Autonomous Data Collection

Stefan Jagieniak

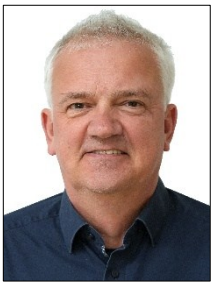
Senior Software Engineer
Aerodata AG
Braunschweig, Germany
Phone: +49 531 2359-135
E-mail: stefan.jagieniak@aerodata.de

Marcel Hoffmeister

Project Manager
Aerodata AG
Braunschweig, Germany
Phone: +49 531 2359-193
E-mail: marcel.hoffmeister@aerodata.de

Andreas Kleffmann

Project Manager
Aerodata AG
Braunschweig, Germany
Phone: +49 531 2359-196
E-mail: andreas.kleffmann@aerodata.de



ABSTRACT

Modern Flight Inspection System operation aims to improve efficiency by using non-inspection flight phases for additional data collection. This paper describes the idea of design and implementation of an automatically executed Autonomous Data Collection and Evaluation feature integrated into a Flight Inspection System. The feature allows systematic and automatic monitoring of navigation aids during ferry flights without the need of an operator.

The developed capability provides configurable criteria for autonomous data collection, including selection of facility types (VOR and DME) as well as altitude and elevation limits. During operation, the system periodically identifies suitable navigation, starts measurement runs, and evaluates key performance parameters. To reduce data volume and post-processing effort, only summary results are stored by default. Full measurement data is saved for later in-depth analysis. Facilities that do not meet tolerance criteria are automatically flagged, allowing selective data transfer and simplified cleanup of recordings.

Autonomous data collection is strictly separated from active flight. By using ferry flights for continuous and low-effort monitoring of navigation aids, the feature supports a more efficient overall flight inspection process. The paper presents the operational concept, system behavior, and experience from implementation and testing.

INTRODUCTION

The operational efficiency of Flight Inspection Systems (FIS) is a critical factor for flight inspection organizations. Traditionally, measurement data was only collected during dedicated flight inspection runs, while significant time spent during ferry flights or transitions between airfields remained unused for system monitoring. Manually performing measurements during these phases would increase the workload of the Flight Inspector (FI) and distract from mission planning.

To address this, a new feature for “Autonomous Data Collection” has been developed within the AeroFIS software. The primary objective is to enable the FIS to independently identify, tune, and record data from VOR and DME facilities whenever the aircraft is airborne and not

engaged in a primary inspection task, transforming ferry time into productive monitoring time.

A key challenge in autonomous recording is the management of the resulting data volume. To ensure that the system remains practical for daily use, the implementation focuses on intelligent data reduction: only summary parameters are kept for high-performing facilities, while detailed measurement data is preserved only when signal anomalies or tolerance violations are detected. This paper details the technical implementation, the configuration logic for the FI, and the automated data management strategy.

Traditional flight inspection operations focus on the acquisition of measurement data during dedicated inspection flights following predefined geometries and procedures. However, a significant portion of total aircraft operating time consists of ferry flights or enroute transitions between operational areas. Autonomous data collection enables supplementary monitoring of navigation aids during such phases without increasing operational workload. The collected data is explicitly not intended to replace certified flight inspection procedures but to provide supplementary monitoring information outside formal inspection geometries.

IMPLEMENTATION IN AEROFIS SOFTWARE

Autonomous data collection is implemented as a special inspection type referred to as a "Collection". It can be initiated either manually or automatically at power on or after finishing an inspection. Each Collection is executed using an enroute run within the standard flight list, ensuring seamless integration into existing Flight Inspection System logic. Autonomous data collection is strictly decoupled from active flight inspection operations. Any initiation of a regular inspection task immediately terminates an active collection run. The autonomous function never accesses or modifies inspection-critical configurations or calibration states.

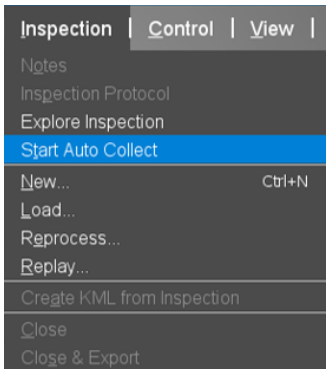


Figure 1: GUI Integration

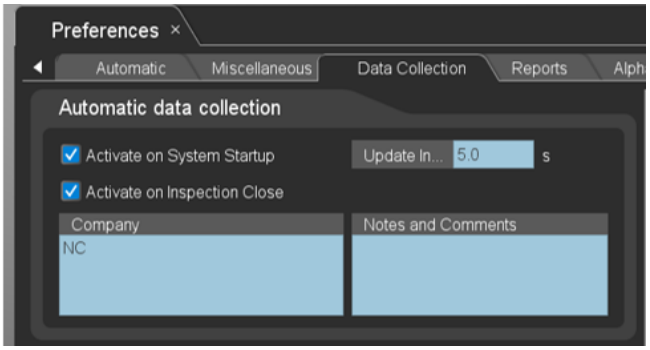


Figure 2: Startup and Update Settings

Automated Selection and Collection Logic

During autonomous operation, the system continuously evaluates aircraft position and environmental conditions. At a configurable update interval, typically five to ten seconds, the Flight Inspection System scans its navigation aid database to identify suitable VOR and DME facilities in the vicinity. Facility selection is based on minimum aircraft altitude, received signal strength, and valid coverage geometry. Stabilization mechanisms prevent excessive start-stop behavior.

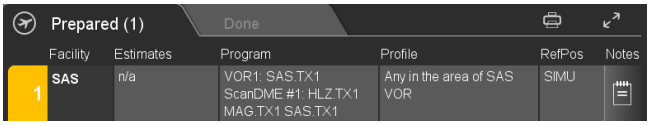


Figure 3: Active Collection in Flight List

Automated Evaluation and Data Management

Measured navigation aid parameters are continuously evaluated against defined tolerance limits. All tolerance thresholds used for autonomous evaluation are configurable within the Flight Inspection System and typically aligned with applicable ICAO and national regulatory requirements.

Figure 4: Individual Tolerances

The detailed intermediate parameters are only recorded if any measurement exceeds the defined tolerance limits. Otherwise, only a compact summary is generated. This way, the amount of recorded data is minimized while still allowing for in-depth analysis if required.

RESULTS PRESENTATION

Results of autonomous data collection are condensed into summary files that enable rapid assessment of navigation aid performance.

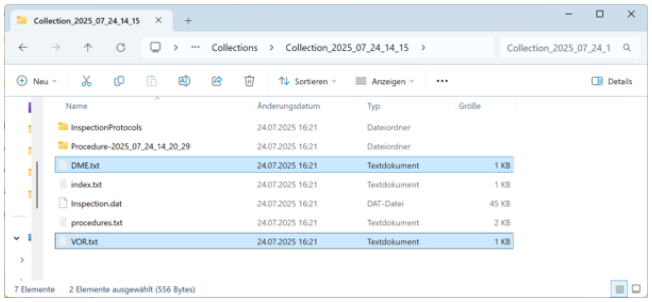


Figure 5: Summary Files

These summary files are formatted as comma-separated-values (CSV) so that they can be directly imported into various software tools (including Microsoft Excel) for further analysis.

Date	Ident	min. Azimuth [deg]	max. Azimuth [deg]	max. Distance Error [NM]	Assessment (Pass|Fail)	Comment
24.07.2025 14:54	DME HLZ	0	360	+0.004	PASS	agc ok:84.7%
24.07.2025 14:54	DME BWG	0	360	-0.004	PASS	agc ok:37.1%
24.07.2025 14:54	DME SAS	50	134	-0.004	PASS	agc ok:92%

DME summary imported into MS Excel.

Date	Ident	min. Azimuth [deg]	max. Azimuth [deg]	max. PFE [deg]	Avg 9960Hz Mod. [%]	Avg 30Hz Mod. [%]	Assessment (Pass|Fail)	Comment
24.07.2025 14:54	VOR SAS	49	134	-0.031	30.0	30.0	PASS	agc ok:100%

VOR summary imported into MS Excel.

Figure 6: Contents of Summary Files

CONCLUSIONS

Autonomous data collection transforms previously unused ferry flight time into productive monitoring capability. The concept enhances operational efficiency without interfering with certified inspection procedures and supports continuous, data-driven navigation aid monitoring.

By strategically planning the ferry flights, flight inspection operators can (up to a certain degree) control for which navigation aid they want to gather additional measurements.

ACKNOWLEDGEMENTS

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