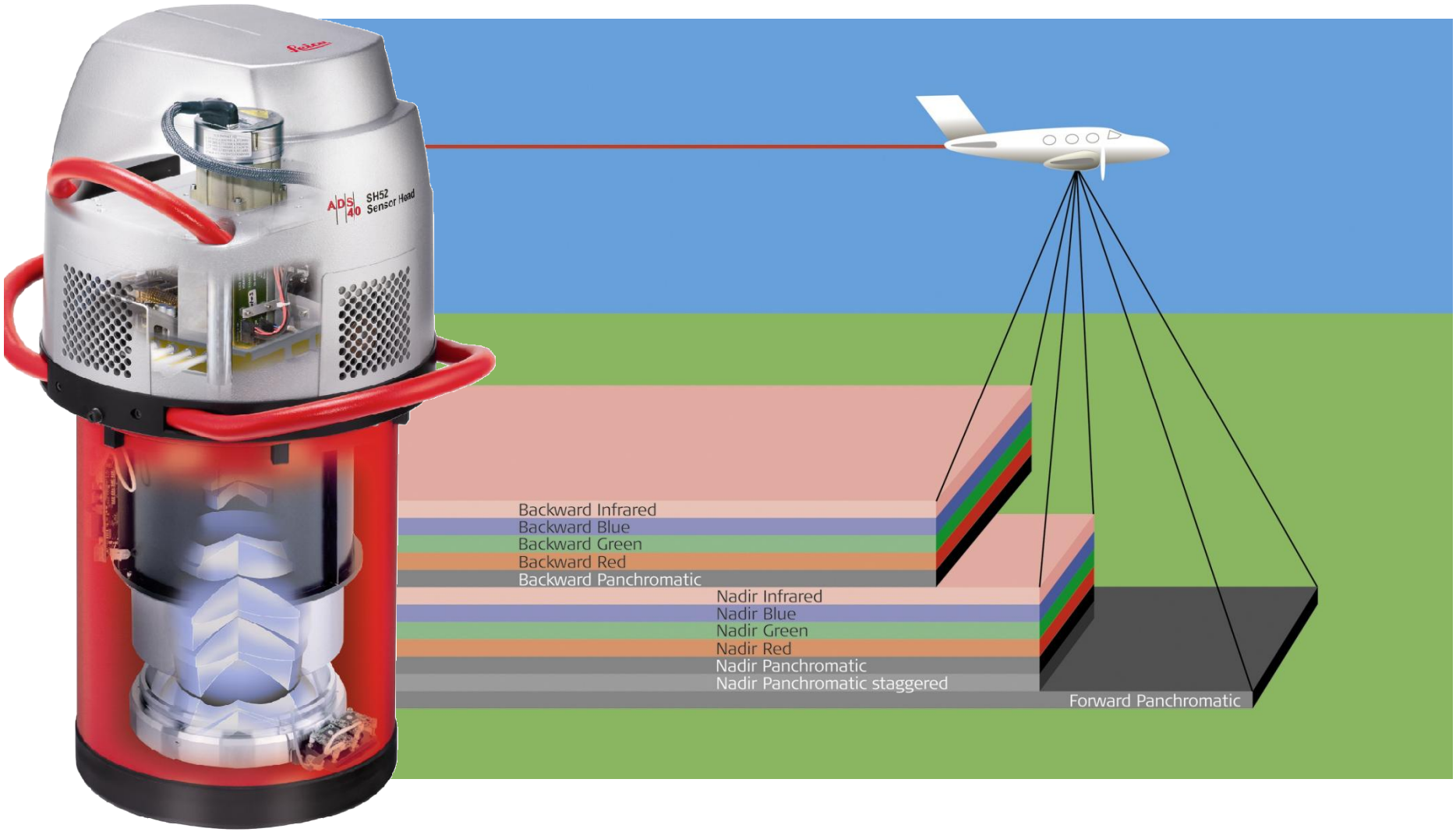
Hyytiälä experiment

- Over **16 000 reference trees** for SP-detection tests

- Aerial images from 1946–2004, 2006-2009
  UltraCAM D 2006, 2007, (UltraCAM Xp 2010)
  ADS40-SH52 2008* (1, 2, 3, and 4 km)
  Z/I DMC 2009*
  * NASA, IN-SITU, SMEAR

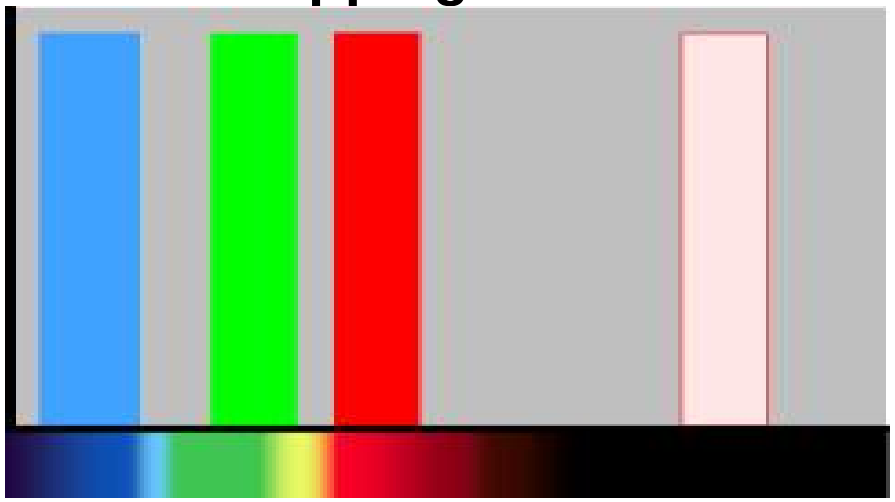
- LiDAR data 2004, **2006-2008 (12-15 p/m2)**

ADS40 2nd Generation



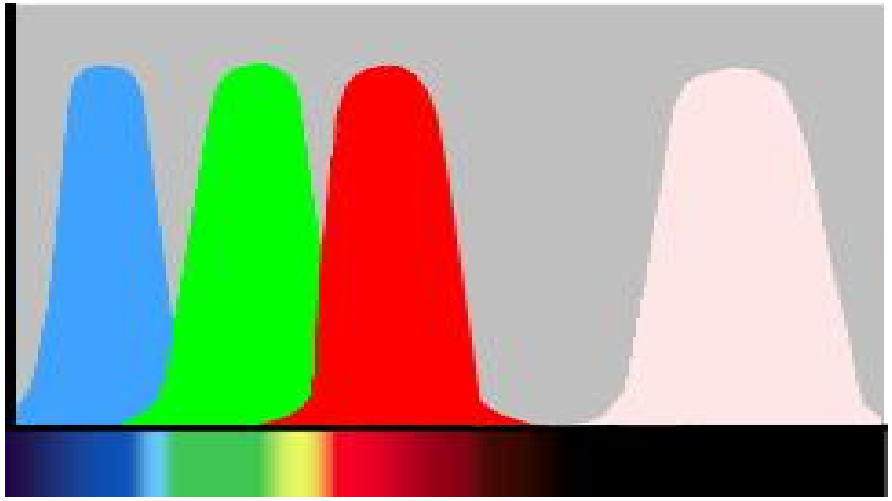
Narrow Multispectal bands for Remote Sensing

Non-overlapping narrow bands



nm

Overlapping bands



nm

Only interference filters are suitable for remote sensing applications where response in non-overlapping narrow bands is evaluated

Workflow of research Q1.

- Image aqcuisition, in-situ measurements, geometric post-processing
- Radiometric corrections (ATSR, ATM, BRDF, BRDF-ATM)
- Feature extraction for the reference trees
- Feature selection and analysis
- Classification trials

What happened until today

- Flight on August 23, 2008 over Hyytiälä (clouds)
- Four altitudes: 1, 2, 3 and 4 km
- In-situ observations using a goniospectrometer for reflectance tarps & natural targets, also at-sensor radiance & nadir-reflectance
- Aerosol optical depth ($\lambda_{j,j=1..8}$) with AERONET sun-photometer
- Main processing (Imagery & DSO) by Leica Geosystems 115 Gbytes of Level-0 data
- Sensor model implementation in KUVAMITT using Leica-SDK

Where are we now

- Validating of radiometrically processed images with in-situ data (@FGI, Lauri Markelin, Eija Honkavaara, Juha Suomalainen)
- (ATSR, ATM, BRDF, BRDF-ATM) production using XPro 4.2 (with Dr. Ulrich Beisl @ Leica),
  L1 data (epipolar resampling)
- Debugging KUVAMITT for L0/L1-capabilities
- Cloud-screening
- Shadow- and occlusion determination for crown points

Future progress / aims

- Feature extraction for ~ 12000 pine, spruce, birch trees in ~90×4 images (cluster of KUVAMITT-PCs)
- Mono- and biangular RGBNIR-data
  - Quest for strong, invariant features
  - How do they change with GSD 10-40 cm
  - How the features behave with varying age of trees
  - Using a combination of features, classification trials, comparison of radiometric correction methods

... And?

NN-imputation, RF?

”Expected Conclusions”

- We hope to be able to quantify the effects of GSD and atmosphere, and find some invariant features
- We get image features to be plugged in together with LIDAR features
- We set baseline for camera comparisons