

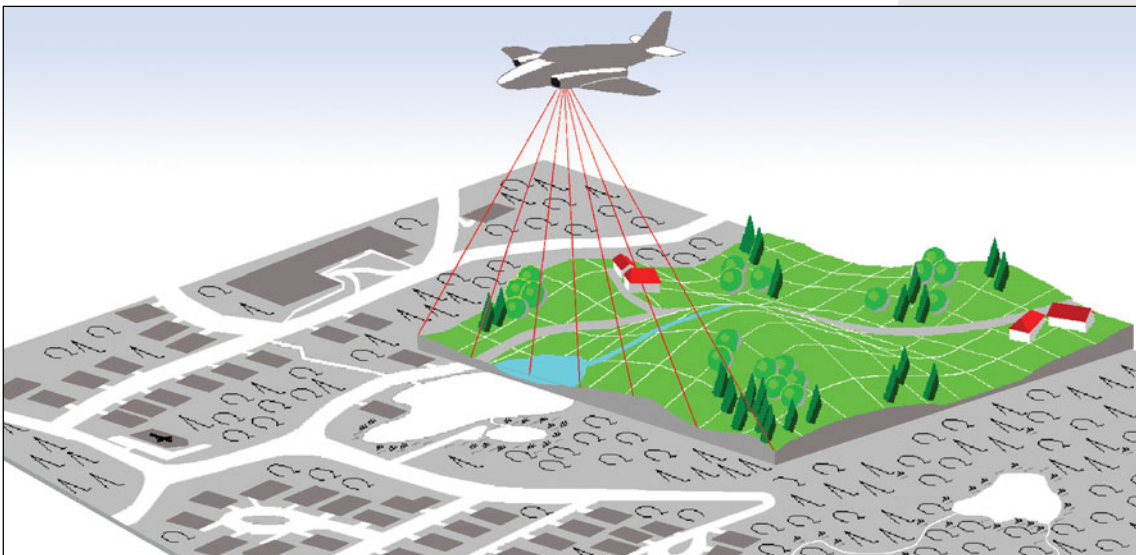


FALCON

LIDAR SENSOR SYSTEM

AIRBORNE ACQUISITION
OF DIGITAL ELEVATION MODELS
AND ORTHO IMAGES

ON-BOARD SYSTEM
AND DATA PROCESSING



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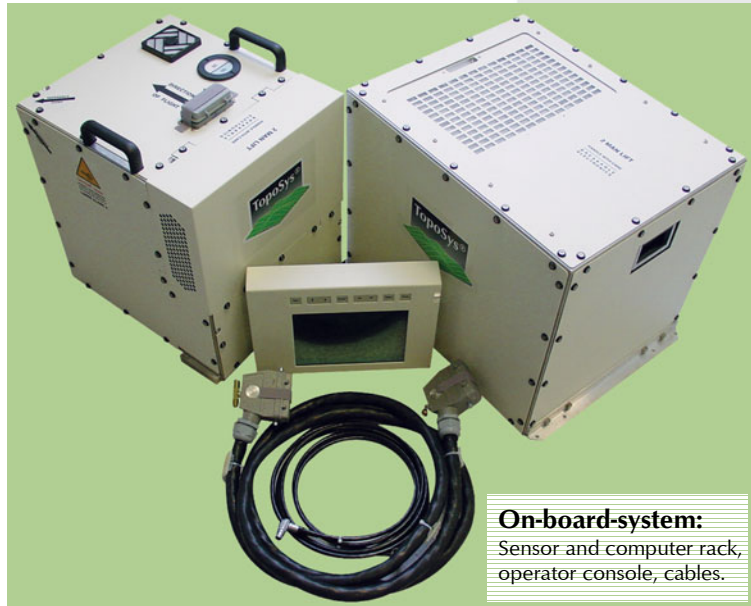
FALCON

is an airborne LIDAR system for the acquisition of digital elevation models (DEM) and ortho images. FALCON has been developed based on three years' experience in operation of the „TopoSys I“ LIDAR system. It comprises the on-board sensor system (hardware) and a modular software package to process acquired data.

While FALCON is already in operation for three years, TopoSys continues to develop the system. Aim is to keep both FALCON hardware and software always at the current state of technology.

DEM and ortho images delivered by TopoSys to many users in and outside Europe demonstrate the capabilities of the system in producing reliable, high resolution base data for a variety of applications.

The unique scan technique combined with its extreme measurement rate distinguishes FALCON from other LIDAR systems. The modular processing software has been developed by taking into account the specifics of the FALCON LIDAR. The software includes routines to convert products to nearly any data format, so TopoSys DEM and ortho images may be handled by e.g. ERDAS imaging, ENVI, PCI Geomatics, ESRI ArcGIS, Terrasolid, Surfer.



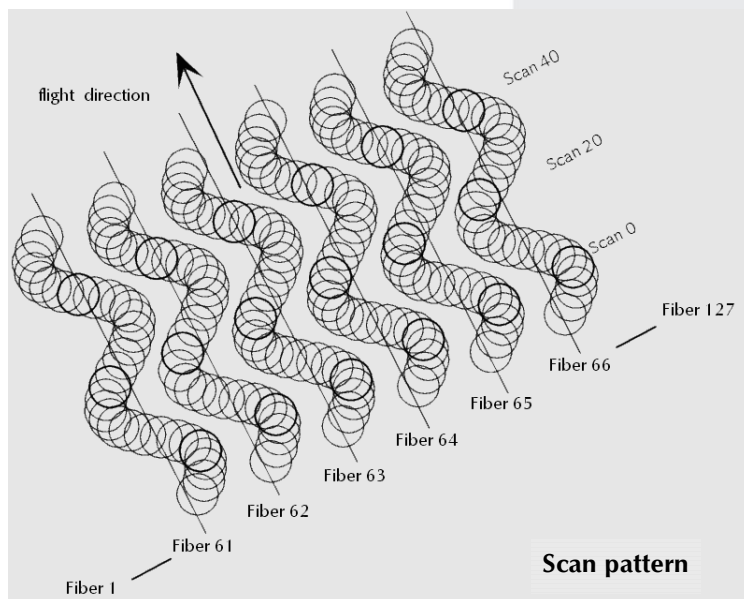
On-board-system:
Sensor and computer rack,
operator console, cables.

LIDAR

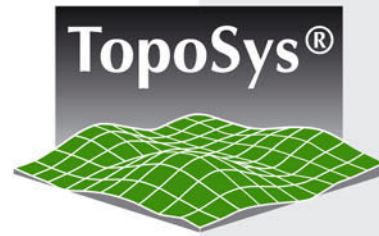
FALCON combines a number of special features; each of it contributes to a system which is leader in precise LIDAR technology.

FIBER-SCANNER

In case of FALCON, the laser pulses are transmitted and received by two separate lines of glass fibers. The individual beam directions are firmly aligned due to a mechanically solid orientation of the fibers. For an optimized scan pattern providing best coverage of the scanned area the swing mode has been implemented. The arrangement is not sensitive to vibrations of the airborne carrier.



Scan pattern



LASER

FALCON's laser pulse rate of approximately 83 000 Hz is basis for precise LIDAR DEM. The high pulse rate results into an overlap of the measurements (redundancy) which allows for plausibility and consistency checks - one reason why TopoSys DEM are so reliably.

FALCON's laser operates at a wavelength of 1560 nm. Reflection and absorption at this wavelength is different from that at about 1000 nm, a part of the spectrum in which other LIDAR systems work. One consequence of the chosen wavelength is that the FALCON LIDAR is eye-safe already at a distance of about 0.5 meter providing easy and safe handling in operational use.

RGB/NIR - LINE SCANNER

For many applications the line scanner data is not only a nice supplement.

Image data recorded simultaneously with the LIDAR range measurements frequently simplify the interpretation of the elevation data.

The RGB/NIR line scanner is an optical scanner which captures image data digitally in four spectral channels: red (R), green (G), blue (B) and near infrared (NIR). It includes a high-grade light sensitive lens enabling gathering of data even in case of poor lighting conditions.

The line scanner hardly needs manual settings due to its automatic control of exposure und aperture.

TRUE ORTHO IMAGES

The final product of processing line scanner data is a true ortho image – an image in which objects are presented in bird's eye view, which means that buildings and trees do not have a lean.

Taking R,G,B allows a true color presentation (RGB), while taking NIR,R,G results into a color infrared (CIR) presentation of image data.

The CIR image allows an easy separation of vegetation and sealed areas.





OPERATION

AIRCRAFT INTEGRATION

Fast and reliable integration of FALCON in various airplanes and helicopters was an important design factor during development.

So, FALCON provides a minimum of mechanical and electrical connections to the aircraft, which makes it possible that mounting and demounting of the equipment is done in less than one hour.

CALIBRATION

FALCON includes three major components: fiber scanner, inertial navigation system and the RGB/NIR line scanner. These three components are mounted close together on a stiff carbon fiber plate.

The internal orientation of these sub-units is invariant and remains constant even when the sensor system is integrated into another aircraft. So, only one single calibration is needed to determine the relationship of these three components to each other.

OPERATIONAL FLIGHT CONDITIONS

FALCON has been designed to operate under nearly all conditions (at day and night). Naturally, there are some limitations: no clouds and no fog beneath the aircraft, no image data during night operation.

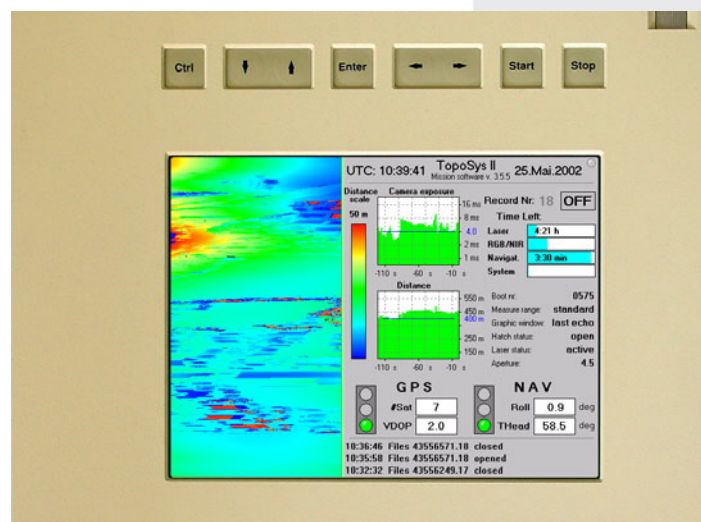
The maximum range of 1600 m above ground level has been chosen as trade-off between requirements like measurement of poor reflecting surfaces, low power consumption, high measurement rate and last not least: average cloud ceiling in medium latitudes.

OPERATOR CONSOLE

Like the other system components, FALCON's operator console was designed for operation in rough aircraft environment (direct sunlight, strong vibrations, extreme temperatures etc.).

The operator console displays results of the automatic hardware test as well as other monitoring information in graphical form.

Real-time system control is easy, because information is shown in a user-friendly, intuitive manner.





PROCESSING SOFTWARE „TopPIT“

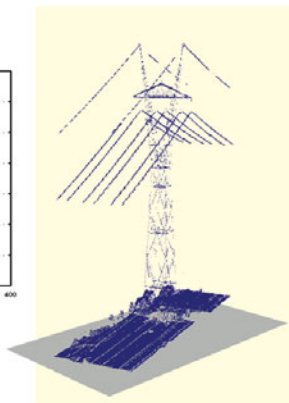
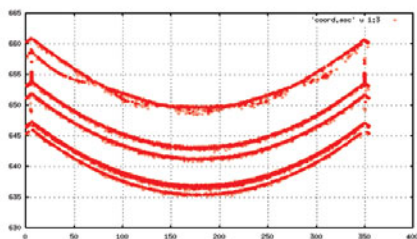
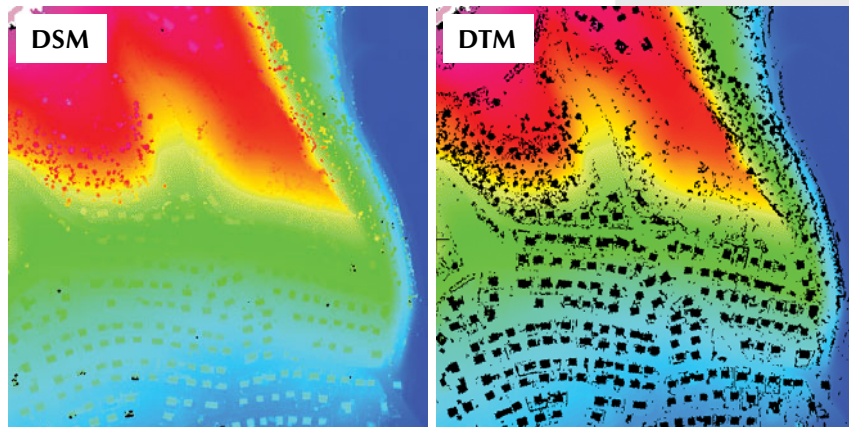
TopoSys Processing and Imaging Tool (TopPIT) is a modular software package comprising LIDAR and RGB/NIR data processing as well as basic modules for image production. Included are specific tools for data analysis, flight planning and quality control. TopPIT also allows for automated multilevel handling processes.

LASER DATA MODULES

Laser and navigation data (position and orientation of all sensors) are converted by module „XYZ Coordinates“ into ground coordinates (point-cloud) in any national coordinate system. The point-cloud can be stored in either ASCII or binary format.

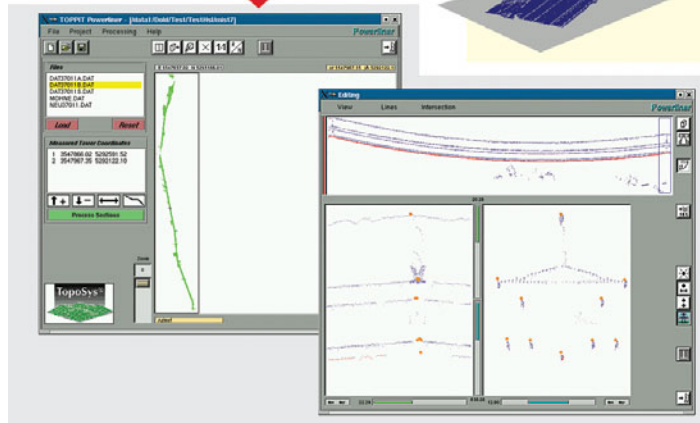
The Digital Surface Model (DSM) in raster format is produced by sorting point-cloud data into a raster. TopPIT module „gridding“ may produce various raster widths; it offers import and export tools providing compatibility to GIS and image handling software.

Filter tools allow eliminating vegetation and objects in order to produce a Digital Terrain Model (DTM). There are several filters available which can be chosen depending on kind of application, dynamic of terrain etc.



HSL - MODULE

The extraction of overhead transmission lines from FALCON LIDAR data is done by the interactive software tool „HSL“. HSL takes the point-cloud of LIDAR elevations and produces 3D-vectors of the power-lines. Output of HSL is available in standard vector formats and customer specific formats.



RGBI - MODULE

„TopPIT“ module „RGBI“ produces true ortho images from simultaneously taken image and LIDAR data. The true ortho image is calculated by taking the LIDAR DSM as data set for rectification. The output geo-referenced images in true color and color infrared are available at a scale between 1 : 2 500 to 1 : 10 000.



TECHNICAL PARAMETERS

FALCON

Power requirements		28VDC/15A/<420 W
Sensor rack	(WxHxD in cm ³) weight	39 x 47.5 x 45 41 kg
Computer rack	(WxHxD in cm ³) weight	47 x 48 x 58 54 kg
Operator console	(WxHxD in cm ³) weight	35 x 6 x 26 3.8 kg

LIDAR

Range		1600 m
Distance resolution		1.95 cm
Scan width		14.3°
Scan rate		653 Hz
Laser pulse rate		83 000 Hz
Effective measurement rate		83 000 per sec
Laser wavelength		1560 nm
Eye safety distance		0.5 m
Data recording:	First Echo Last Echo Intensity	

RGB/NIR LINE SCANNER

Spectral channels	Blue Green Red Near InfraRed	450 nm - 490 nm 500 nm - 580 nm 580 nm - 660 nm 770 nm - 890 nm
Pixel per channel		682
Resolution across track		0.5 mrad
Line rate		up to 330 Hz
Viewing angle		21.6 °
Lens aperture		1 : 1.4

March 2004
Specifications subject to change without notice.