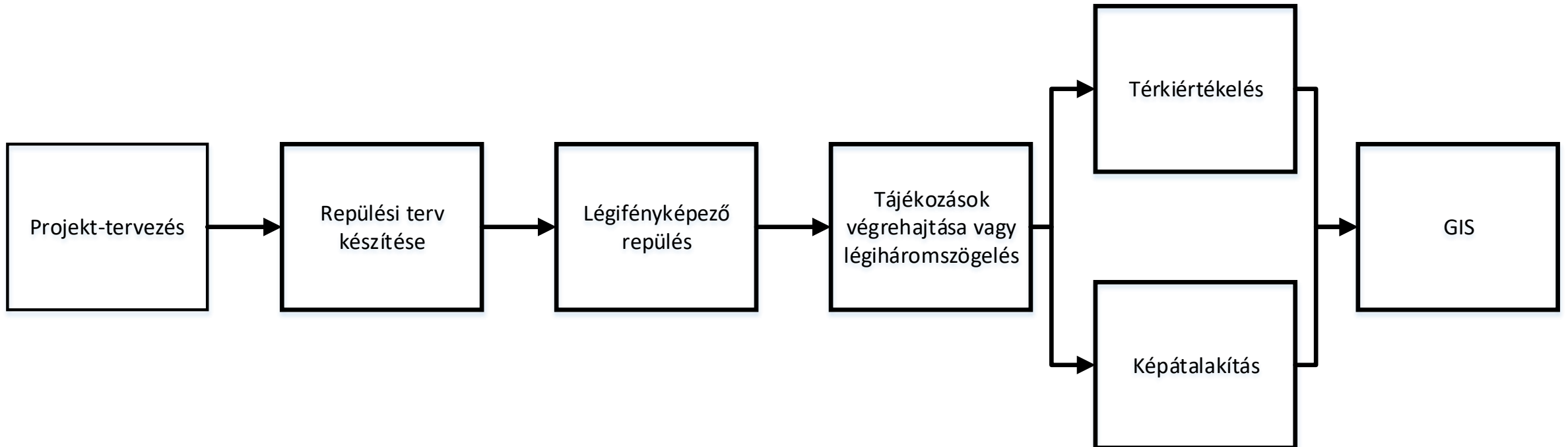


Fotogrammetria és lézerszkennelés

Offline Edition 2021

A légifényképező repülés:
tervezés, kamerák, kiegészítő berendezések

A légifotogrammetriai technológia

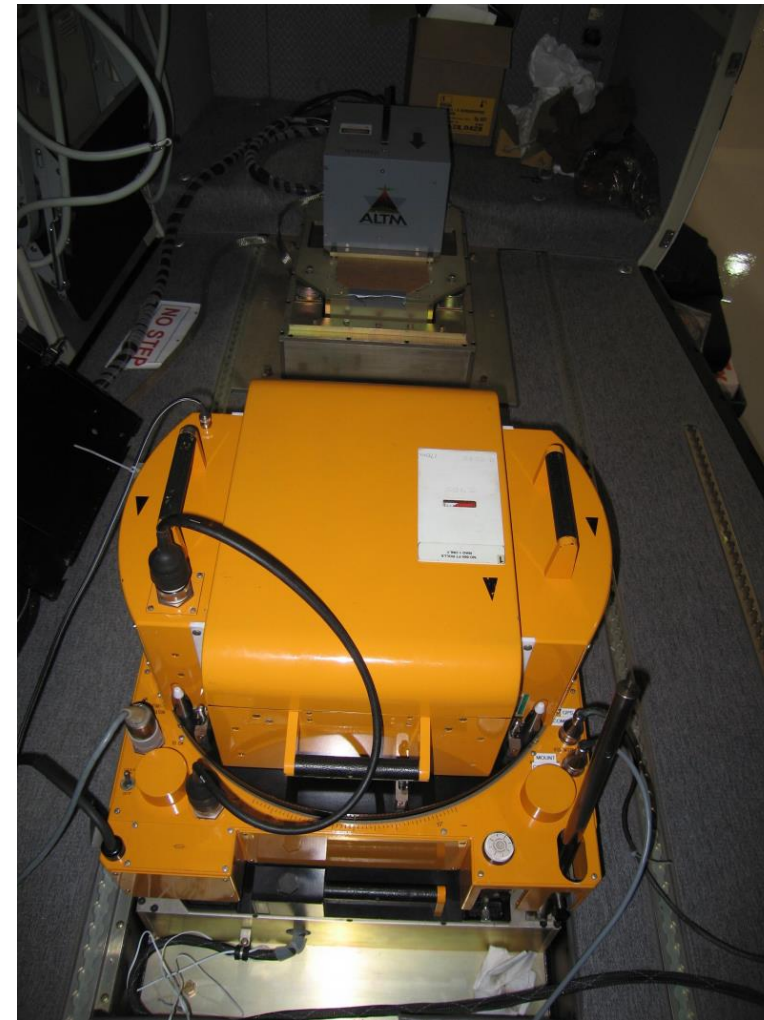
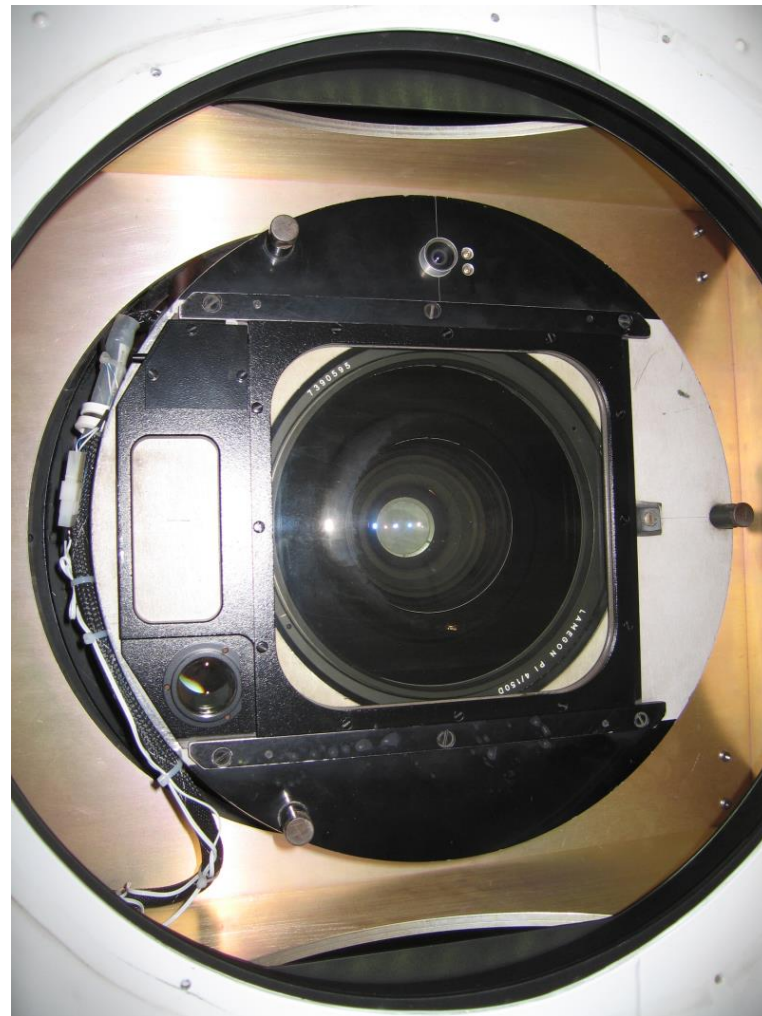


A légifényképező repülőgépek

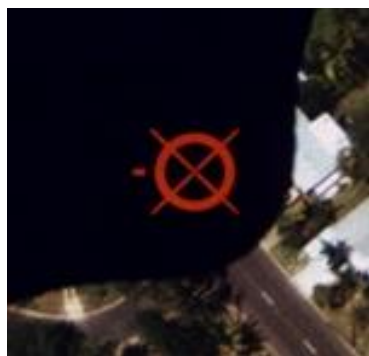


	AN2	Cessna 402	Pilatus PC-6
Hossz [m]	12.4	11.1	11.0
Szárnyfesztáv [m]	18.2	13.5	15.9
Sebesség [km/h]	60-258	132-428	96-280
Max. repülési magasság [m]	4500	8200	8100
Max. hatótávolság [km]	845	2360	730
Max. felszálló tömeg [kg]	5500	3100	2800

A kamera a repülőgépen

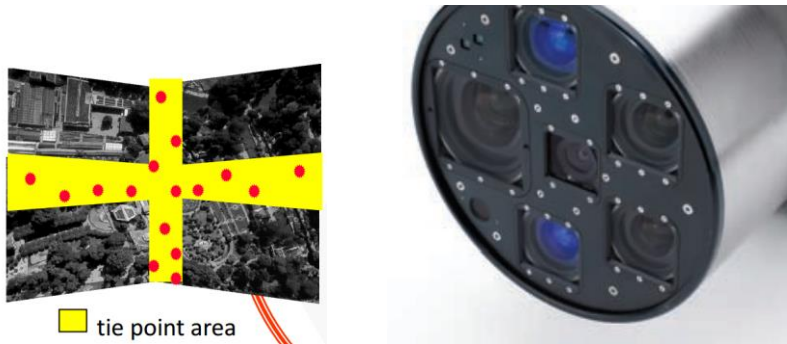


Egy „klasszikus” filmes kamera: Wild RC20

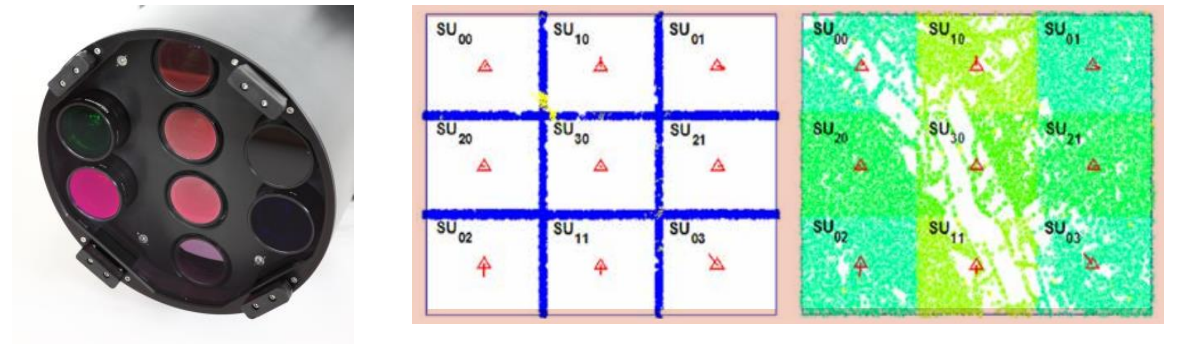


Digitális kamerák I.

- Intergraph DMC II 250



- Microsoft Ultracam Eagle



Digitális kamerák II.

- Leica DMC III

PAN

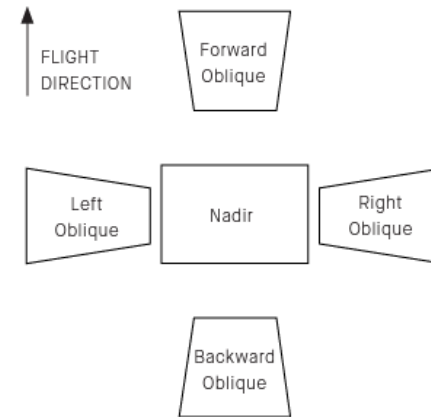
Pixel across track	25,728
Pixel along track	14,592
FoV across track	57.2°
FoV along track	34.4°
Focal length	92 mm
Pixel size	3.9 μm
GSD@500m	2.1 cm

MS

Pixel across track	8,956
Pixel along track	6,708
FoV across track	61.7°
FoV along track	48.2°
Focal length	45.0 mm
Pixel size	6.0 μm
GSD@500m	6.7 cm



- Vexcel Ultracam Osprey 4.1



SENSOR SYSTEM

Nadir

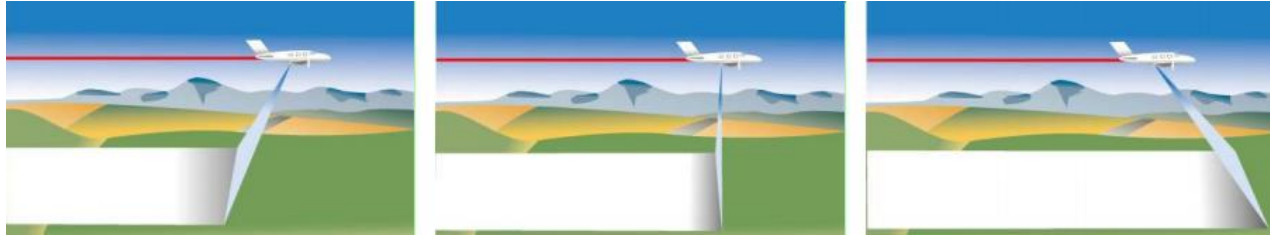
PAN image size	20,544 x 14,016 pixels
PAN physical pixel size	3.76 μm
Color capability (multi-spectral)	4 channels - RGB Bayer pattern & NIR
Color image size	12,840 x 8,760 pixels
Color physical pixel size	3.76 μm
Pansharpen ratio	1 : 1.6

Oblique

Color capability	3 channels - RGB Bayer pattern
Color image size	14,144 x 10,560 pixels
Color physical pixel size	3.76 μm

Imaging sensor	CMOS
Shutter (longlife central leaf)	Prontor magnetic-0 HS; field exchangeable
Motion compensation (multi-directional)	Adaptive Motion Compensation (AMC)
Frame rate (min. inter-image interval)	1 frame per 0.7 seconds
Dynamic range	> 83 dB at base ISO
Analog-to-digital-conversion at	14 bits
Spectral bands (FWHM ¹)	R (580 - 690 nm) G (480 - 600 nm) B (420 - 510 nm) IR (690 - 800 nm) PAN (430 - 690 nm)

Digitális kamerák III.



Leica ADS 100



CHARACTERISTICS OF DATA ACQUISITION

Focal plate (FPM)	Total of 13 CCD lines with 20,000 pixels each in three line groups (forward, nadir, backward), pixel size 5µm, TDI stages selectable 1, 2, 4, 8, 15 (1/2, 1/4, 1/8, 1/16 @ Cycle time > 1 ms)
SH100	Forward 25.6°, backward 19.4°
SH120	Forward 14°, backward 10.4°
Dynamic range of CCD	72 dB
Resolution A/D converter	14-bit
Data channel	16-bit
Data compression	Lossless 14-bit
Recording interval per line (cycle time)	> 0.5 ms

SPECTRAL RANGE

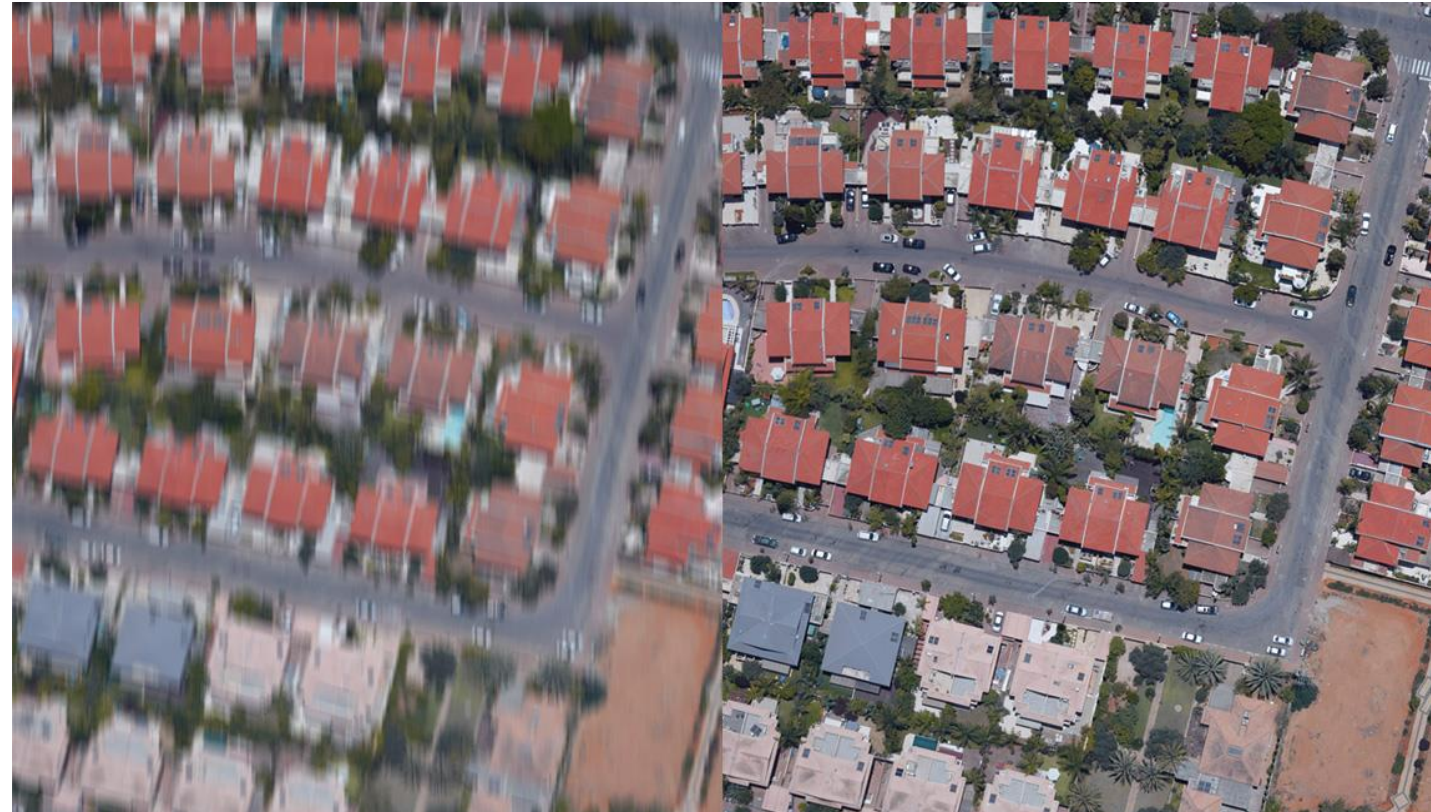
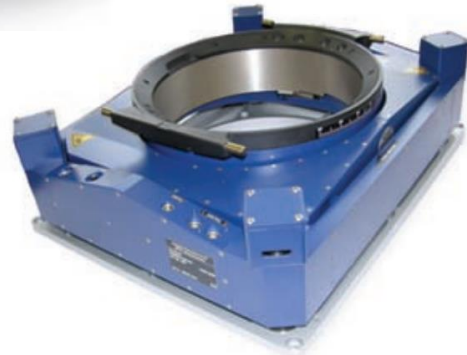
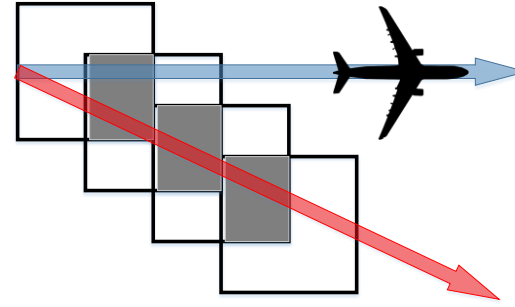
Spectral range	Red, green, blue, near-infrared
Spectral bands	
Red	619 – 651 nm
Green	525 – 585 nm
Blue	435 – 495 nm
NIR	808 – 882 nm

OPTICS DO120

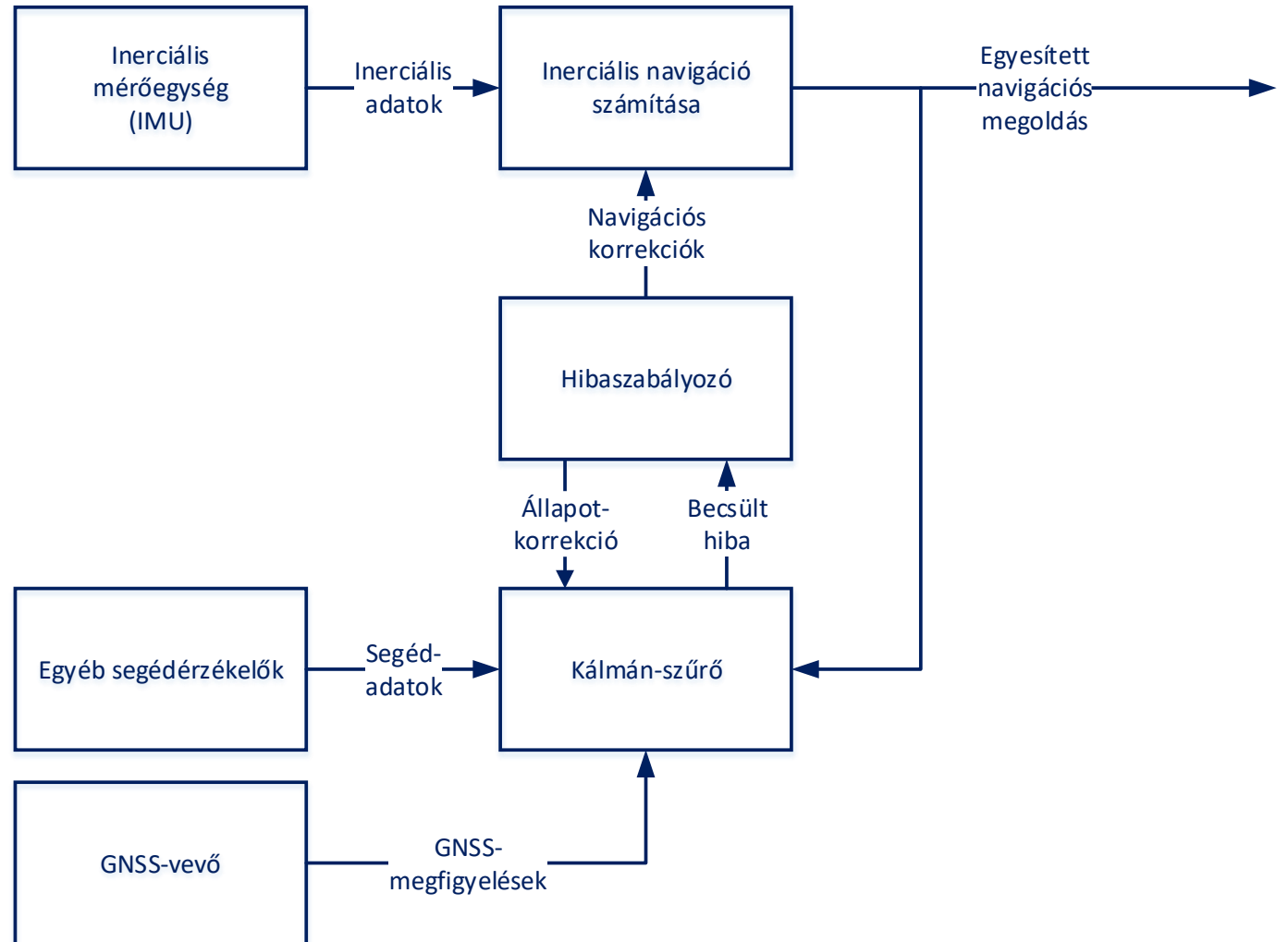
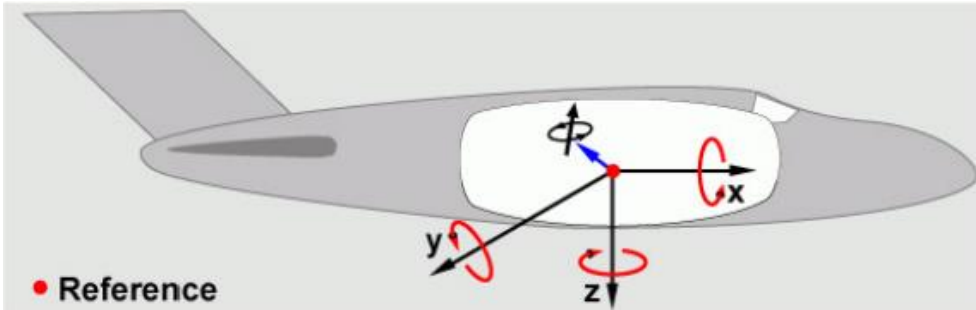
Field of view (FoV)	
SH100	Forward 65.2° across track Nadir 77.3° across track Backward 71.4° across track
SH120	Forward 36.9° across track Nadir 45.2° across track Backward 41° across track
Focal length	
SH100	62.5 mm
SH120	120 mm
F-number	4
Registration accuracy	1 µm
Lens design	Telecentric lens design. Maintains position and width of filter edges over whole FoV. Thermic and pressure compensation for high accuracy.
Flying height multiplier	
SH100	12,500 : 1, 10 cm GSD = 1,250 m AGL
SH120	24,000 : 1, 10 cm GSD = 2,400 m AGL

Kamera felfüggesztések

- Forward Motion Compensation (FMC)
- Angular Motion Compensation
- Vibration Compensation



Inerciális berendezések



A berendezések kezelése

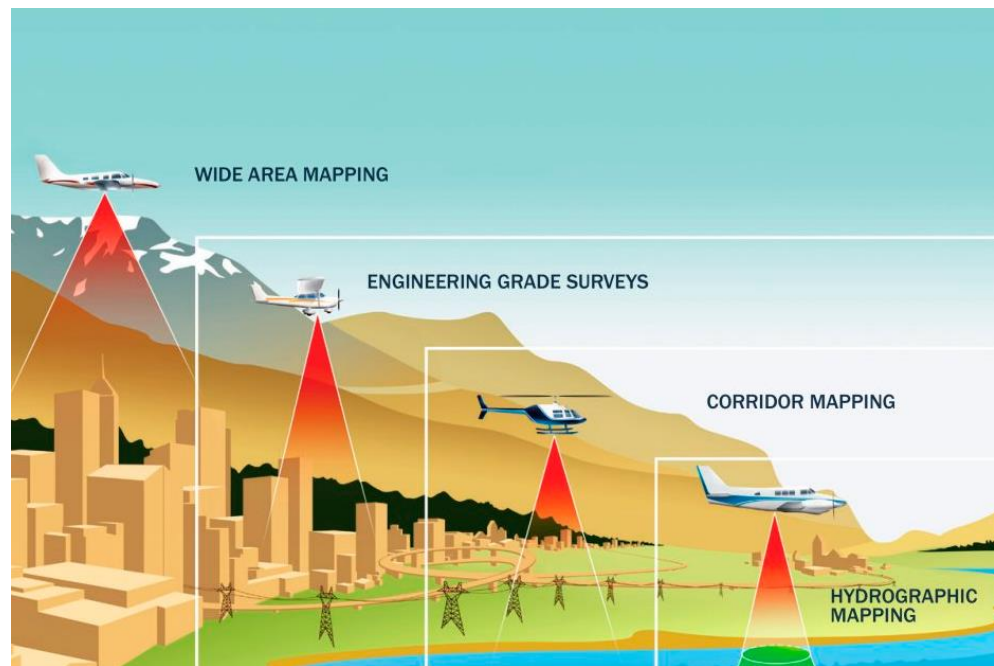


A térképi és képi méretarány kapcsolata

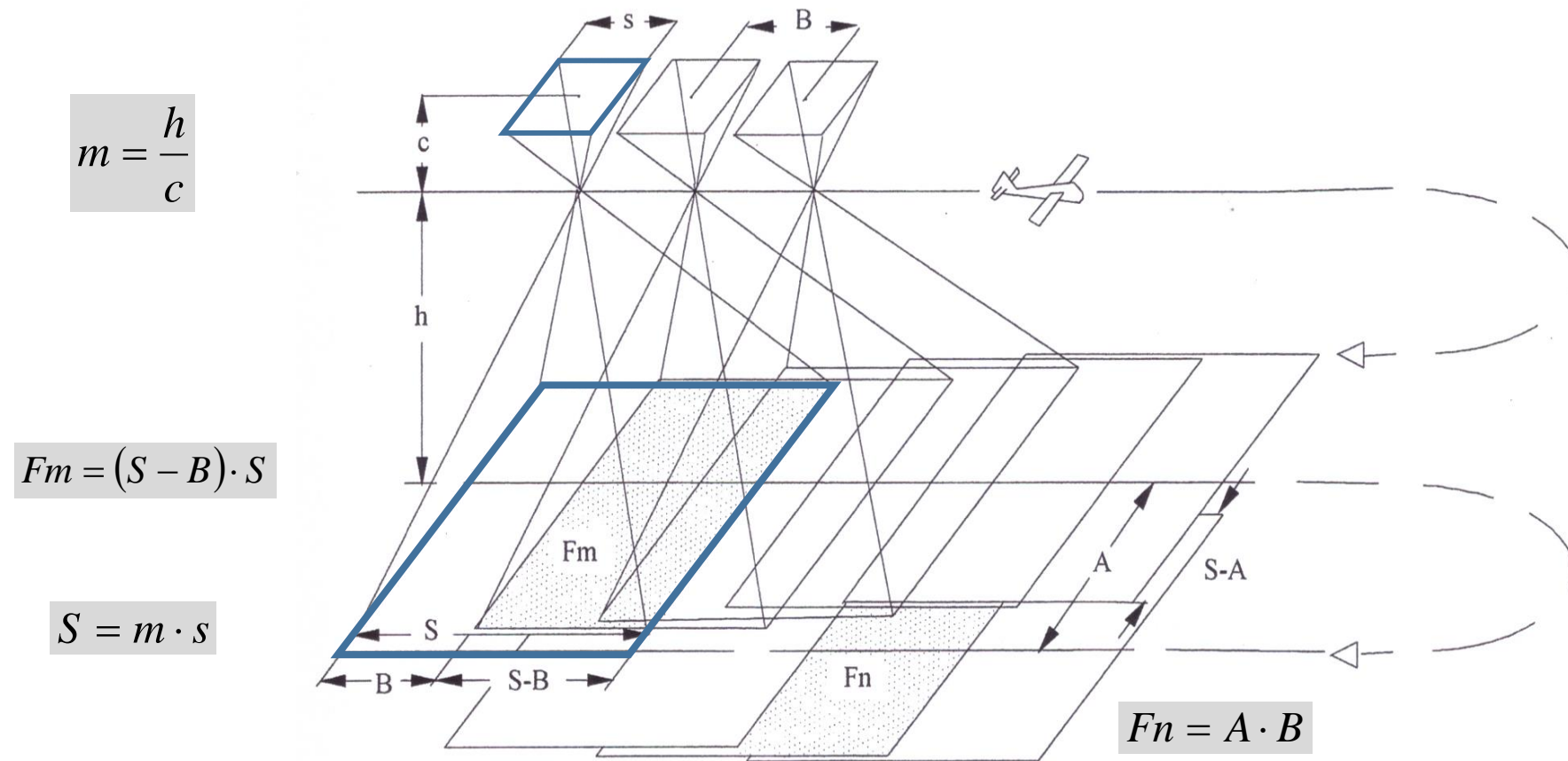
Térkép	Légifénykép
1 : 1 000	1 : 4 000 – 1 : 8 000
1 : 5 000	1 : 8 000 – 1 : 15 000
1 : 10 000	1 : 15 000 – 1 : 20 000
1 : 50 000	1 : 40 000 – 1 : 50 000

	Kis látószög	Normál látószög	Nagy látószög	Igen nagy látószög
Kameraállandó [mm]	600	300	150	90
Látószög [gon]	33	62	100	140
Bázisviszony	1 : 6.6	1 : 3.3	1 : 1.6	1 : 0.95

Képméretarány	Repülési magasság [m]
1 : 1 000	150
1 : 5 000	770
1 : 10 000	1530
1 : 30 000	4590



Az átfedő képek és sorok



$$A = S \cdot \left(1 - \frac{q\%}{100}\right)$$

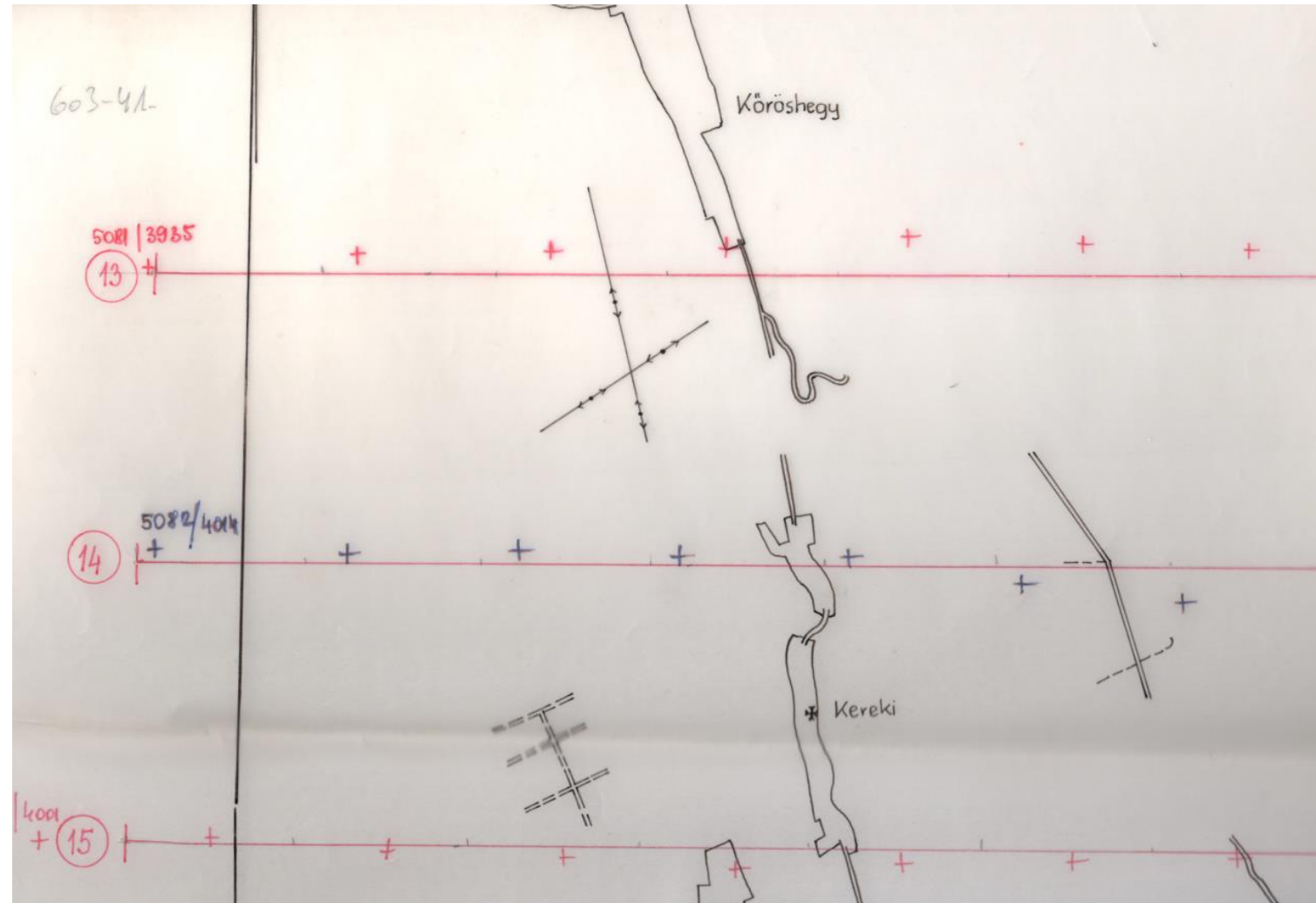
$$q\% = \left(1 - \frac{A}{S}\right) \cdot 100$$

$$B = S \cdot \left(1 - \frac{p\%}{100}\right)$$

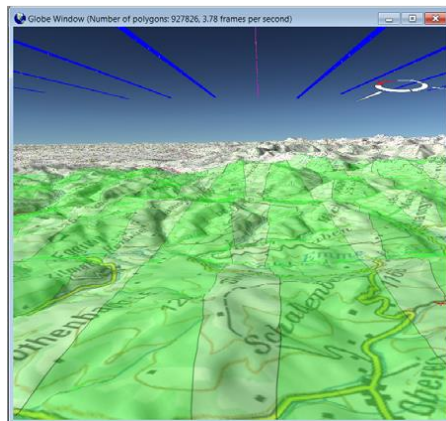
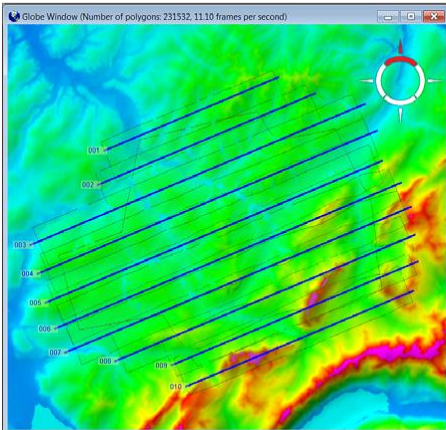
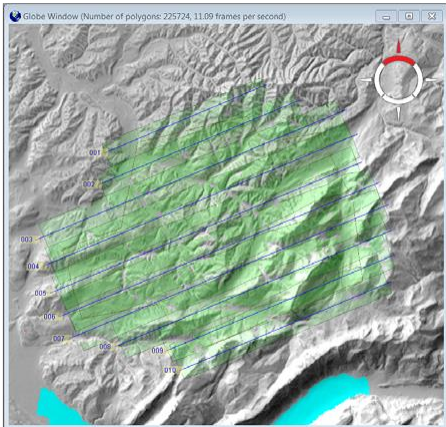
$$p\% = \left(1 - \frac{B}{S}\right) \cdot 100$$

Repülési terv

- Részei:
 - egy térkép vagy fénykép alapú vázlat
 - rövid szöveges leírás



Repüléstervezés szoftverrel



Landeskartierung - FPES

Menu Bar: File, Edit, Project, Tools, Configuration, View, Window, Help

Tool Bar: Zoom Level 4.26 1

Project Explorer:

- Project - [Landeskartierung]*
 - Ortho Items
 - DTMs
 - DTM - [SRTM]
 - Globe Window Layers
 - Images
 - Boundaries
 - TopoMaps
 - User Map Layers
 - Placenames
 - DTM as Image
 - Thumbnails
 - Flights
 - Ground Control Points
 - Graphic Objects
 - Flight Plan - [NordWest Schwyz]
 - Flight Lines
 - Events
 - AOI - [Ostsektor]
 - AOI Corridor - [Aareschlucht]
 - AOI - [Jurassidufuss-Seeland]
 - Flight Plan - [Zentralschwyz]
 - Flight Lines
 - Events

Property View - AOI - [Ostsektor]

Recent

Item	Value
Name	Ostsektor
Type	AOI
AOI Area [km ²]	20
# Active Lines	2
# Inactive Lines	0
Line Direction [deg]	90.0
Artificial Line Length [km]	51.8 N.S.

more ... panels

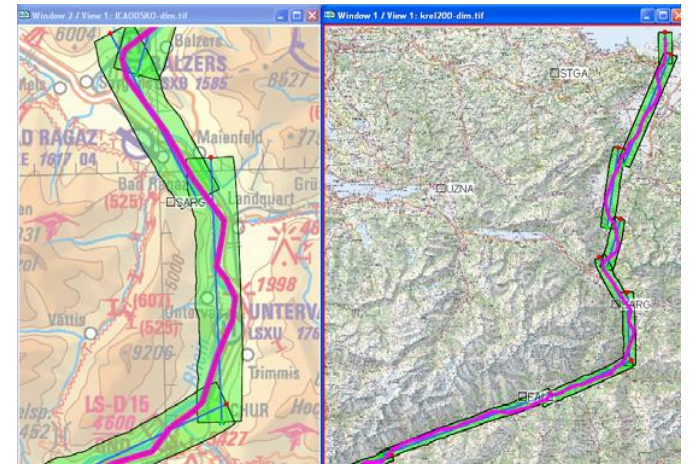
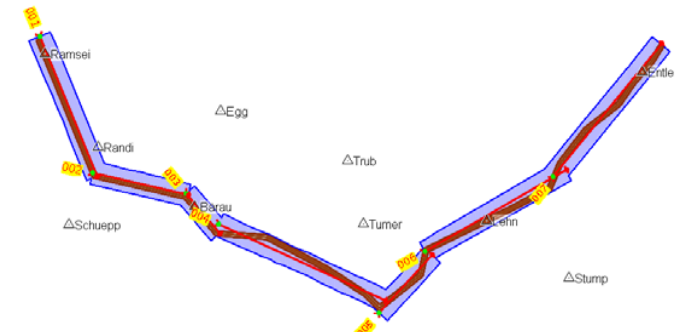
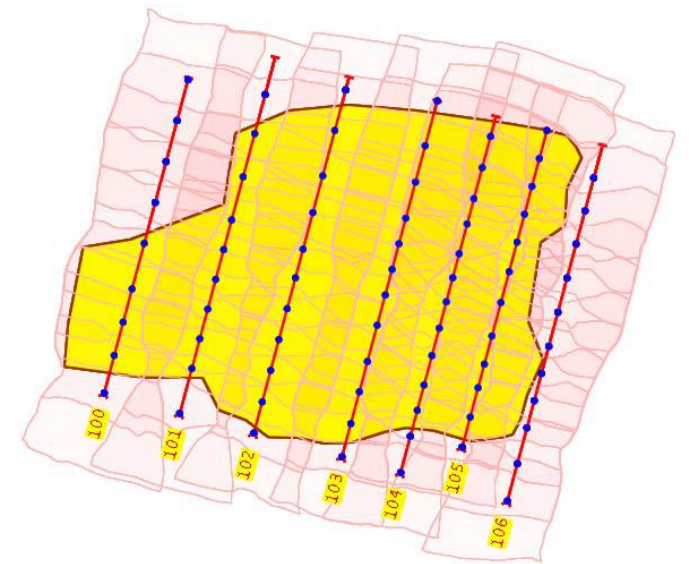
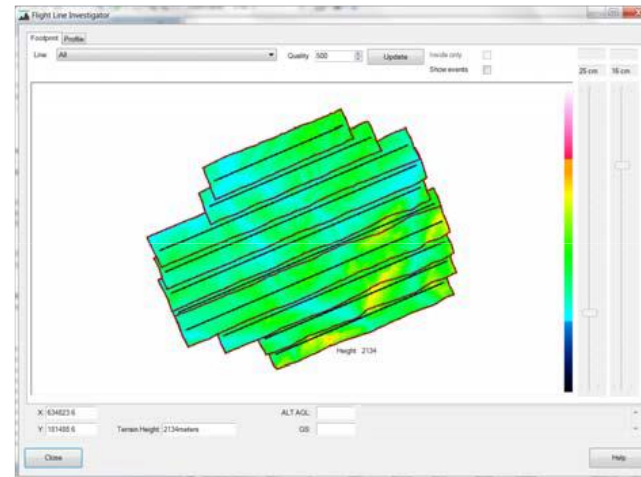
Data View - AOI - [Ostsektor]

Data view

List of Flight Lines:	Length [km]	Alt MSL [ft]	Min Alt AGL [m]	Max Alt AGL [m]	# Active	Min GS...	Max GS...	Min Invd...	Max Invd...	1st Event local [Default]	1st Event WGS84 [Default]	Last Event local
008	27.27	7215	1645.14	1807.14	51	10	11	64.5	64.5	7105992.2705974 2199.1	47°34'36.3"N 8°54'31.3"E 2245.7	737867.7 2705
009	31.08	7215	1574.14	1807.14	60	10	11	66.0	66.0	707361.8 269571.3 2199.1	47°34'05.0"N 8°51'55.5"E 2245.8	738438.2 2695
010	33.69	7215	1501.14	1807.14	62	9	11	67.6	67.6	704972.3 268555.1 2199.1	47°33'33.5"N 8°50'00.0"E 2245.8	738659.4 2685

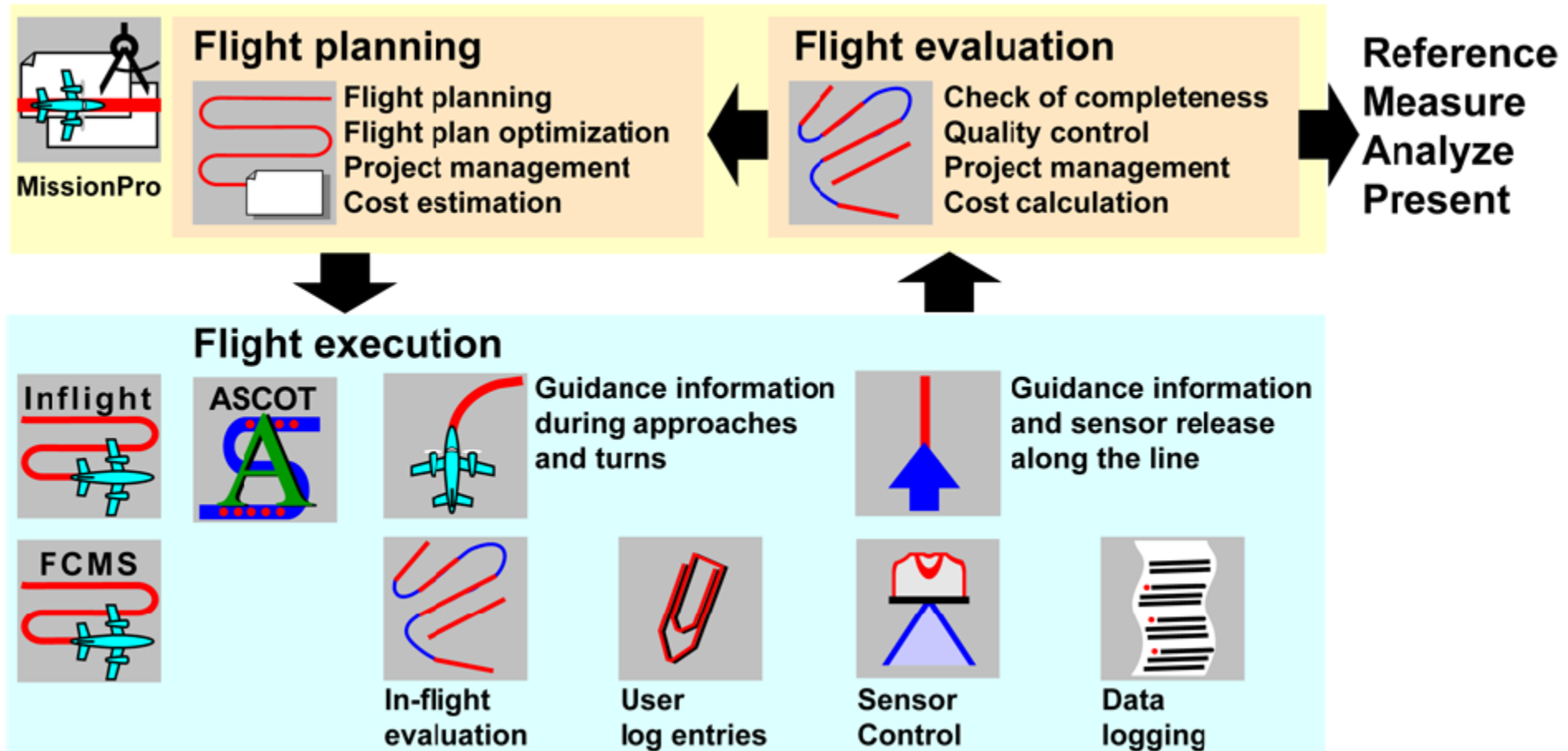
Coordinate and Status Line

Mittwoch, 1. Februar 2012



Repüléstervező szoftverek

- Tervezés – végrehajtás - értékelés

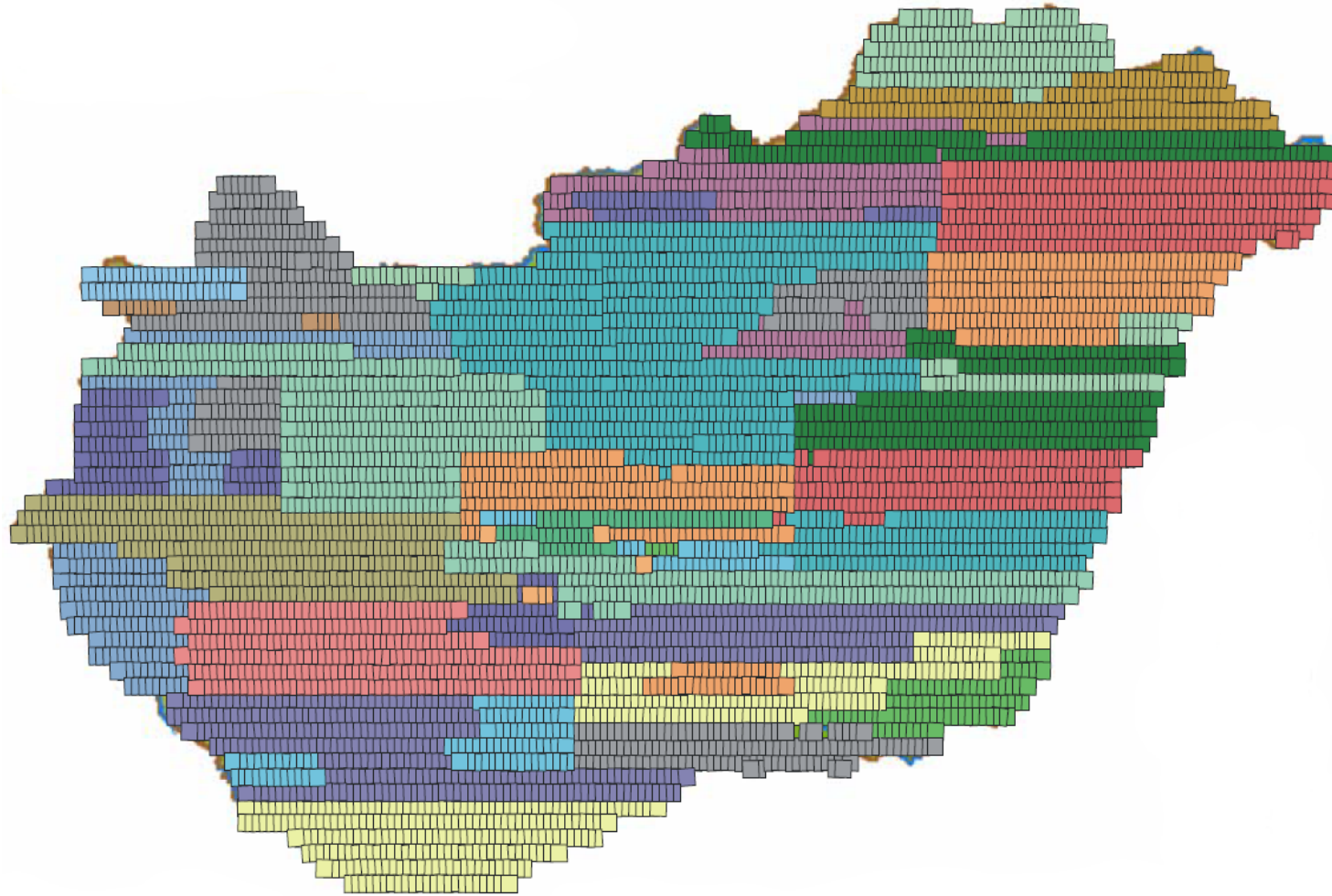


Szoftverek a Leica világában (példa)

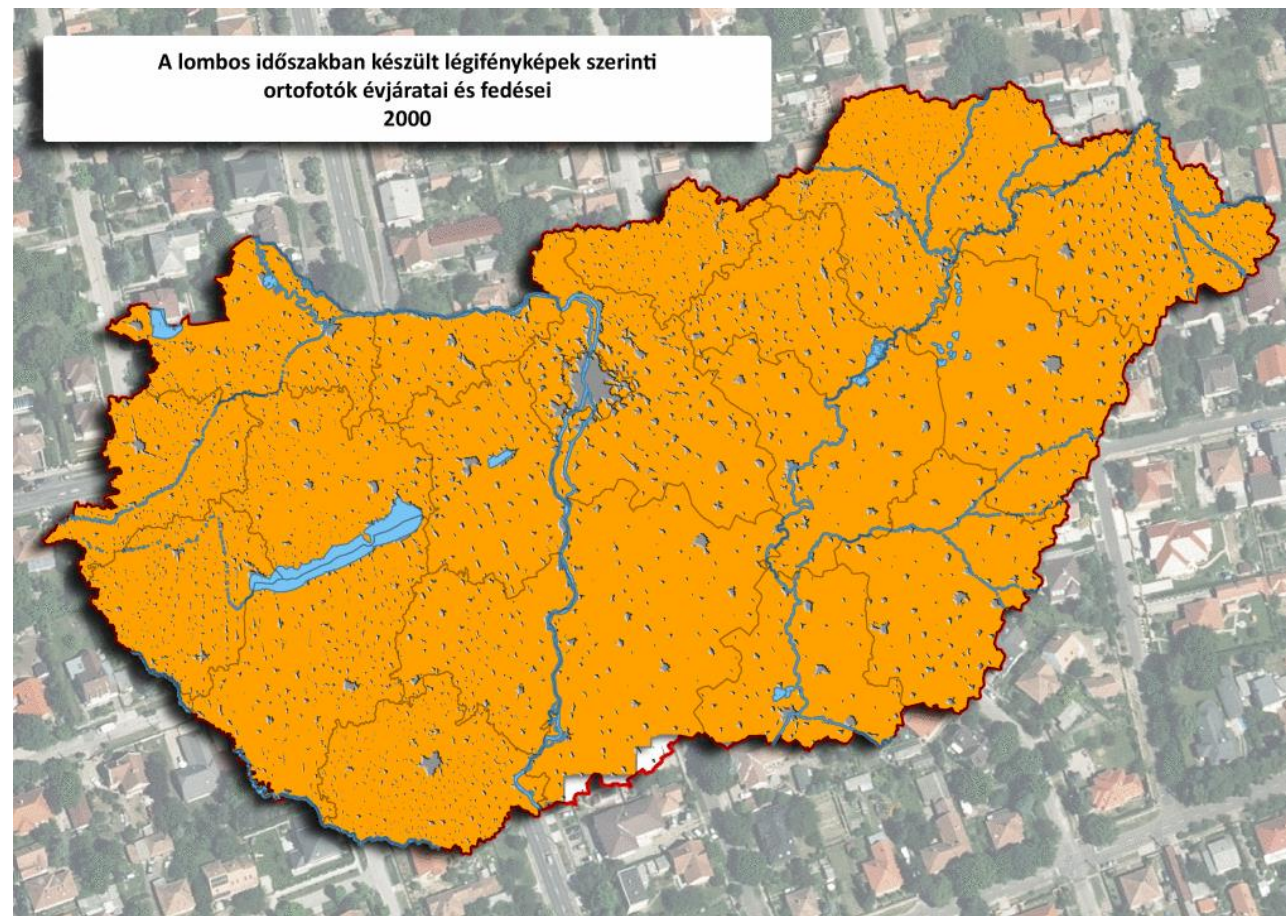
- MissionPro
 - Mission planning & evaluation
- FlightPro
 - Flight management & sensor control



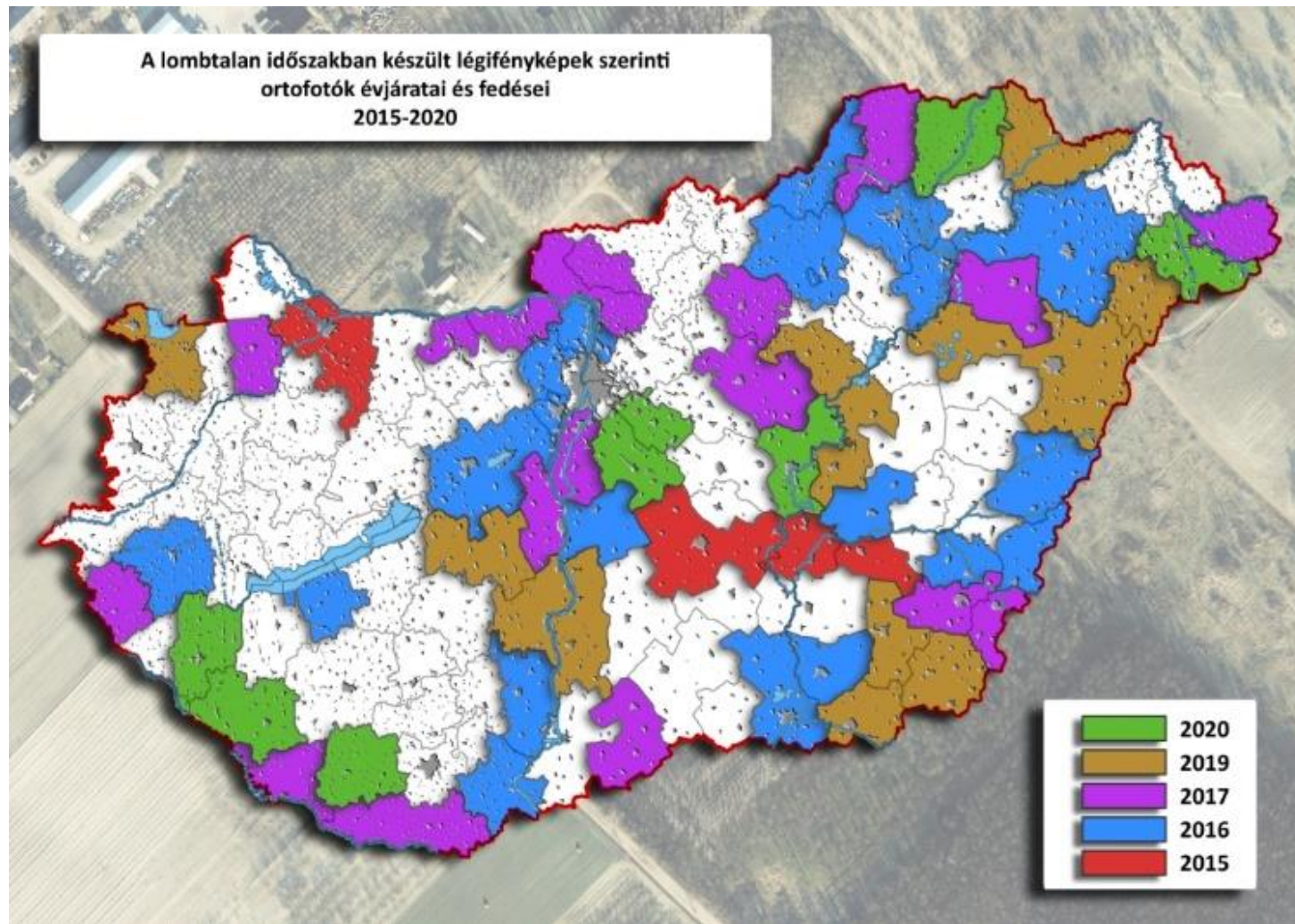
A tervezés eredménye: Magyarország Légifényképezése 2005



Magyarország Légifényképezése 2000-2020



Magyarország Légifényképezése 2015-2020



Köszönöm a figyelmet!