

FCS - UAV Flight Control System with INS/GPS

UAV Flight Control System (FCS) uses adaptable control laws, predictive flight guidance algorithms and proprietary technology for integration of low-cost solid state inertial sensors with Global Navigation Satellite System receivers (GPS, GLONASS or future systems).

FCS design objective was minimizing size and weight while maximizing flexibility, functionality, and expandability. FCS autopilot can be configured for nearly any fixed wing platform with the initial control laws being validated and fine-tuned during minimal number of test flights. All control law gains are field adjustable. Mission set-up and testing is simplified with virtual reality training mode. Waypoints are downloadable through a standard serial port.

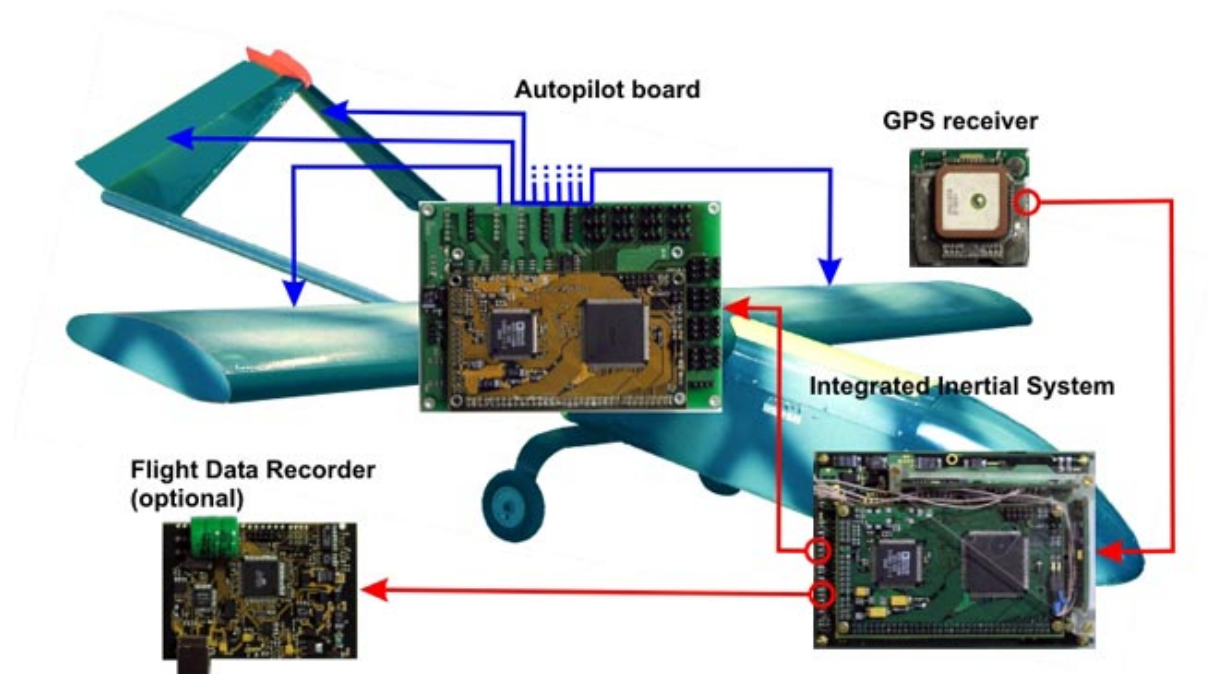
Airborne segment

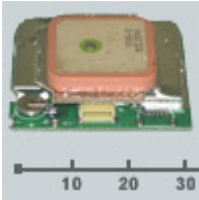
Architecture

We supply three parts for the airborne segment:

- Inertial navigation system (INS) board
- Autopilot board
- SiRF GPS receiver/ antenna board
- Data Recorder (optional)

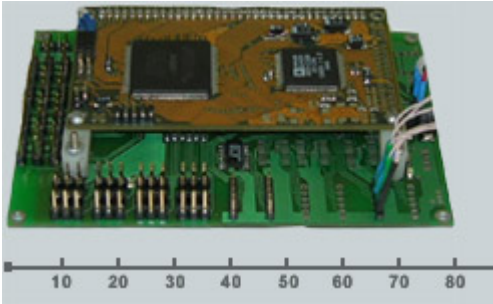
All parts were designed to meet state-of-the-art electrical and mechanical requirements for hi-tech electronics and manufactured at ISO9001-certified facilities.





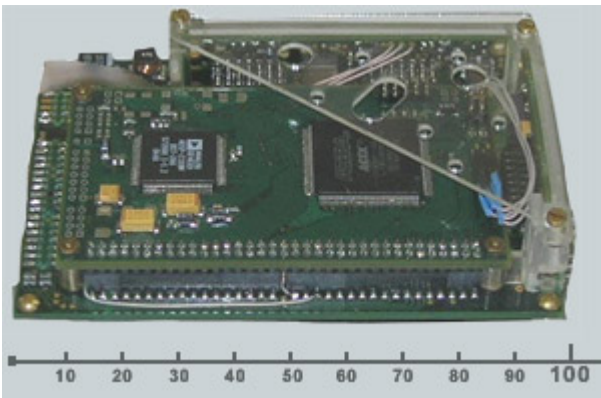
GPS receiver

is an integrated receiver/antenna modulus (SiRF StarII/LP chipset) provides inertial system with coordinates information



Autopilot board

Acquires inertial system data, elaborates the control signals according with the control laws and provides the standard PWM signals to servos. 12 channels are available. The Autopilot Board is compatible with manual remote control and can be engaged/disengaged upon the command.



Integrated Inertial System

It contains the MEMS sensors (accelerometers and rate sensors) combined into full performance inertial navigation system (INS) aided by GPS receiver and built-in barometric altimeter. The system outputs the attitude and position data and transmits it to the autopilot board.

Performance

- 3-Dimensional Navigation (latitude, longitude, altitude, time/speed)
- 255 Pre-programmed Waypoints
- Plan Downloaded via a Serial Interface
- Automatic Altitude Hold (geo or baro)
- GPS loss tolerant
- Adaptable to multiple flight platforms
- Control gains adjustable by operator
- Onboard data logging (option)
- Automatic takeoff and landing (option)
- Air Data System (option)

Specification

Electrical

Input voltage VDC	10 ~ 30
Power W (max)	2
Servos voltage VDC	5

Environmental

Temperature deg F(deg C)	-40 ~ +160 (-40~+70)
Vibration/Shock g (survival)	20

Operating ranges

Angular rates (max) deg/sec	300
Accelerations (max) g	10
Altitude (max calibrated) ft(km)	15,000 (5)

INS/GPS system performance

Integrated Accuracy

	Units	GNSS On	GNSS Gap 5min	GNSS Off
Position	m RMS	6 (*)	500 (**)	Not available
Velocity				
X,Y Velocity	m/s RMS	0,2	3	Not available
Z Velocity	m/s RMS	0,25	0,3	0,4
Pitch and roll				
Straight Horizontal Flight	deg RMS	0,2...0,3	0,2...0,3	0,3...0,5
Normal Manoeuvre (***)	deg RMS	0,3...0,5	0,3...0,5	0,7...1
Complex Manoeuvre (***)	deg RMS	1	1	2
Heading (****)	deg RMS	0,4	0,4	2
Altitude	m	2	2	6

Notes (*) Applies to a standard configuration with GPS receiver Garmin GPS35 (positioning accuracy of 15 m RMS).

(**) Assumes straight level flight prior to and during GPS gap.

(***) Normal is "pitch and roll less 45 deg", complex is "pitch and roll 45 deg...75 deg".

(****) Heading is calculated as deviation from the track angle value which is output by GNSS receiver immediately after VITANS initialization.

The increments are sensed by IMU.

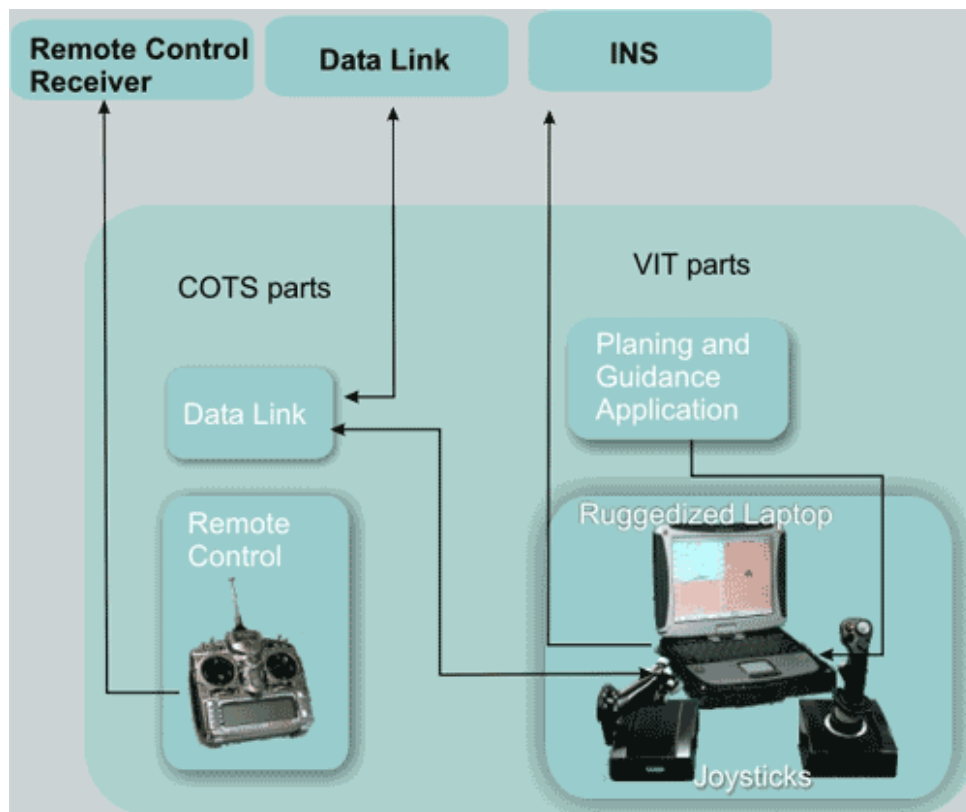
Dynamic Ranges

		Range	Resolution
Roll, Pitch	deg	$\pm 180, \pm 90$	0,05
Accelerations	g	± 10	10-4
Heading	deg	0...360	0,1
Angular rate	deg/sec	± 150	10-3
Max. calibrated altitude	m	6,000	0,2
(for barometric altimeter)	ft	18,000	1

Ground Station (designed-to-order)

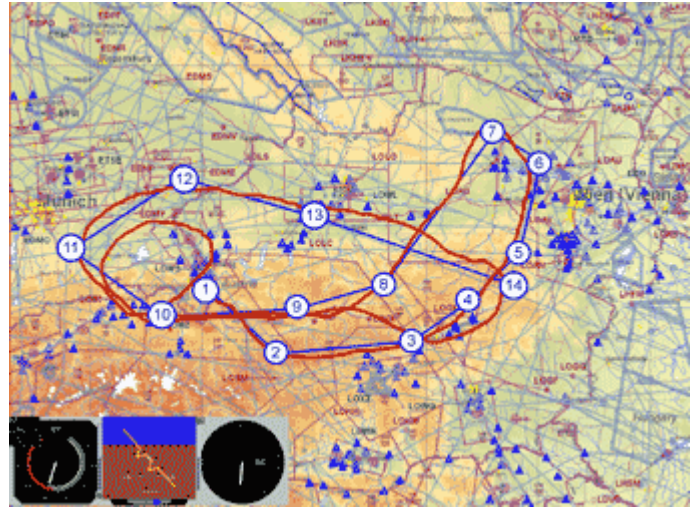
Ground Station allows remote control of UAV, receives and processes navigation data from UAV via the data link, supports flight planning and communicates with the autopilot board on ground via RS232 interface (flight plan upload, system configuration and control laws adjustment). Conventional Remote Control is responsible for Autopilot engagement and disengagement as well as allows manual / remote controlled flight operations during visual contact with UAV. If Data Link is installed, Ground Station can support flight control without visual contact with UAV through proprietary software application with predictive flight guidance and synthetic vision capability.

Ground Segment Architecture



Software Applications

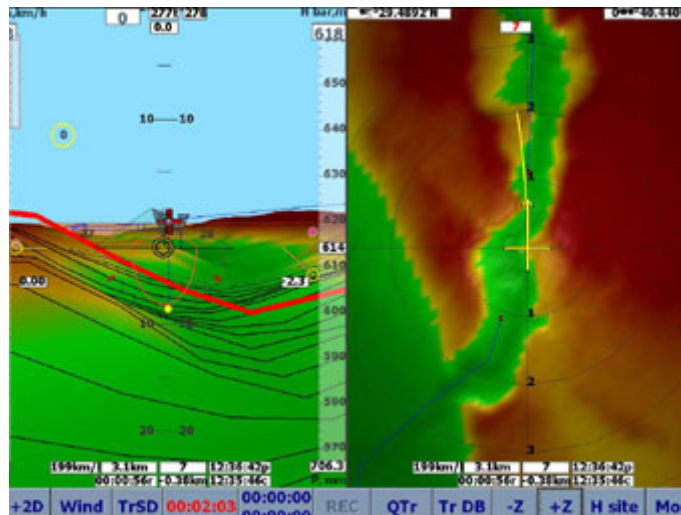
Flight Planning and Analysis



The Flight Planning Application allows to design the route by simple clicking on the digital map. The waypoint attributes are: latitude, longitude, altitude and desired ground speed.

Flight Analysis Software allows to download the flight data and "playback" the flight to analyze the positioning accuracy as well as attitude stabilization performance

Synthetic Vision



The 3D flight parameters representation is available as INS/GPS data

FCS Applications

Accurate and stable attitude and position coordinate determination of an UAV enables the user to recombine the full image from the taken partial pictures in a fast and easy manner.

- Fixed wings UAV autopilot
- Fixed wings UAV flight stabilization
- Remotely Piloted UAV (both fixed and rotary winged)