Flight Calibration Services

Colibrex
Smart Drone Solutions

Global Spectrum Experience

Drone Measurements

Drone-based ILS & VOR Measurements

Colibrex/FCS NavAidDrone
Designed by CNS experts for CNS users

NavAidDrone

The best alternative to ground-based ILS inspection and a useful tool to reduce flight checks.

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 LOC and GP "slope or approach flights" to be conducted within a segment of the ILS approach path, as realized during flight inspection. Prior to NavAidDrone this level of accuracy and speed of measurement was not possible.

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

The NavAidDrone merges the flight inspection and R&D 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.

NavAidDrone and pilot in operation

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 measurements on a signal-in-space basis. These measurements are especially useful to detect installation errors of CVOR/DVOR facilities that lead to wrong bearing information as well as multipath detection in the near environment.

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.

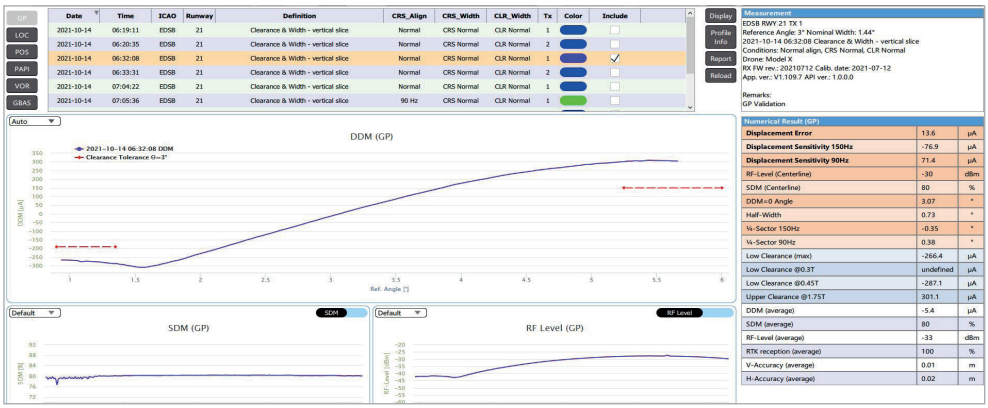
Measurement of VOR signals

The measurement system allows:

- All localizer (LOC) and glide path (GP) measurments, i.e. DDM, SDM, course/clearance ratio linearity
- 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; for Doppler-VOR, the system can also evaluate a single SBO antenna radiation in both LSB and USB

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. A live view of the telemetry data and of the main measurement parameters allows the operator to follow the good progress of the measurement.



Example of GP measurement results

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 software (live measurement, waypoints & telemetry)

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
- Slide-in battery packs for easy swap of batteries
- Removable arms, legs and antennas for comfortable transport

Detailled view of the NavAidDrone

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.

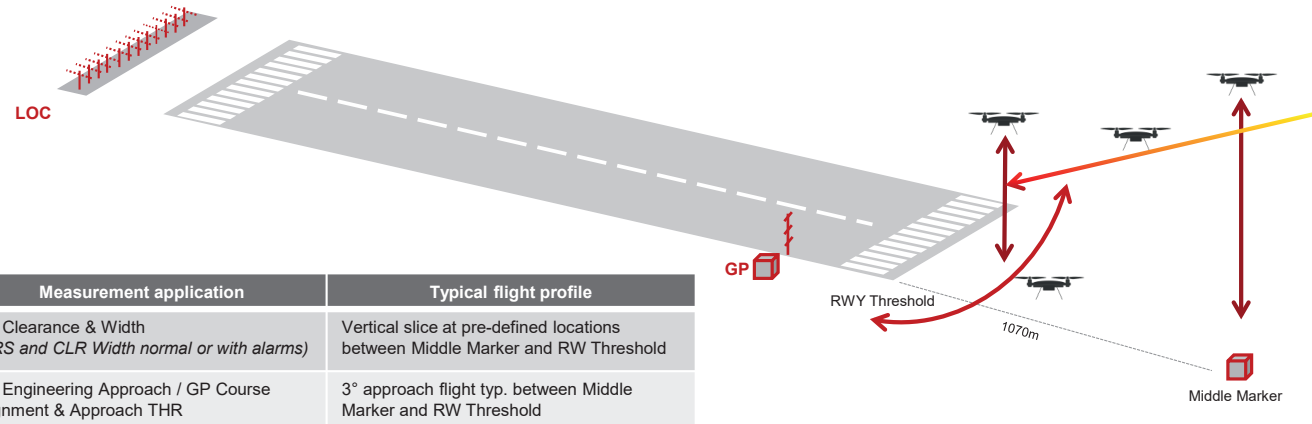
Thanks to open interfaces, the NavAidDrone is prepared for the integration into any UTM system. Tracking the NavAidDrone with a system in parallel to the surrounding aircrafts is a key factor of acceptability by airport controllers, and is part of a comprehensive concept of operations (ConOps).

NavAidDrone operation without runway closure

Advantageous use cases

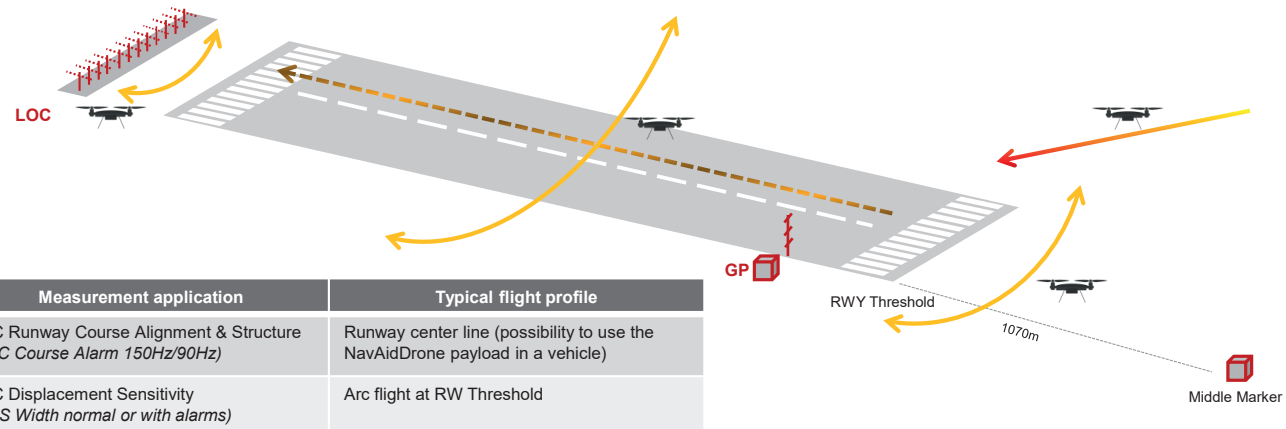
- ILS periodical inspection compliant to ICAO Doc.8071 for ground testing, with much better results and operational facilities than conventional ground-based solutions
- Support of ILS/VOR commissioning, fault finding and maintenance with new measurement possibilities, enabling reduction of flight check and corresponding financial and CO2 savings
- Measurements as input for correlation work to ultimately extend flight inspection intervals !

NavAidDrone: ILS Glide Path Measurement Flights



Measurement application	Typical flight profile
GP Clearance & Width *(CRS and CLR Width normal or with alarms)*	Vertical slice at pre-defined locations between Middle Marker and RW Threshold
GP Engineering Approach / GP Course Alignment & Approach THR	3° approach flight typ. between Middle Marker and RW Threshold
GP Engineering / Sector ARC	Arc flight near to RW Threshold

ILS Localizer Measurement Flights



Measurement application	Typical flight profile
LOC Runway Course Alignment & Structure *(LOC Course Alarm 150Hz/90Hz)*	Runway center line (possibility to use the NavAidDrone payload in a vehicle)
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
LOC Nearfield Sector	Arc flight near to LOC antenna
LOC Course Alignment	3° approach flight

It´s all about accuracy, efficiency and cost reduction NavAidDrone in brief:

Key Points		Benefits
Measurement receiver with adaptive signal processing	1	The true signal-in-space is measured
High-end RTK GNSS system, coordinate transformation processing	2	Very high position accuracy and correct position referencing
Purpose-designed, low weight dual antenna	3	Accuracy of the results, no need to change antenna between GP and LOC/VOR measurements
Validation of the overall set-up (incl. antenna) following standards from the flight inspection industry	4	Compliant to ICAO Doc. 8071 ground inspection and highest accuracy available for a drone-based solution
State-of-the art failsafe mechanisms and safety features	5	Safe operation
Compact drone design, removable arms – legs – antennas, slice-in battery packs	6	Easy logistic, fast deployment
One system software integrating all ´functions (mission preparation, controlling and reporting) incl. live view data	7	Easy preparation & operation of measurement flights, fast deployment
Automated workflow, recording and uploading of previous mission profiles	8	Facilitates regular inspection and generation of correlation data as prerequisite to an extension of flight inspection as recommended by ICAO
Innovative acquisition models incl. calibration and maintenance support	9	Secured investment, adapted to frequency of use

CFA

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