Advanced monitoring technology development in NATURA 2000 forest sites of Pannonian Biogeographic Region

N. Szőllősi[1] – T. Fórián[1] – A. Nagy[1] – J. Fehér[2] – S. Rahner[3] – H. Heilmeier[4] – G. Nagy[5] – T. Jancsó[5] – P. Riczu[1] - J. Tamás[1]

[1]University of Debrecen, Institute of Water and Environmental Management
[2]VITUKI
[3]YGGDRASIL
[4]Technische Universität Bergakademie Freiberg,
[5]University of West-Hungary, Faculty of Geoinformatics

In "*Debrecen-hajdúböszörményi tölgyesek*" (site code: HUHN20033) NATURA 2000 site field measurements were carried out by University of Debrecen. *Debrecen-hajdúböszörményi tölgyesek* area is 5634.62 ha. Main habitat classes are Broad-leaved deciduous woodland and Artificial forest monoculture (e.g. Plantations of poplar or other trees).
Main impacts in Debrecen-hajdúböszörményi tölgyesek are replanting, forestry clearance and hunting which are high influenced. Impact of these activities on oak tree habitats are detectable by laser-scanning and hyperspectral flights technology.
On this site laser-scanning and hyperspectral flights were carried out during the summer of 2011 to detect human influenced disturbances and impacts in oak woods. This new technology is used at first time which is an advanced monitoring technology development.
The hyperspectral sensor consists of one optic, one spectrograph and one digital cam. The two hyperspectral sensors are assembled in a house; therefore it is known ASIA DUAL system (*Figure 1*).

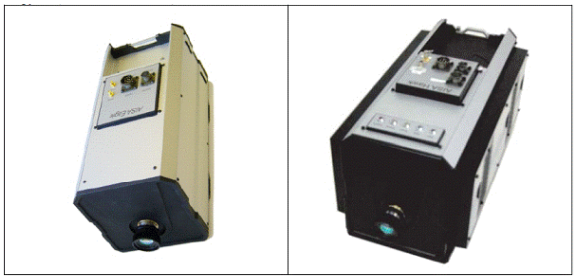

Figure 1: Eagle és a Hawk sensors

The Eagle camera takes images in visible and near infrared range (VNIR), while Hawk operates in the middle infrared range (SWIR). By means of establishing of two cameras a DUAL system (*Table 1*) were installed. The full range is 400-2450 nm, which can be set 1.25-10 nm wavelength band and maximum 498 spectral channels. Two sensors can also be operated separately, so it makes possible to utilize the wider wavelength of higher resolution (1024 pixels) VNIR sensor.

Table 1: Technical parameters

	VNIR sensor (Eagle)	SWIR sensor (Hawk)	AISA Dual
Spectral range	400-970 nm	970-2450 nm	400-2450 nm
Spectral resolution	244	254	498
Spectral sampling/px	2.3 nm	5.8 nm	
Spectral binning options	12	14	14
Spatial pixels	1024	320	320
Fore optics	18.04 mm	18.04 mm	
FOV	37.7 degrees	24 degrees	24 degrees
IFOV	0.037 degrees	0.075 degrees	0.075 degrees
Image rate	Up to 100 img/s	Up to 100 img/s	Up to 100 img/s

ENVI 4.7 software was applied for the analysis of hyperspectral images. Based on both the airborne reflectance measurements, vegetation idices were calculated. Remote sensing technologies (*Figure 2*) make a possibility to the time series analyzing of the oak forests and obtaining information of qualitative and quantitative parameters of plants.

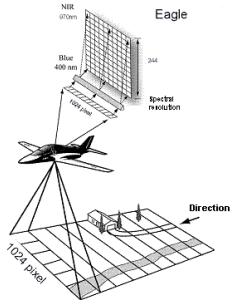

Figure 2 : Remote sensing technology

Leica ScanStation C10 laser scanner (*Figure 3, Table 2*) includes scanner, tilt sensor, controller, data storage, auto-adjusting video camera and laser plummet. During measurement process a short laser pulse is emitted towards the object and is reflected on its surface; a part of the reflected radiation comes back to the scanner where it is detected by a sensor.

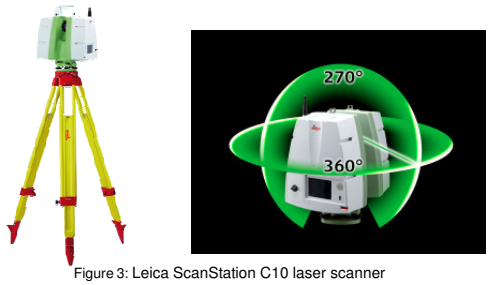

Figure 3: Leica ScanStation C10 laser scanner

Table 2: Technical parameters of laser scanner

Laser Scanning System	
Type	Pulsed; proprietary microchip
Color	Green, wavelength = 532 nm
Laser Class	3R(IEC 60825-1)
Range	300 m (minimum range 0.1 m)
Scan rate	Up to 50,000 points/sec, maximum instantaneous rate
Scan resolution	
Spot size	From O- 50m: 4.5mm (FWHH-based); 7 mm |Gaussian-based|
Point spacing	Fully selectable horizontal and verticai; < 1 mm minimum spacing, through full range; single point dwell capacity
Field-of-View	
Horizontal Verticai	360° (maximum) 270° (maximum)
Aiming/Sighting	Parallax-free, integrated zoom video
Scanning Optics	Vertically rotating mirror on horizontally rotating base; Smart X-Mirror™ automatically spins or oscillates for minimum scan time
Data storage capacity	80 GB (onboard hard disk)
Communications	Dynamic Internet Protocol (IP) Address, Ethernet
Intergrated color digital	Single 17° x 17° image: 1920 x 1920 pixels (4 megapixels)
camera with zoom video	Full 360° x 270° dome: 230 images; streaming videó with zoom; auto-adjusts to ambient lighting Touchscreen control with stylus, full colour graphic
Level indicator	External bubble, electronic bubble in onboard control and Cyclone software

The measurement of laser scanner is based on time-of-flight (TOF) method. In a given medium, light waves travel with a finite and constant velocity. The resolution of the image is 5 mm on 10 m, it means, we can make calculations even on leaf level with high accuracy and we could recognize the geometry of the trees (*Figure 4*).

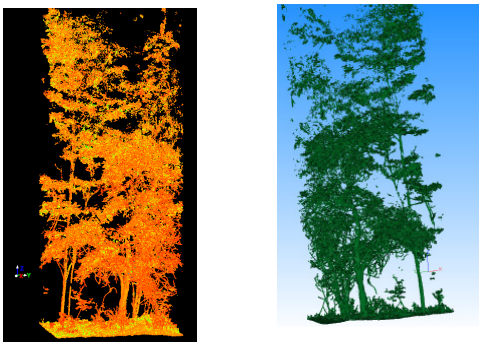

Figure 4: Trees in Leica softver and 3D Reshaper softver

These technologies will be used in CHANGEHABITAS_2 project. About the field portable laser scanning technology and other technological details will be published in poster section.

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