



Flight Calibration Services

Colibrex

Smart Drone Solutions



Drone Measurements



Drone-based ILS Measurements

Colibrex/FCS NavAidDrone
New era in NavAids inspections

NavAidDrone

A fully integrated flying measurement system for ILS GP/LOC commissioning support and regular inspection

The new Colibrex/FCS NavAidDrone is a unique and revolutionary tool to carry out specialized field measurements required for commissioning and regular maintenance of Instrument Landing Systems (ILS) of all categories. It is especially designed for use by ANSP CNS (Communication, Navigation, Surveillance) maintenance staff as well as NavAids system manufacturers' service engineers.

The NavAidDrone provides measurement data for areas that cannot be easily accessed by vehicles or conventional telescopic masts or for which measurement was previously not possible. The advantages are considerable for the adjustment and regular inspection of a glide path antenna: whereas the limited height of a telescopic mast allows near field measurements only, and wider-angle measurements are not possible, the measurement with the NavAidDrone can be made at the middle marker, where a fully established signal-in-space in the 3° approach path is available. For the localizer, clearance and width measurements can be realized with "arc flights" without the necessity of service roads. As a whole, various measurement profiles have been defined including mixed LOC and GP "slope flights" to be conducted within a segment of the ILS approach path, as realized during flight inspection.

All in all, the NavAidDrone offers an alternative to time- and manpower consuming ground based measurements, facilitates commissioning before final flight inspection and opens the way to potential extension of flight inspection periods with the corresponding savings.

The NavAidDrone is a system resulting from a multi-year R&D project. It merges the flight inspection and receiving/processing expertise of FCS Flight Calibration Services GmbH and the expertise in design and international commercial operation of RF measurement drones (UAS) of Colibrex GmbH.

The technology has been designed in cooperation with and approved by PTB, the National Metrology Institute of Germany and Germany's highest authority when it comes to accurate and traceable measurements.



The NavAidDrone flying in an airport

A documented calibration process for measurement receivers, processing and antennas ensures that all measurement results of the NavAidDrone are fully reproducible and conform to industry standards requested to meet the ICAO recommendations. A high-end RTK GNSS system and coordinate transformation processing in the software ensure that the results are correctly aligned with the referenced position of the LOC and GP antennas, a crucial issue for ILS measurements. The NavAidDrone, by means of an additional software module, is also suitable for VOR and GBAS measurements - without any hardware changes.

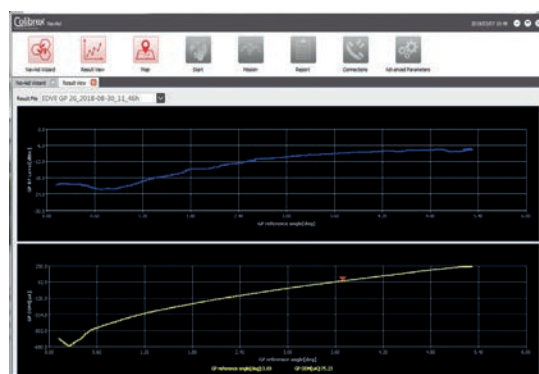
Key Advantages and Benefits of NavAidDrone

Unique measurement technology

The extremely lightweight receiver, which consists of RF front-end and processing subsystems, has been designed to cope especially with the measurement of "signal-in-space" from a moving platform. To guarantee that the DDM value can be measured at highest precision, an adaptive signal processing is implemented that adjusts filtering efforts in real-time. Unlike other standard ILS receivers, the measurement system of the NavAidDrone features high bandwidth internal processing and recording of the entire transmission channel, permitting in-channel separation of useful ILS signals and interference sources. Potential propeller modulation from the drone can thus be analyzed and eliminated.

The measurement system allows:

- All localizer (LOC) and glide path (GP) measurements, i.e. DDM, SDM, course/clearance ratio linearity and true field strength due to traceable antennas
- Selectable software filtering of DDM data according to ICAO Annex 10 and DOC 8071 specifications
- Separate analysis of course and clearance signal in a single measurement
- Optional VOR measurements, including separate representation of both AM and FM tone phases
- Optional GBAS demodulation and signal analysis



Example of GP measurement results

Advanced drone platform

The flying platform of the NavAidDrone has been purpose-designed. Architecture and components have been selected to match highest criteria in terms of performance, easy operation and logistics, as well as safety.

Some of the key features are:

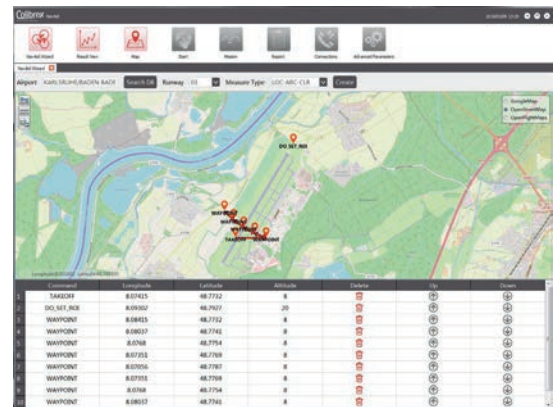
- X8 robust frame with 4x2 motors for increased redundancy
- High-end RTK GNSS for navigation and measurement position accuracy of less than 10cm
- Own electronic boards to reduce the amount of cabling and connectors (thus increasing the reliability of the whole system) and to enable features like battery monitoring, integration of safety lights, emergency parachute deployment, etc...
- Slide-in battery packs for easy swap of batteries
- Removable arms, legs and antennas for comfortable transport



The NavAidDrone in the air

More than just a receiver mounted on a drone – a complete integrated system

Unlike other concepts available or announced on the market, the NavAidDrone is not just a drone equipped with a measurement receiver, but a fully integrated system with specifically designed hardware and software technology. The complete system has been numerically simulated to obtain the performance of the installed antenna. Specific attention has been given to EMC influences and the limitation of interference to the measurement. And finally yet importantly, dedicated radio links ensure both the control of the system and the download of the captured data for semi-real time processing.



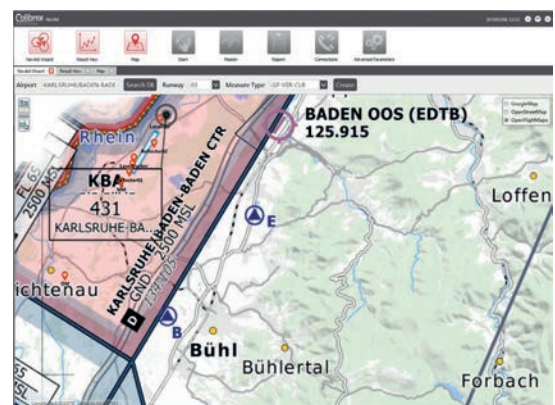
Mission planning via the system software

All-in-one software and workflow management

A smooth software-integrated workflow manages the upload of airport data, coordinate transformation, selection and creation of measurement profiles, the generation of the corresponding flight plans, control of the drone, download and processing of the measurement data and finally generation of the measurement reports.

Various map formats incl. Open street maps or Open flight maps can be used.

A live transfer of the measurement results to a remote workplace can facilitate operations of maintenance or adjustment of ILS antennas.

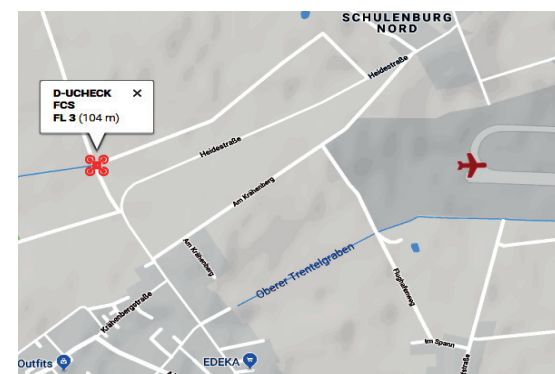


Overview system software

Safe operation and integration in the airport environment

Flying drones around airports require the highest level of safety. Beside its conceptual architecture with redundancy in motors and batteries, the NavAidDrone is equipped with numerous hard and soft safety features. The voltage and the actual current drawn by the batteries are monitored. Safety lights and an emergency parachute can be integrated. Appropriate failsafe mechanisms are pre-defined and selectable by the pilot.

Thanks to open interfaces, the NavAidDrone is prepared for the integration into any UTM system. Tracking the NavAidDrone with a system in parallel to the surrounding aircrafts is a key factor of acceptability by airport controllers, and is part of a comprehensive concept of operations (ConOps).



Tracking of the NavAidDrone - Example from DFS

Advantageous use cases

- ILS periodical measurements as specified by ICAO, to reduce ground-based inspection cost; Correlation with flight inspection data for overall optimization of ILS/VOR installations and preparation for the extension of flight inspection periods with the corresponding savings
- Special measurements to detect degradation of ILS/VOR signals coming from change in the surrounding infrastructure or moving structures (cranes, temporary buildings, ...)
- Support of ILS commissioning during/after installation of new systems or replacement/repair of antennas, potentially enabling a reduction of flight inspection efforts
- Special measurements to facilitate maintenance and problem detection; possibility of extensive offline data analysis

Typical pre-defined measurement profiles for ILS

Measurement application	Typical flight profile
GP Clearance & Width (CRS and CLR Width normal or with alarms)	Vertical slice at Middle Marker or RW Threshold
GP Engineering / Expert Approach	Vertical slices at pre-defined locations between Middle Marker and RW Threshold
GP Engineering / Expert Sector ARC	Arc flight near to RW Threshold
LOC Runway Course Alignment & Structure (LOC Course Alarm 150Hz/90Hz)	Runway center line, possibility to conduct this measurement with the NavAidDrone and its RTK GNSS in a vehicle
LOC Nearfield Sector	Arc flight near to the LOC antenna
LOC Displacement Sensitivity (CRS Width normal or with alarms)	Arc flight at RW Threshold
LOC Clearance & Width Sector (CRS and CLR Width normal or with alarms)	Arc flight from a predefined point on the RW
Partial LOC+GP Course Alignment	Slope flight typ. between Middle Marker and RW Threshold

It's all about **efficiency** and **cost reduction!** NavAidDrone in brief:

Key Points	Benefits
Measurement receiver with adaptive signal processing designed to capture ILS signals by a moving drone	The true signal-in-space is measured, unwanted effects like propeller modulation are eliminated
High-end RTK GNSS system, coordinate transformation processing	Very high position accuracy and correct position referencing
Measuring antennas specially developed and simulated acc. to the drone structure	The measurement unit is formed by the complete system, leads to better accuracy
Measurement technology developed in cooperation with and approved by the PTB in Germany	High accuracy with tolerances acc. to industry standards requested to meet the ICAO recommendations
State-of-the-art failsafe mechanisms and safety features	Safe operation
Compact drone design, removable arms – legs - antennas, slice-in battery packs	Easy logistic, fast deployment
One system software integrating all functions (airport DB & measurement profiles, mission planning, drone control, measurement report)	Easy preparation & operation of measurement flights, fast deployment
Automated workflow, recording and uploading of previous mission profiles	Facilitates regular inspection and generation of correlation data as prerequisite to an extension of flight inspection, as recommended by ICAO
Expert mode	Access to detailed parameters of the ILS signals for improving commissioning and fault finding
Innovative acquisition models incl. calibration and maintenance support	Secured investment, adapted to frequency of use
Measurement service offered by Colibrex as experienced drone operator, expert support from FCS	Alternative to acquisition, no CAPEX and manpower resources necessary

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