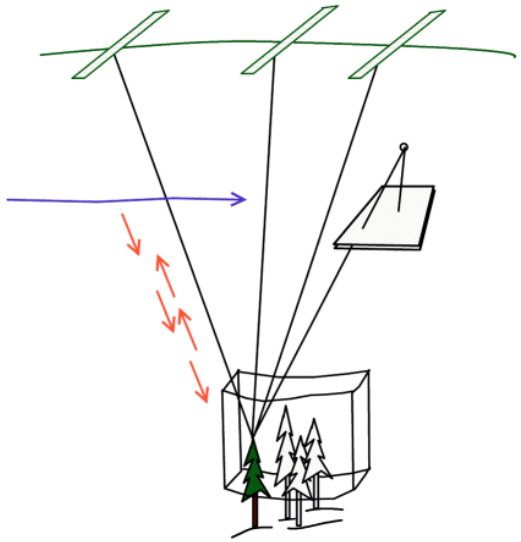
FGI meeting - May 12, 2009

- Hyytiälä experiment
- 2008-2011 projects



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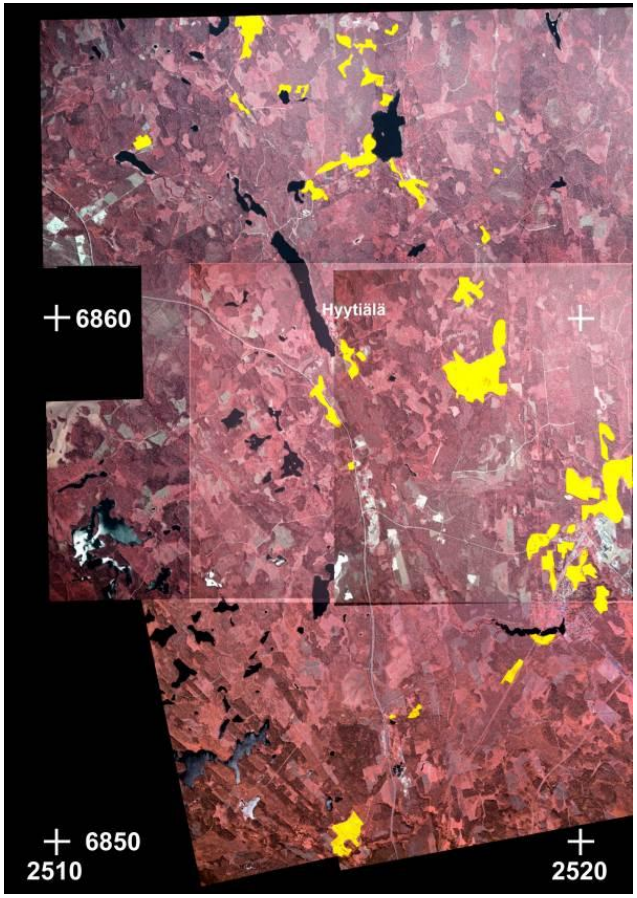
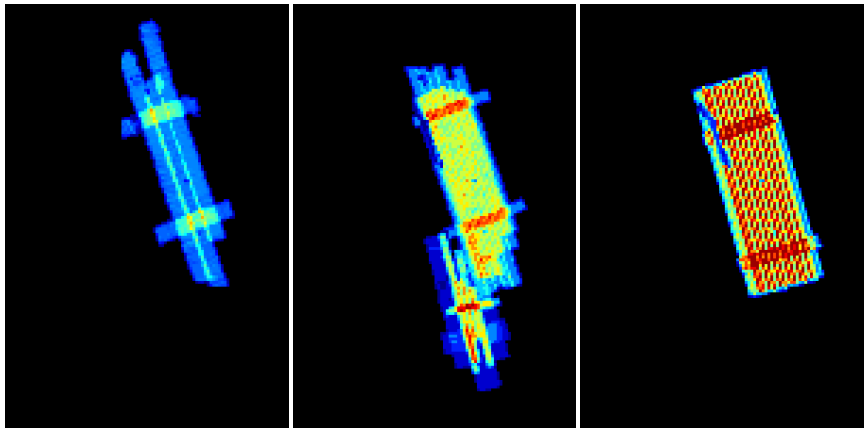
Hyytiälä experiment



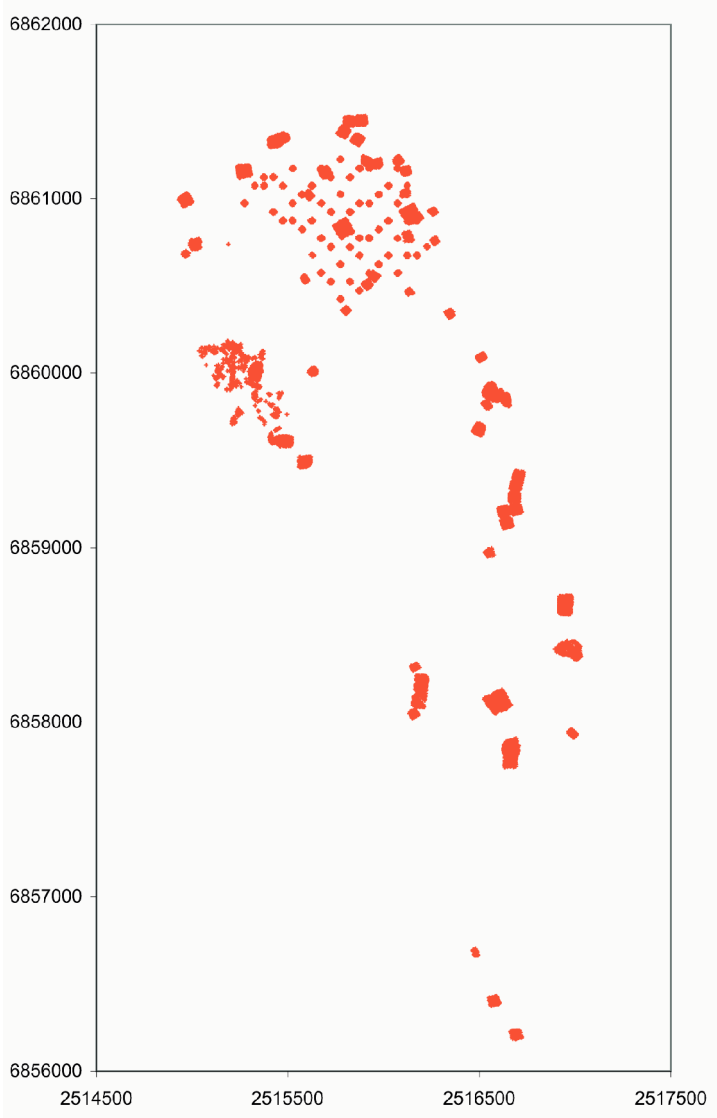
- 62°N, 24°E ⇒ southern boreal vegetation zone
- Forest field station of the University of Helsinki, 1910-
- State owned, private farmer & company forests: forest (85%), lakes (10%), mires (4%), farmland (1%)
- 1995- SMEAR II, state-of-the-art research in vegetation-atmosphere relations
- 1994- establishment of forest plots, tree-mapping, 2 × 6 km area.
- (1946-) 2002- systematic aerial photography & LiDAR
- 2008 part of VALERI network

Experiment in Hyytiälä



LiDAR in 2004, **2006, 2007**, 2008
UCD 2006, 2007
ADS40-SH52 2008
DMC 2009
Trees 2002-; over **<u>17000 positioned</u> trees** (dbh > 25–60 mm); **118 ”plots”.**

”Establishment” in 1994-1995;
combination of research projects,
student exercises etc.
3-5 €/tree



Experiment in Hyytiälä

Researcher **A** maps all trees; **B** measures vars X1..Xn for problem Y_1,making it possible for **C** to study problem Y_2 by adding measurements of Xn+1…Xm,….

Metsähallitus: providing funding and reasonable management of forests.
Hyytiälä: Labour & equipment, SMEAR-II!
Funding: 1997-2009 some 180,000 € invested in RS and field data (Korpela, Tokola et al.).

Experiment in Hyytiälä

Philosophy in PLOT establishment:

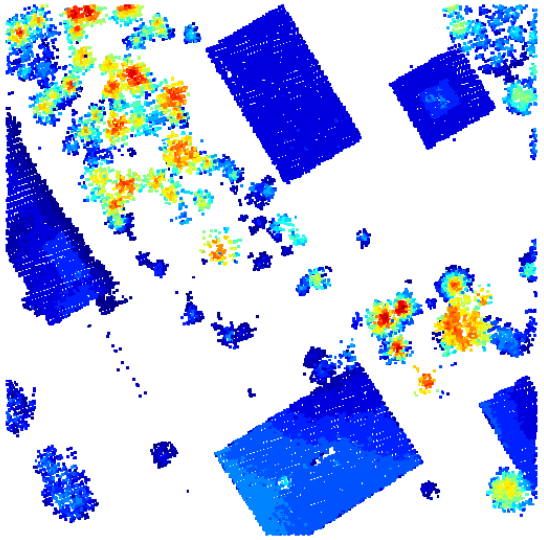
Anticipate that someone is interested in the effect of X ⇒ Find sample areas that cover the reasonable range of X. Try to find areas where “you kill several X-bugs with one sweep”.

X ~ silvicultural treatments, stand structure, species mixture, site conditions, existence of understorey, “difficulty” of e.g. tree detection in STRS algorithms.

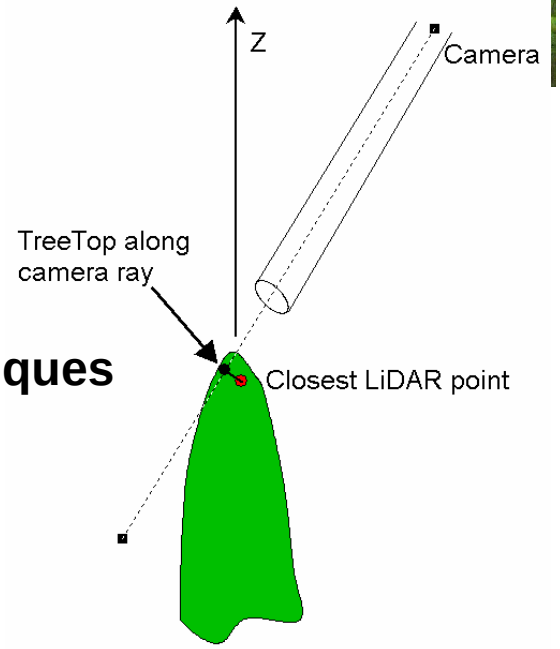
But also, try to establish an objective selection of samples (random/systematic sample), where the researcher cannot, even implicitly/indirectly, impact/bias the results.

Measure also the vars Xn…Xm that might get the other researchers interested in the plot i.e. consider the added, not-immediate value.

Experiment in Hyytiälä



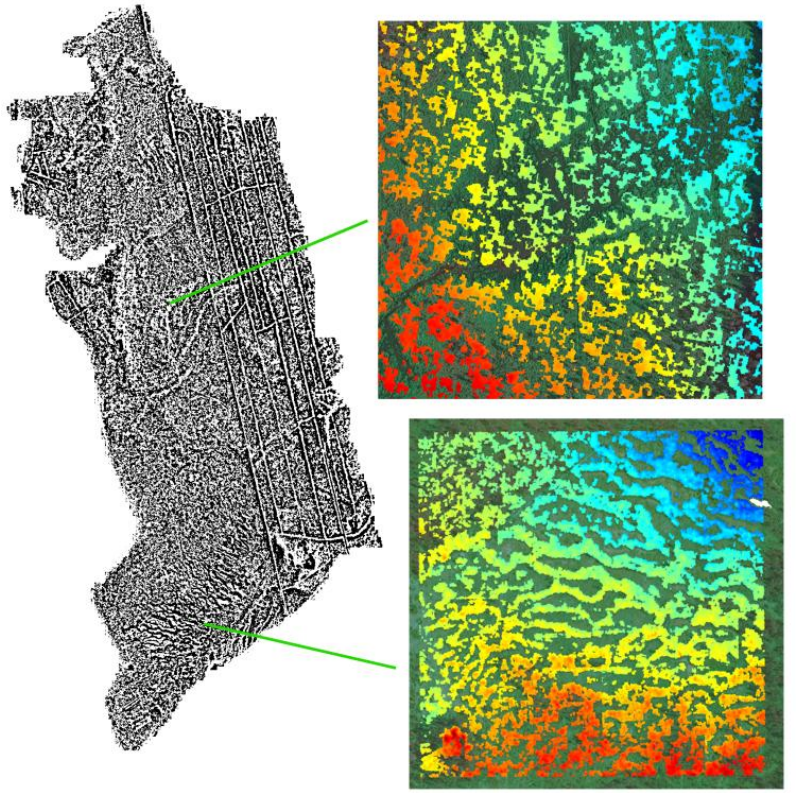
Positioning techniques over the years

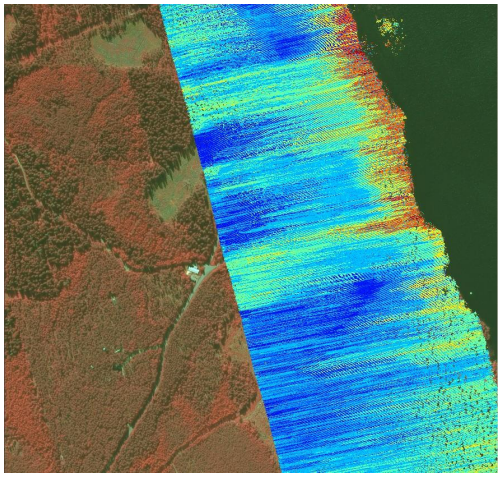


Experiment in Hyytiälä

Research projects with LiDAR in Hyytiälä

- Leaf-on LiDAR in DEM-accuracy (1 km data), Maanmittaus 1/07
- Sparse LiDAR and multi-image matching for single-tree remote sensing, PFG 1/2007
- Modeling tree crowns with LiDAR, ISPRS Hannover/Espoo 2007
- Seedling stand vegetation assessment, LiDAR & UCD, SF 2008
- Detection of certain ground lichens, RSE 2008
- Mire surface patterns, vegetation and habitats, FORECO 2009
- Tree species identification in LiDAR, ISPRS Hannover 2009
- Leaf-on LiDAR in DEM estimation, 1, 2, 3 and 4 km ALS-50; NLS Finland, 2009 (ongoing)





Planned research with LiDAR in Hyytiälä

- Tree species recognition in discrete-return LiDAR
  Study the effects of age, vigour, silviculture.
  Co-use of images for enhanced results
- Detection of the suppressed tree-layer
  (need of new field data)
- LiDAR in the estimation of needle mass
  (need of new field data)
- Acquisition of FW-LiDAR 2009-2011

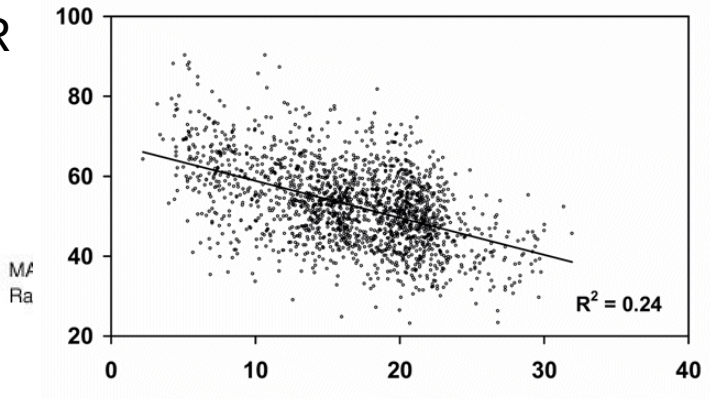
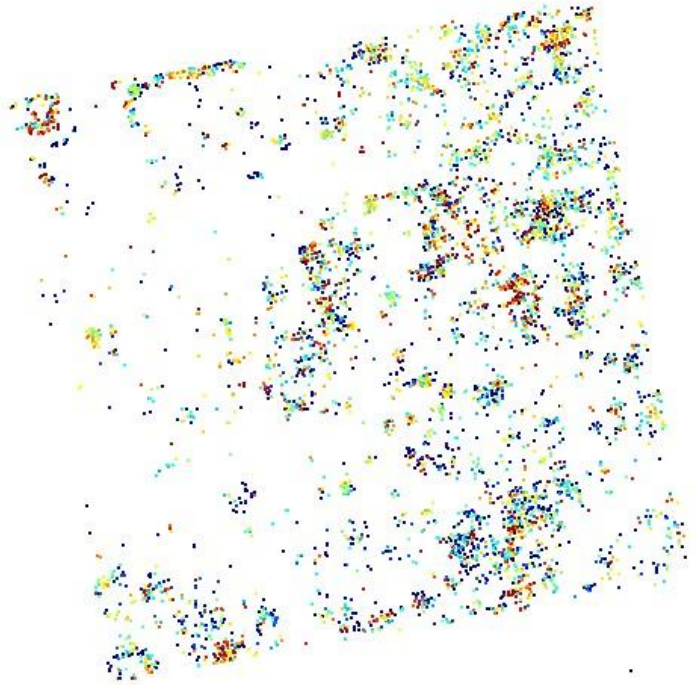
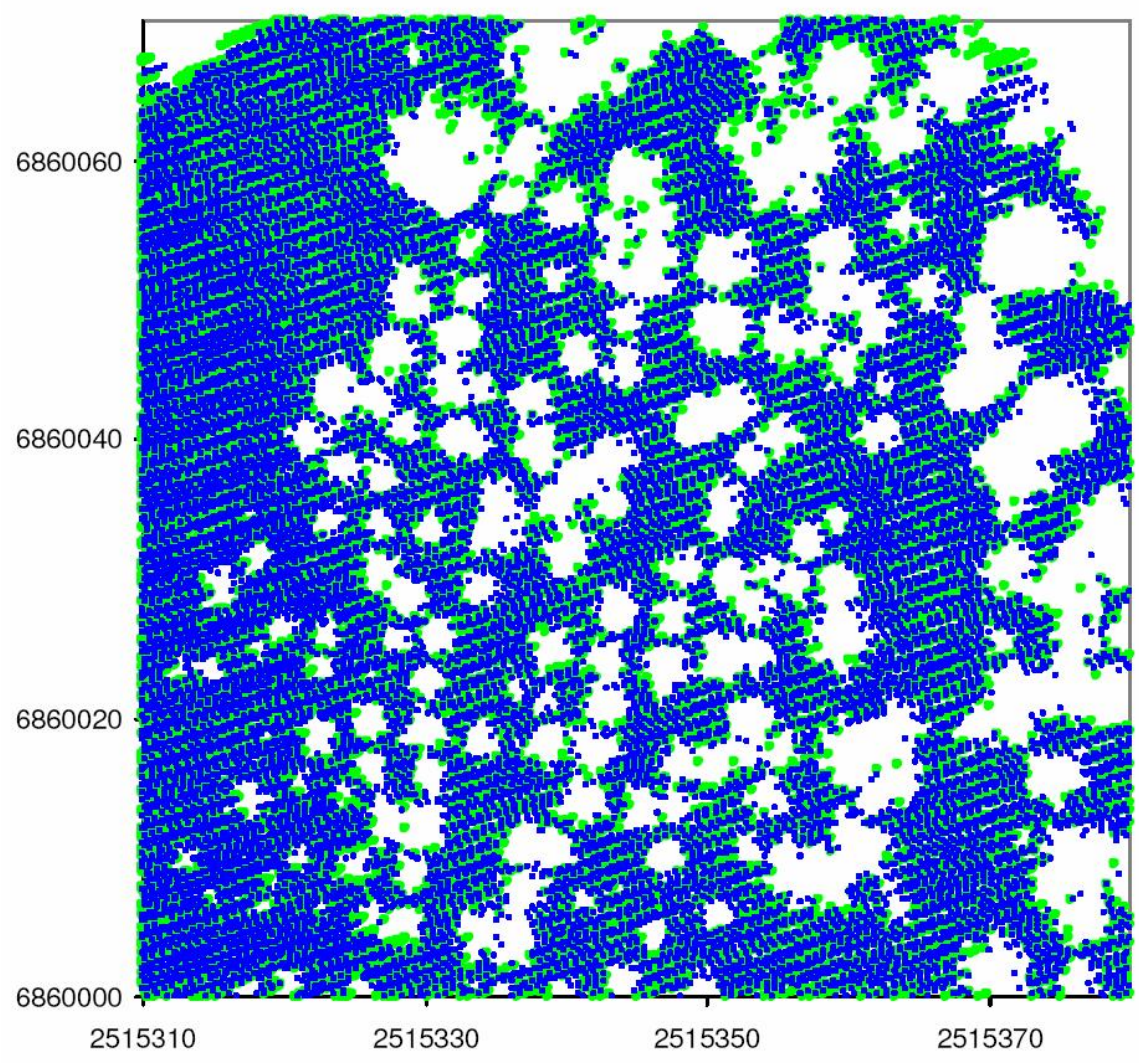


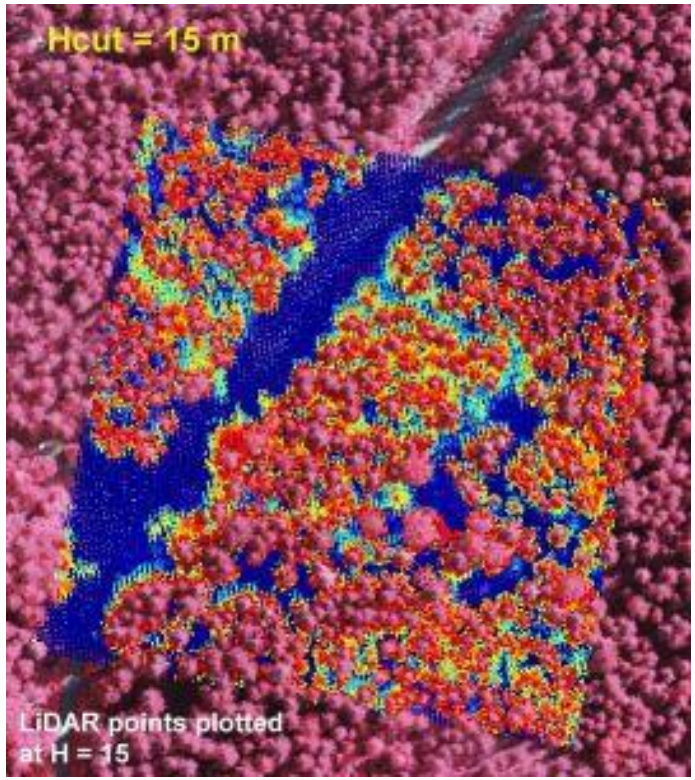
Figure 5. *im* × tree height in 20−135-yr-old birches (n=1979).



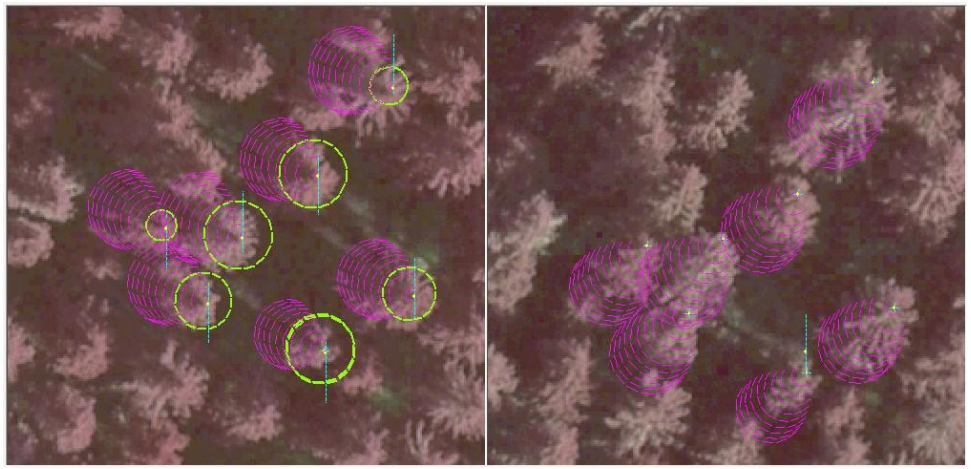
Planned LiDAR Research: LiDAR – pulses or points?

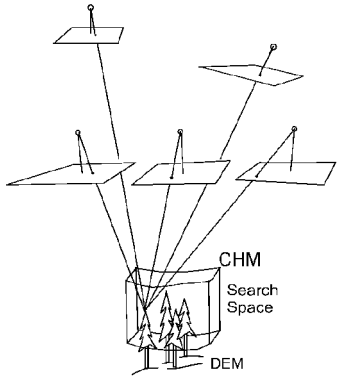
- Using the full geometric information of LiDAR for tree detection and measurement





Research with aerial images in Hyytiälä





- Multi-image matching for 3D tree top positioning, SP-recognition and image–based crown width estimation (SF 2004, ISPRS Hannover 2007)
- Stereo image matching for DSM/CHM estimation (IntJRemSens)
- 1946-2008 time-series of aerial images and LiDAR (SF 2006)
- Photogrammetric-geodetic tree mapping method (SF 2007)
- Stereo/Triplet area-based matching for DEM estimation in archived images (Maanmittaus 1/07)
- Combined LiDAR and images in seedling stands (SF 2008)

Planned research with optical data

Co-op:
Leica / Ulrich Beisl
FGI / Eija Honkavaara
Joensuu / Timo Tokola, Color Lab

Image-based tree species recognition
- some 16000 photo-visible trees are available
- comparison of cameras UCD, ADS40 & DMC is possible
- effect of flying height UCD 1, 2.3 km, DMC 1, 2 & 3 km, ADS 1, 2, 3 & 4 km
- ”seeing BRDF as your friend”, quest for invariant features
- Many effects, e.g. phenology and WX remain without control

Image and LiDAR features
- We might be able to reach 95% for single dominant trees, but how high can we fly? How about area-based estimates (e.g. 10 × 10-m areas)?

Planned (wishful thinking) research with optical data

DSM estimation in 80-90% forward overlap images

Multi-image matching of crowns and canopy (COBRA-style) in UAV imagery.