Challenges in Photogrammetry and Remote Sensing

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Statements

- „Photogrammetry is finished“
  Professor Rinner (bundle block formulation) 1960ies

- „Remote Sensing has always been the method of the future“
  Saying in Forest Science

Old stuff, that never will work?
Economic Predictions

  21st Century *growth markets* seen by US Bureau of Labour
  - Nano-technology
  - Bio-technology
  - Geo-technology

- *The economic value of the Dutch geo-information sector*, Castelein et al., 2010: *Int.J. Spatial Data Infrastructure Research*
  *Geo-Information sector is 0.25% of Dutch GDP*
Obvious Demands

Obvious Demands


- Climate Change and Adaptation
  - Earth Observation
  - Monitoring
  - Remote Sensing
Obvious Demands

- **Resources**
  - Forests is 25% of land mass
  - Fauna-Flora-Habitat Directive
  - Megacities, space consumption
  - Cultural Heritage
to moving measurement platforms
from single to multi-sensor systems
to higher autonomy and automation
to new fields of applications
Presentation outline

the art and science of inferring metric information from images

Photogrammetry, Remote Sensing
and their neighboring disciplines

Challenges

Sensors, Methods, and Applications
Photogrammetry

Geo...
Geometry the Earth

object-based area-based
Photogrammetry

object based

area based

Computer Vision

Remote Sensing

Physics Processes

Image understanding

Applications
from States to Processes
P & RS neighbor: Spatial Information Science

Geo-data infrastructures (GDI) and ubiquitous geo-information

- Virtual Globes: NASA, Google, Microsoft, …
- Navigation
- LBS
- Web 2.0 geodata mash-ups

Omnipresent Geo-Data
Omnipresent Geo-data

Geo-data infrastructures (GDI) and ubiquitous geo-information
- Virtual Globes: NASA, Google, Microsoft, …

- Navigation
- LBS
- Web 2.0 geodata mashups

- Wiki mapping, collaborative mapping, crowd sourcing, …
  - interest driven
  - update stream
- Free global Geo-data
  - SRTM
  - CBERS, …
Omnipresent Geo-data

- Methods for collaboration not yet settled
- Academic contribution to Open Source GDI very little

- Free national Orthophotos, US-Lidar for the nation
- EuroSDR: Crowd sourcing for updating national databases
geo-referenced and geo-physical

P&RS Mission

geo-data and models for a sustainable development of the natural and cultural environment

Where’s the challenge?

- Exploit new sensor technology
- Increase automation in modeling
- Adopt new applications
- Strengthen Sensor – Method – Application feedback
New Sensors
Standard Imaging Sensors

- **Texture sensors**
  - Digital aerial camera: digital workflow
  - Digital semi-metric and consumer cameras
  - Hi-Res/Med-Res RBG/Nir Satellite Imager (hardly large image blocks!)

- **Radiometric and spectral sensors**
  - Multispectral Satellite Imager
  - Airborne Imaging Spectroscopy
  - Microwave/SAR Satellite Imager
  - FLIR cameras

- **Range sensors**
  - Aerial/Terrestrial Laser Scanner
  - Active Triangulation
  - Structured Light

Leica, Specim, Optech, Minolta, SMOS
Sensors Developments

- Sensors combinations
- Radiometric exploitation of digital aerial cameras (EuroSDR-Test, FGI)
- Full Waveform Laser Scanning
- Multi-spectral Laser Scanning
- Time-of-Flight Cameras
- Single Lens Stepping Frame
- Terrestrial InSAR

After Gordon Petrie

© u-blox GPS/Galileo chip

© XSens, MEMS IMU

Antonov of Geokosmos: Optech, Z/I, Rollei
Challenges

- Tighter sensor integration physically
- Integrated processing of data streams e.g. of GNSS, INS, LiDAR, and imaging spectrometer
- Corresponding features, orientation
- Calibration: geometrically and geo-physically
- Understanding measurement processes

Approach

- Tighter integration of physical and geometrical views
- Coupling of Orientation, calibration and primitive modeling
Improve Automation

- Photogrammetry: Lack of Automation
- Remote Sensing: Lack of Reliability / Transferability

120 km²

148,940,000 km² Land
Improve Automation

- Photogrammetry: Lack of Automation
- Remote Sensing: Lack of Reliability / Transferability

Efficient representation and retrieval of implicit and explicit knowledge and experience

SPOT Classification by Kessler, Kim, Steinocher
Standardized Methods and Products

- Satellite image classifications
- Surface/terrain models, orthophotos, point clouds
- 3D city models (roof landscape, facades)
Challenges

- Modeling from different sources: time, scale, observable
- Reliability, correlated observations, quality control
- Representation and retrieval of knowledge and experience
- Contradictory information
- Processing time

Approach

- Exploit redundancy, compression
- Advance from empirical to geo-physical process models
- Exploit machine learning competence
Different sources example …

- Forest inventory data and airborne laser scanning
- Airborne and terrestrial point clouds


© Doneus, Briese, Studnicka
New Applications

- Cartography, Urban Planning, GDI
- Industry, Cultural Heritage, Hydrology

Quantification Processes
- Geography, Geomorphology, Geology
- Biology, Ecology, Forestry

biodiversity, hydraulic resistance, timber volume, channel erosion, dead ice, grain size distribution...
Feedback – Feed Forward – Loops

… be scientifically sustainable by persistent development of methods …
- Loads of interesting work & research ahead
- Openness for applications & sensors essential
- Modeling of geo-physical (and geo-social!) processes
- Integration of geometry and physics
  3D model → global dynamic geo-physical etc. etc. model