Geo-instrumentation and fieldwork equipment

Laboratory of Geo-information Science and Remote Sensing
Wageningen University and Research

Version 0.1

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Background

As sensing and measuring is one of the important research themes of the Laboratory of Geo-information Science and Remote Sensing (GRS) of Wageningen University, we have build-up quit a large instrumentation pool over the past years. These instruments are intensively used for research but also for educational activities (demonstration and fieldwork). On the GRS website several webpages are dedicated to providing an overview and background of the instruments. This document brings all these separate sources of information together.
The purpose of this document is:

- To provide students and researchers an overview of instruments available within GRS;
- To use as a basis for management of the different instruments;

The document will be be synchronized with the relevant websites.

Overview of GRS facilities

Within GRS the following instrument facilities have been set-up:

- Land-survey and GNSS instrumentation, and geo-sensors
- Spectroscopy and goniometer facility
- WU terrestrial Laser Scanning Facility
- Unmanned Aerial Remote Sensing Facility (UARSF)
- Map table and (3D) visualization instruments

In the next sections, an overview is given of the instruments per facility, links to instrument descriptions are provided and if available links to manuals and working instructions.

Land-survey and GNSS instrumentation, and geo-sensors

Contact: Aldo Bergsma and Marcello Novani

The basic data which need to be acquired by geo-information scientists are the coordinates of the objects of interest. Global Navigation Satellite Systems (e.g., GPS) provides the technology to measure coordinates across the earth system. However, also more traditional land surveying instruments are still in use to acquire spatial data. In addition, specific characteristics of the soil-plant-water-atmosphere system are measured with geo-sensors.

Table 1: Overview of GNSS, land-survey and geo-sensor instruments

Instrument	Reference to background	Manual or instruction
GNSS instruments		
Topcon HIPER V: RTK precision within 1 cm (2 instruments)	Company description	Link to manual
Garmin etrex 30: handheld GNSS 5-10 m (25 instruments)	Company description	Link to manual
Xexun TK102-2 GPS trackers		
Bluetooth GPS (5-10 m)		
Leica GNSS RTK (cm. accuracy)		
Survey instruments		
Leica Robotic Totalstation (cm accuracy)		
Swarowski Distance Laser guide Long range		
Leica Distomat D5 short range		
Pentaprism		
Ranging rod		
Rulers 2, 5, 10, 30, 50 m		
Inclinometer: Wild, Breithaupt Suunto Leiss		
Leveling instruments (Automatic and KIP) Nikon, Wild, Breithaupt etc.		
Geo-sensors[1]		
Wind speed meters		
Thermo meter Taylor 2 sensors adjustable interval , long time storage		
Thermo meter Rayngr IR-distance		
NEC Thermotracer TH9100 Thermal camera		

1: for RS and GIS Integration course (GRS60312): other ESG chairgroups could have instruments which could be of relevance for the fieldwork activities: in earlier years instruments measuring water quality, animal movement camera (REG), underwater sonar, …

Spectroscopy and goniometer facility

Contact: Harm Bartholomeus and Lammert Kooistra

To support remote sensing research and education high-quality spectral measurements are critical for calibration and validation of images acquired from satellite or (unmanned) airborne platforms. At GRS a broad range of instruments is available to support this activity.

Table 2: Overview of field spectroscopy instruments

Instrument	Reference to background	Manual or instruction
Field spectrometers		
ASD Fieldspec 3: 350-2500 nm; calibration with reference panel	Company description	Link to manual
ASD Fieldspec Pro FR: 350-2500 nm; calibration with reference panel	Company description	Link to manual
ASD Fieldspec JR: 350-2500 nm; calibration with reference panel	Company description	Link to manual
ASD Fieldspec HH: wavelength range of 325 nm – 1075 nm; calibration with reference panel	Company description	Link to manual
Peripherals for ASD instruments: Integrating Sphere, Contact Probe, Foreoptics, lamps	Company description	
Cropscan (16 bands): upward and downward facing sensors to measure both incoming and reflected radiation	Company description	Link to manual
Dualspec: 400-900 nm; 3 nm resolution; upward and downward facing sensors	Custom made	Manual available on request
Fluorspec: 650-780 nm; 0.3nm resolution, specifically designed to measure fluorescence signal	Custom made	Manual available on request
Robot based Goniometer system (Plantfacility)	Article describing the system	Currently not in operation: contact Jan Clevers
Spectroscopic plant trait instruments		
Licor LAI2000: Leaf Area Index of vegetation canopies	Company description and brochure new version	Link to short manual Link to complete manual
Minolta SPAD: chlorophyll concentration of leaf	Company description	Link to manual
Hemispherical camera: Leaf Area Index, canopy cover, clumping index of vegetation canopies (including forest)	General description of measurement principle	

Terrestrial Laser Scanning Facility

Terrestrial LiDAR (LIght Detection and Ranging) is a ground-based remote sensing technique that can retrieve the 3D structure of objects on the earth surface in high detail. Within GRS this especially adopted for mapping and monitoring vegetation: forest and crops.

Contact: Harm Bartholomeus

Table 3: Overview of laser scanning instruments

Instrument	Reference to background	Manual or instruction
RIEGL VZ-400 laser scanner materials mentioned below are add-ons to this system	Company description	Manual available on request: contact Harm Bartholomeus
Scanner mount for manual tilt (adjustable in steps of 15° up to 90°)		
Integrated digital compass and GPS antenna Full waveform (FWF) readout		
NIKON D700 digital camera on high precision camera mount (NIKKOR 14/2.8 lens and NIKKOR 85/1.8 lens		
Zebedee: handheld 3D mapping system	Company description: link provides also example applications	Manual available on request: contact Harm Bartholomeus
RIEGL Unmanned Laser Scanning Ricopter: VUX-SYS scanner	Company description Ricopter@WUR Seminar Drones for research – observing the world in 3D from a Lidar-UAV + movie	Manual available on request: contact Harm Bartholomeus
Trimble V10 Imaging Rover: integrated camera system that precisely captures 360-degree digital panoramas	Company description	Owned by Wageningen Environmental Research: contact Henk Kramer

Unmanned Aerial Remote Sensing Facility

Contact: Lammert Kooistra and Harm Bartholomeus

To support environmental management there is increasing need for timely, accurate and detailed information on our land. Unmanned Aerial Vehicles (UAV) are increasingly used to monitor agricultural crop development, habitat quality or urban heat efficiency. An important reason is that UAV technology is maturing quickly while the flexible capabilities of a UAV fill a gap between satellite based and ground based geo-sensing systems. At GRS, we have established a significant instrument pool for UAV based research in cooperation with the team Earth Informatics of Wageningen Environmental Research, and the department of Soil Physics and Land Management (SLM) of Wageningen University. The UAVs of the UARSF can only be flown by certified pilots.

Table 4: Overview of UAV platforms and camera's

Instrument	Reference to background	Manual or instruction
Unmanned Aerial Vehicles		
DJI Phantom 3: light-weight UAV with RGB camera + video	Company description	
Altura AT8: Octocopter carries up to 2 kg flying 10 minutes and can carry different camera's (see below)	Some details of the UAV are described in Suomalainen et al. 2014	Operation Manual available on request: contact Lammert Kooistra
DJI S1000: Octocopter carries up to 3.5 kg flying 10 minutes and can carry different camera's (see below)	Company description	Operation Manual available on request: contact Lammert Kooistra
RIEGL Unmanned Laser Scanning Ricopter: fixed VUX-SYS scanner + RGB camera's: flight time 20-30 minutes	Company description Ricopter@WUR Seminar Drones for research – observing the world in 3D from a Lidar-UAV + movie	Manual available on request: contact Harm Bartholomeus
Mavinci Sirius: fixed wing UAV (operated by SLM): payload 600 gram, flight time 30-40 minutes	Company description	
Camera's		
MUMSY: multispectral mapping system: 2 NIKON camera's with 4-band RGB-NIR		Processing manual available on request: contact Lammert Kooistra
HYMSY: hyperspectral mapping system, push-broom: 450-950 nm with 100 spectral bands	Details of the camera are described in Suomalainen et al. 2014	Processing manual available on request: contact Lammert Kooistra
Rikola: hyperspectral frame camera: 111 spectral bands in range from 450-950 nm; in most cases flown with 20-30 programmable bands	Company description Details of the camera are described in Roosjen et al. 2017	Processing manual available on request: contact Lammert Kooistra

Fluorspec: 650-780 nm; 0.3nm resolution, specifically designed to measure fluorescence signal	Custom made	Manual available on request
Workswell WIRIS: thermal camera	Company description	Processing chain under development

Map table and (3D) visualization instruments

Contact: Ron van Lammeren and Aldo Bergsma

In many multi- and transdisciplinary studies the role of maps as medium to communicate and participate is of great importance. The exchange of information by maps ranges from mass media by newspapers, television and websites to very individual by sketch paper and tablet.
The exchange of information by maps in small groups (2 up to 6 persons) can be supported more efficiently and effectively supported by the use of Map Tables. But also new technology like the Microsoft Hololens is currently tested.

Table : Overview of instruments

Instrument	**Reference to background**	**Manual or instruction**
Map Table: Samsung SUR40 pixelsense technology	Short description	The Map Table can be used for group work during courses. Lecturers and students currently have no support.
Microsoft Hololens (available from May 2017)	Microsoft HoloLens Development Edition: short description	Currently in development