SENS4ICE

SENSORS AND CERTIFIABLE HYBRID ARCHITECTURES
FOR SAFER AVIATION IN ICING ENVIRONMENT

Selection process definition and sensors downselection for Gate 2

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Selection process definition and sensors downselection for Gate

The direct ice detection technology development is the most complex of the tracks due to multitude of sensors being developed and finite budget to flight test the sensors. To manage these constraints, the process established for sensor selection in the project SENS4ICE takes into account **two decision gates**

1. **GATE 1** already done at the beginning of 2020

2. **GATE 2** ongoing, its completion is expected in June 2021

Objectives

- The purpose of this process is to review and categorize the sensors. The first categorization (Gate 1) already placed February 2020 have been based on a short sensor design review and a road map towards flight test readiness
- The expected outcomes for Gate 1 were:
  - Sensor is deemed unfeasible with no path towards IWT – development is stopped
  - Sensor is deemed feasible for IWT, but there exists no path towards F/T – development is continued to IWT to evaluate the concept, but not F/T maturation budget will be provided
  - Sensor is deemed feasible for IWT and a path exists for F/T – some F/T budget will be provided after Gate 1

Sensor Selection

- ACTIVITY CONCLUDED FOR GATE 1 & Results

“Based on the analyses and evaluations from the Advisory Board and the project consortium it was found that no major issues had been identified and that no particular sensor technologies are clearly falling behind, while no sensor technology is standing out either. Accordingly it was decided after a final discussion on 04 FEB 2020 during the Steering Committee meeting in a formal vote that all sensor technologies pass Gate 1 and proceed toward IWT testing. Furthermore, no sensor was deemed to not have a path to flight test, so all sensors remain eligible for flight test after Gate 1”

Sensor Selection

- OUTCOME expected for GATE 2:
  - Sensor is deemed not ready for flight test and further development within the SENS4ICE project is stopped
  - Sensor is deemed ready (or on track to be ready) for flight test
  - Sensor is deemed ready (or on track to be ready) for both flight test and hybridization

Gate 2 goal is to identify the best sensor technologies for flight testing within SENS4ICE

Discussion are in progress with HONEYWELL, ATR, DLR and LEONARDO.

Based on ATR input and proposal the sensor selection for flight test campaign will be based on:

- Engineering value, like GATE 1 structure
- Icing Wind Tunnel Testing results

ED 103 document is guideline to establish a subset of test parameters in order to proceed with a comparative analysis with IWT test results

Objective of activity:

- Identify detection performance
- Identify repeatability of test

For the technology evaluation it is to be taken into account that the primary project goal is the sensor application for the hybrid system, and only on a secondary level the direct application as an individual/ single sensor. This has also been reflected in the development of the evaluation criteria and weights

Sensor Selection

- Overview of criteria established for GATE 2 selection

DETECTION OF ICING OR ICING CONDITIONS	Detect or Detection means: “sense, detect, and annunciate”. A combination of the following sensing techniques can be used as detection : -Ice Accretion Detection -Atmospheric Condition Detection For the purposes of this project only the icing envelopes defined by Appendix C and Appendix O are considered - Appendix D/P is not considered. Ref. ED-103 § 2.4 and Chapter 3 for Performance Specification For this category, the time required to recognize icing situation is not taken into account only the successful detection of it.
RESPONSE TIME	Any sensor which is used as an icing sensor needs to respond in a reasonable amount of time. The RESPONSE TIME is the time from initial exposure of the ICE sensor to the liquid water drops until the first detection of the condition. The response times apply to only the detection of the condition, not the measurement of any of its characteristics (e.g. LWC). The target RESPONSE TIME for SENS4ICE is taken from equation 1 of §3.4.1.1 of ED-103 - a selection of calculated values for specific conditions are found in Table 8. Extensive rational for these response time requirements is laid out in Appendix A of ED-103. For SENS4ICE test conditions not included in the Table 8 of ED-103 test matrix, a response time will be calculated using equation 1 of section 3.4 and Appendix A of ED-103.
FALSE ALARM RATE	A false alarm is defined as the detection of icing in non-icing conditions - this could be in dry air conditions, icing conditions below the suggested thresholds in ED-103, ice crystals (or other particulate) conditions, etc

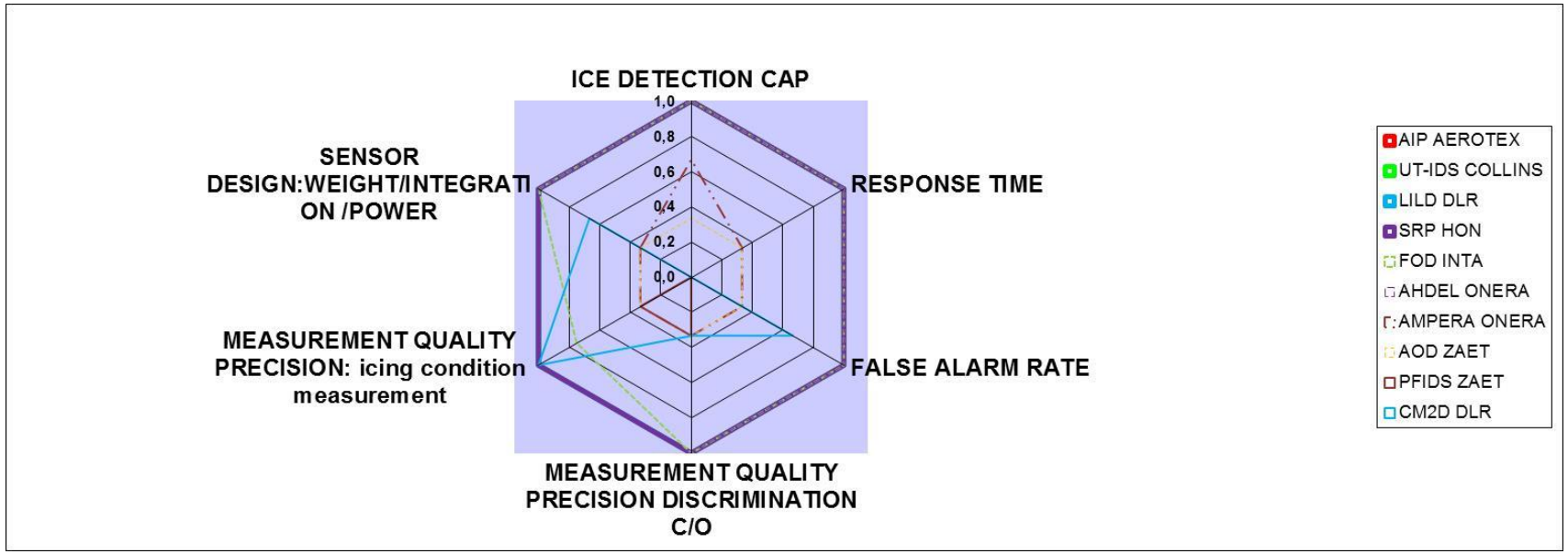
Sensor Selection

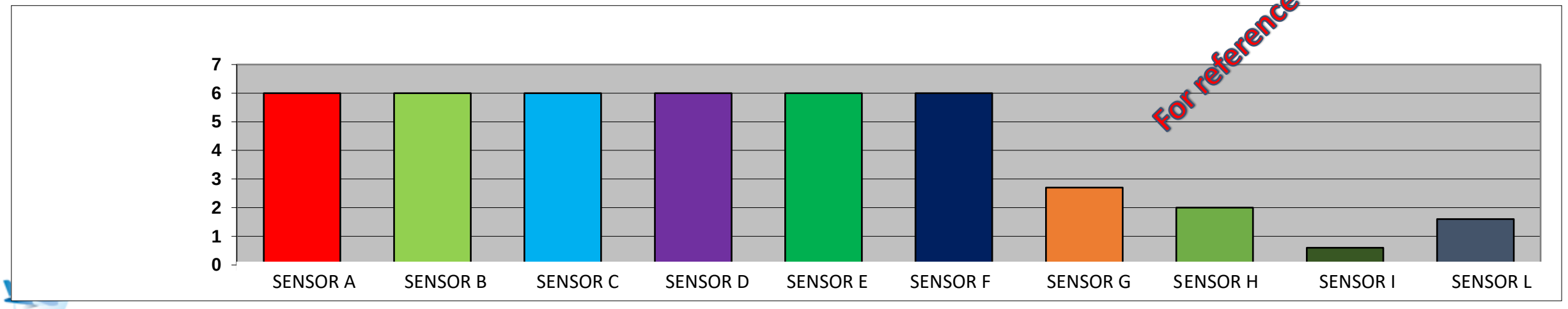
- Overview of criteria established for GATE 2 selection

DISCRIMINATION C/O	The sensor may discriminate between Appendix C and Appendix O. This is defined as when liquid drops having diameters exceeding a particular value as defined in §3.3.1.3.1 of ED103 (>100um). This project does not require the sensor to distinguish between the FZDZ and FZRA envelopes of Appendix O. This discrimination should be done within the recommended response time as outline in ED-103
MEASUREMENT OF ICING OR ICING CONDITION CHARACTERISTICS	The sensor may make measurements of the icing or icing conditions beyond the simple identification of the situation. Potential measurements, depending on the sensor type, are: MVD, LWC, accreted ice thickness, ice accretion rate. For this category, the measurement or response time shall be reported, but no explicit requirements are given. The evaluator shall use their expert judgment to determine if the measurement time is sufficient. The quality of the measurement will be judged based on the accuracy of the measurement against the tunnel reference condition.
SENSOR DESIGN:WEIGHT/INTEGRATION /POWER	While it is understood that most sensors in the project are early stage prototypes, some eye must be kept on the potential for the sensor to be productized. To this end, the sensor should be judged on what is viewed as its POTENTIAL regarding: size, weight, power, ease of integration/installation, maintenance considerations, and path to certification. Specific implementations of the sensors, such as the use of standard computers for data acquisition or bulky electronics (when it is clear that there is much room for miniaturization), should not be considered. The reviewer should attempt to ascertain if there are fundamental limits to any of these parameters or specific complications in its design which could prevent it from being productized.

Sensor Selection

- Technical Performance Measured methodology proposed by LDO and approved by all Partners participants for sensors comparative analysis will be used for selection process .





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