FLAPsense

Optical Sensor System for Realtime Proprotor Flapping Angle Monitoring

List of project related publications

19th of October 2023

Development of a contactless measurement system for real time monitoring of a proprotors flapping angle – Part one.

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European Test and Telemetry Conference 2021 (ETTC 2021), 15th – 16th of June 2021, Toulouse, France.

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Abstract: *Monitoring the flapping and lagging motions of a proprotor in real-time is important to ensure flight safety of modern tilt rotor aircraft. Within the Clean Sky 2 Joint Undertaking funded project "FLAPsense" (No. 785571) a sensor system is being developed suitable to perform that measurement task contactless and in real-time. The system will be integrated in the proprotor assembly and co-rotate with the rotor hub. It will be based on a highly accurate optical sensing method providing the actual flapping motion of the rotor disc to the avionic system. The paper provides an overview on the measurement task to be performed and briefly presents the chosen approaches for the sensor system. Finally, it delivers an outlook on the next steps to be made in order to flight test the FLAPsense sensor system in the frame of the Next Generation Civil Tilt Rotor Technology Demonstrator.*

https://elib.dlr.de/143018/

Test Harness Development for an Optical Flapping Sensor.

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Bachelor Thesis, Baden-Württemberg Cooperative State University (DHBW), Mannheim, Germany 2021

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Abstract: *Within the FLAPsense project an optical sensor is developed to capture the motions of a rotor hub. A reference version of this sensor is implemented in Python within this work. As the main part a Test Harness is developed which examines the sensor in several rotor hub orientations and failure states. For this purpose, test cases are generated from a state transition diagram, derived from the software requirements document, and other test case generation procedures. A model of the sensor assembly is used to generate test data for normal test cases as well as robustness test cases. The Test Harness offers a generic interface to which not only pure software solutions but also integrated sensor systems can be attached, and is thus reusable in subsequent development stages. Moreover, the integration of RTCA DO-178C work products and traceability of requirements are also part of the Test Harness to simplify future certification according to RTCA DO-178C. A data-driven test strategy is utilized, leading to only a few test procedures which need to be implemented but a huge test case repository for extensive testing of the SUT. The set of test cases is applicable to test-driven development because it covers several evolution steps of the sensor. The test cases are documented in a human-readable style using XML as the main documentation format. Afterwards, they are interpreted by the test harness to generate the executable test cases on-demand from the high-level documentations.*

https://elib.dlr.de/146305/

Development of a contactless measurement system for real time monitoring of a proprotors flapping angle – Part two.

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European Test and Telemetry Conference 2023 (ETTC 2023), 14th – 15th of June 2023, Toulouse, France.

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Abstract: *To ensure the flight safety of a tilt-rotor aircraft, it is important to monitor the flapping motion of the proprotor in real time. Therefore, as part of the Clean Sky 2 Joint Undertaking funded project "FLAPsense" (No. 785571), a sensor system is being developed that can perform this measurement task in a non-contact and real-time manner. The system, which is integrated into the proprotor assembly and rotates with the rotor hub, is based on a high-precision optical sensor method that provides the avionics system with the actual flapping motion of the rotor disc. As a continuation of the "part one paper" from ETTC '21, the "part two paper" will provide a reminder of the details of the measurement task and present the latest achievements in terms of the FLAPsense sensor unit development. Finally, it gives an outlook on the next steps to bring the FLAPsense sensor system into flight.*
Keywords: rotor measurements, flapping, optical sensor NGCTR, safety analysis.

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