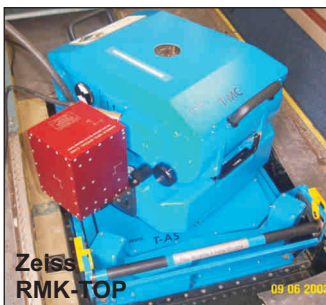


AEROcontrol™

AEROcontrol is IGI's GPS / IMU system for the precise determination of position and attitude of an airborne sensor. This can be the position of the projection center and the angles omega, phi, kappa of an aerial camera system and an airborne laser scanner.

The *AEROcontrol* system consists of a fibre-optic gyro based Inertial Measurement Unit (IMU-IId) and a computer with integrated high end GPS receiver.

AEROcontrol can be operated either as a stand alone system or via IGI's *CCNS4* positioning and sensor management system for aerial survey flight missions. The *CCNS4* and *AEROcontrol* together form a fully integrated system.



CCNS4 combined with *AEROcontrol* is the standard guidance and GPS / IMU system for the Intergraph DMC, the *LiteMapper* airborne LiDAR system and the *StreetMapper* mobile LiDAR system.

Depending on GPS constellation and distance from GPS Base / Monitor Station, a positioning accuracy better than 0.05 m RMS and attitude accuracy of 0.01 deg RMS for heading and of 0.004 deg RMS for roll and pitch is available in post-processing.

This accuracy is sufficient for direct georeferencing for many tasks. For large scale photogrammetric projects, where a higher accuracy is required, the use of *AEROcontrol* results as additional information for an aerial triangulation (Integrated Sensor Orientation) leads to large savings in GCPs



The airborne computer of the *AEROcontrol* system is used for data recording of

- IMU-IId raw data, i.e. angular and velocity increments (128 Hz or 256 Hz)
- GPS raw data, position and velocities

Real-time platform calculations allow to use this information as navigational input for IGI's *CCNS4*.

All accumulated data (IMU and GPS) are stored on the *AEROcontrol* Mission Card for post flight processing.

The system approximately records 18 MB (128 Hz) or 33 MB (256 Hz) of data per hour giving a maximum mission time of at least 15 hours with available 512 MB *AEROcontrol* Mission Cards.

Installation material for the IMU, including a mechanical adapter plate, are available for the following aerial camera systems:

- Carl Zeiss Jena: LMK, LMK1000, LMK2000
- Intergraph: DMC
- JenaOptronik: JAS
- Microsoft / Vexcel: UltraCam-D / X / Xp
- Wild-Leica, Heerbrugg: Rc10, RC10A, Rc20, Rc30
- Zeiss-Oberkochen: RMK-A, RMK-TOP
- Z/I Imaging: RMK-TOP



Image showing laser scanner of *LiteMapper* system with IMU of *AEROcontrol* and *DigiCAM*

AEROcontrol™ - Precise Positioning & Attitude Determination

For the precise position determination of the airborne sensor, the position of the phase center of the aircraft (a/c) GPS antenna has to be transformed to the sensor position. The lever arm between the GPS antenna and the sensor can be determined during system installation.

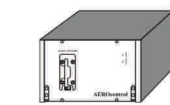
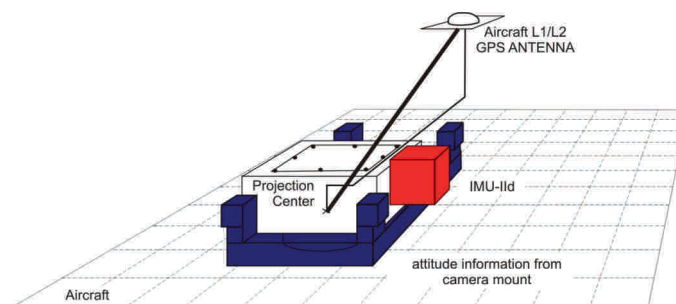
Because of a/c movements in flight, this lever arm has to be corrected for the actual attitude.

- If the camera is rigidly mounted to the a/c's frame, the lever arm remains constant during sensor operation. In this case, the projection center is calculated directly from the constant lever arm and the GPS / IMU information. No additional measurements are needed.
- If the camera is not rigidly mounted to the a/c, e.g. if a stabilized camera mount is operated (GSM3000, Intergraph T-AS, Leica PAV30), this lever arm depends on the movement of the camera with respect to the a/c frame.

In this case this movement has to be taken into account for the lever arm correction. This can be done by using the attitude information of the stabilized mount. The CCNS4 / AEROcontrol provides an automatic attitude readout interface for all state-of-the-art stabilized sensor mounts.

AEROoffice software package:

- DGPS computations by GrafNav software package (one licence included, others on request)
- Kalman filter software for combined GPS/IMU calculation
- Lever-arm correction
- Integrated Sensor Orientation with BINGO/BINGO30 AT software as part of AEROoffice



Computer & Data Storage
incl. 12-channel L1/L2 GPS receiver
AEROcontrol
Precise Positioning & Attitude Determination



CCNS
Computer Controlled Navigation System

Post-Processing:

Depending on GPS conditions, with AEROcontrol DGPS and IMU-IId data the following accuracies, in a circle of <30 km radius around the GPS Base / Monitor Station, can be expected:

Position: <0.05 m RMS
Height: <0.1 m RMS

Phi / Omega: 0.004 deg RMS
Kappa: 0.01 deg RMS

During the "Test Vaihingen 2000" by Stuttgart University (ifp), the following results have been achieved:

Position: <0.08 m RMS
Height: <0.05 m RMS

Phi / Omega: <0.003 deg RMS
Kappa: <0.007 deg RMS

IMU-IId Specifications:

- FOG-Bias: 0.1 deg / h
- FOG-RW: 0.02 deg / sqrt(h)
- Resolution: 0.0038 mrad (at 128 Hz)
- Resolution: 0.0019 mrad (at 256 Hz)
- Accelerometer Bias: 0.5 mg
- Resolution: $0.122 \cdot 10^{-3}$ m / s (at 128 Hz)
- Resolution: $0.061 \cdot 10^{-3}$ m / s (at 256 Hz)
- Dimensions:
 - Length: 133 mm
 - Width: 138 mm
 - Height: 185 mm
- Volume: 3.4 litre
- Weight: 3.1 kg
- Update and transmission rate: 128 Hz; optional 256 Hz
- Power consumption: 20 W at 28 VDC

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