**INSPIRe**

**Spec4.1 - Functional and Software Design and Test Specifications – (DFMC & DR VAIM)**

Prepared for:

ESA


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# 1 INTRODUCTION

## 1.1 Purpose

This document is deliverable Spec4.1 of the INSPIRe project, titled ‘Functional and Software design and test specification DFMC GNSS and Dead Reckoning (DR) VAIM. This deliverable document is an output for WP4 providing which includes the

- Functional specification and associated test specification for DFMC GNSS and Dead Reckoning (DR) VAIM.
- Software design specification for implementing the DFMC GNSS and Dead Reckoning (DR) VAIM algorithms.
- Software test specifications for each module for integration and at the system level.

## 1.2 Scope

Following the background information presented in Section 1.1, the layout of the remainder of the document is as follows:

- Section 2 contains a list of applicable and reference documents.
- Section 3 provides an overview of the algorithm design.
- Section 4 provides an overview of the functional and software requirements.
- Section 5 provides a description of the test plan to be executed to validate the systems implementing the Architecture and the resulting outcomes.

## 1.3 Definitions and Acronyms

### *1.3.1 Definitions*

Concepts and terms used in this document and need defining are included in the following table:

*Table 1-1 Definitions*

| Concept / Term | Definition |
|---|---|
| MG-RAIM | Maritime General-RAIM: integrity algorithm designed for the configuration of single.<br>constellation, single frequency and without augmentation |
| MRAIM | MRAIM: integrity algorithm designed for a configuration of potential multi-constellation, multiple frequencies, and with/without augmentation |
| VAIM | Integrity Monitoring: this is a maritime-specific implementation of the M(G)RAIM concepts developed in this project to provide the requested integrity including dead-reckoning techniques, like aircraft autonomous integrity monitoring (AAIM) concept used in aviation, enhancing user-level integrity and providing additional resilience in the navigation solution |

### *1.3.2 Acronyms*

Acronyms used in this document and need defining are included in the following table:

*Table 1-2 Acronyms*

| Acronym | Definition |
|---|---|
| AL | Alert Limits |
| ARAIM | Advanced Receiver Autonomous Integrity Monitoring |
| CDF | Cumulative distribution function |
| DFMC | Dual Frequency Multi constellation |
| DGNSS | Differential GNSS |
| DGPS | Differential GPS |
| DOP | Dilution of Precision |
| ECAC | European Civil Aviation Conference |
| EGNOS | European Geostationary Navigation Overlay Service |
| ESA | European Space Agency |
| FD | Fault Detection |
| FDE | Fault Detection and Exclusion |
| GBAS | Ground-Based Augmentation System |
| GEAS | GNSS Evolutionary Architecture Study |
| GLONASS | GLObal NAvigation Satellite System |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| GRAD | GLA Research and Development |
| GSA | European GNSS Agency |
| HAL | Horizontal alarm Limit |
| HDOP | Horizontal Dilution of Precision |
| HMI | Hazardous Misleading Information |
| HPE | Horizontal Position Error |
| HPL | Horizontal Protection Level |
| IALA | International Association of Marine Aids to Navigation and Lighthouse Authorities |
| ICAO | International Civil Aviation Organisation |
| IEC | International Electrotechnical Commission |
| INSPIRe | Integrated Navigation System-of-Systems PNT Integrity for Resilience |
| IMO | International Maritime Organisation |
| IR | Integrity Risk |
| ISM | Integrity Support Message |
| LPV | Localizer Performance with Vertical guidance |
| MHSS | Multiple Hypothesis Solution Separation |
| MOPS | Minimum Operational Performance Standards |

| | |
|---|---|
| MGRAIM | Maritime General RAIM |
| MRAIM | Maritime RAIM |
| MSC | Maritime Safety Committee |
| MSR | Multi-system shipborne receiver |
| N/A | Not Applicable |
| NLOS | Non-Line of sight |
| NPA | Non-Precision Approach |
| PFA | Probability of False Alarm |
| PL | Protection Level |
| PHMI | Probability of Hazardously Misleading Information |
| PMD | Probability of Miss detection |
| PNT | Positioning Navigation and Timing |
| PVT | Position, Velocity and Time |
| RAIM | Receiver Autonomous Integrity Monitoring |
| RTCA | Radio Technical Commission for Aeronautics |
| RTK | Real-time kinematic positioning |
| SARPS | Standards and Recommended Practices |
| SBAS | Satellite Based Augmentation System |
| SIS | Signal in Space |
| SOLAS | Safety at Life at Sea |
| TBC | To Be Confirmed |
| TTA | Time to Arrival |
| UL | Uncertainty Level |
| VAIM | Vessel Autonomous Integrity Monitoring |
| VAL | Vertical alarm Limit |
| VHF | Very High Frequency |

# 2 REFERENCE

## 2.1 Applicable Documents

The following documents, of the exact issue shown, form part of this document to the extent specified herein. Applicable documents are those referenced in the Contract or approved by the Approval Authority. They are referenced in this document in the form [AD.x]:

*Table 2-1 Applicable Documents*

| Ref. | Title | Code | Version | Date |
|---|---|---|---|---|
| 1. | INSPIRe Technical Proposal, Taylor Airey | T-062-001-02 Part 1 | - | June 2022 |
| 2. | INSPIRe Management Proposal, Taylor Airey | T-062-001-02 Part 2 | - | June 2022 |
| 3. | INSPIRe Proposal GMV | GMV 10842/21 | v2/21 | |

## 2.2 Reference Documents

Although not part of this document, the following documents amplify or clarify its contents. Reference documents are those not applicable and referenced within this document. They are referenced in this document in the form [RD.x]:

*Table 2-2 Reference Documents*

| Ref. | Title | Code | Version | Date |
|---|---|---|---|---|
| [RD.1] | INSPIRe D4.1Technical report of developments and test of M(G)RAIM | INSPIRe-GMVNSL-D1-v1.1 | V1.1 | 22/09/2023 |
| [RD.2] | MarRINav D3b GNSS Integrity: Maritime Integrity at User Level with EGNOS V3 & M-RAIM | | 2.0 | 28.02.2020 |
| [RD.3] | IEC, 'Maritime navigation equipment - GNSS, part 1: GPS' | *IEC 61108-1* | - | 2003 |
| [RD.4] | RTCA MOPS for GPS / WAAS Airborne Equipment | DO-229 | F | 11.06.2020 |
| [RD.5] | SEASOLAS D030 - Final Report | SEASOLAS-GMV-D030 | 1.2 | 05/10/2018 |
| [RD.6] | NAVIPEDIA | - | - | - |
| [RD.7] | Advanced RAIM Reference Airborne Algorithm Description Document | ARAIM ADD | V3.1 | 06/2019 |
| [RD.8] | Advanced RAIM Reference Airborne Algorithm Description Document | ARAIM ADD | V4.2 | 02/2022 |
| [RD.9] | RTCA DO-229F Minimum Operational Performance Standards (MOPS) for Global Positioning System/Satellite-Based Augmentation System Airborne Equipment | N/A | F | 11/06/2020 |
| [RD.10] | Minimum operational performance standard for Galileo/Global Positioning System/ Satellite-Based augmentation system airborne equipment | N/A | 1.0 | 02/2019 |

| | | | | |
|---|---|---|---|---|
| [RD.11] | IMO Resolution A.915(22). Revised maritime policy and requirements for a future Global Navigation Satellite System (GNSS) | IMO A.915(22) | - | 29/11/2001 |
| [RD.12] | INSPIRe Algorithm documentation (GPS M(G)RAIM) | INSPIRe-GMVNSL-Alg2.1 | 1.1 | 02/023 |
| [RD.13] | INSPIRe Algorithm documentation (DFMC MRAIM) | INSPIRe-GMVNSL-Alg3.1 | 1.1 | 05/023 |
| [RD.14] | Technical Report of Developments and Test of GPS M(G)RAIM | INSPIRe-GMVNSL-D4.1 | 1.0 | 09/023 |
| [RD.15] | INSPIRe Algorithm documentation (VAIM) | INSPIRe-GMVNSL-Alg4.1 | 1.0 | 11/23 |

# 3 ALGORITHM DESIGN OVERVIEW

As discussed in [RD.1], the terms MG-RAIM, M-RAIM and VAIM are defined as follows:

- MG-RAIM: Maritime General RAIM, which is a chi-squared fault-detection process with simple geometric screening rules to ensure safety.
- M-RAIM: Maritime RAIM, is a maritime-specific implementation of the aviation ARAIM concept and performs a multiple-hypothesis solution-separation process, then computes a protection level and iteratively optimises this PL through re-allocation of integrity risk.
- VAIM: Vessel Autonomous Integrity Monitoring: this is a maritime-specific implementation of the M(G)RAIM concepts developed in this project to provide the requested integrity including dead-reckoning techniques, similar to aircraft autonomous integrity monitoring (AAIM) concept used in aviation, enhancing user-level integrity and providing additional resilience in the navigation solution.

The following subsection provides a description of the process and mathematical formulation of the defined maritime integrity VAIM concepts developed for on top of the M(G)RAIM concepts. The purpose of this additional VAIM concept is to take into consideration the availability of further sensor on-board a vessel and the increased robustness of dead-reckoning sensors.

It should be noted that any intermediate output could be used if required by any specific application implementation. In particular, if NMEA-0183 standard messages is a desire output, the required information for GGA, ZDA, GFA, etc. messages could be provided.

## 3.1 VAIM General Description

The maritime integrity algorithm proposed is based on M(G)RAIM algorithms developed in previous work packages. After these concepts, the availability of dead-reckoning sensors on-board is used to increase the integrity performances and the solution robustness.

The algorithm is based on three sequential steps once the position is calculated with all the available satellites.

- M(G)RAIM algorithms: Depending on the solution used, the first step is to perform all the procedures considered by the M(G)RAIM integrity concepts, in order to obtain the inputs required for the additional VAIM concept.
- Coherence test: In case an amber or green light is provided by the M(G)RAIM module, it is performed a coherence test comparing the position provided by GNSS and by the dead-reckoning sensors. This positioning is propagated from a previous valid epoch.
- State Vector propagation: In case any of the previous tests provide a non-green flag, the state vector from a previous valid epoch could be propagated, together with its Accuracy of 95% or its PL. This will provide robustness for short failures and outages, and it allows the optimisation of the performance since it could be selected the best solution from the current one and one propagated from a safe previous positioning.

An overview of the approach is provided in section 3.1.1 and the specific mathematical implementation is provided in [RD.15].

### *3.1.1 High-Level Architecture*

This section aims to describe at a high level the proposed maritime integrity algorithm, explaining the required PVT engine and the additional integrity layer provided by the algorithm.

#### 3.1.1.1 Processing Overview

This section provides a high-level description of the different VAIM modules, a detailed description of the algorithm is provided in [RD.15]. However, the main information flow and relationship between modules is detailed in the Figure 3-1.

Figure 3-1 is depicted for a single epoch processing. VAIM algorithm considers the propagation could be made not only from the previous epoch, but for sliding window. Then, VAIM algorithm will select those with the best performances (minimum PL or ACC95) and its associated PVT information.

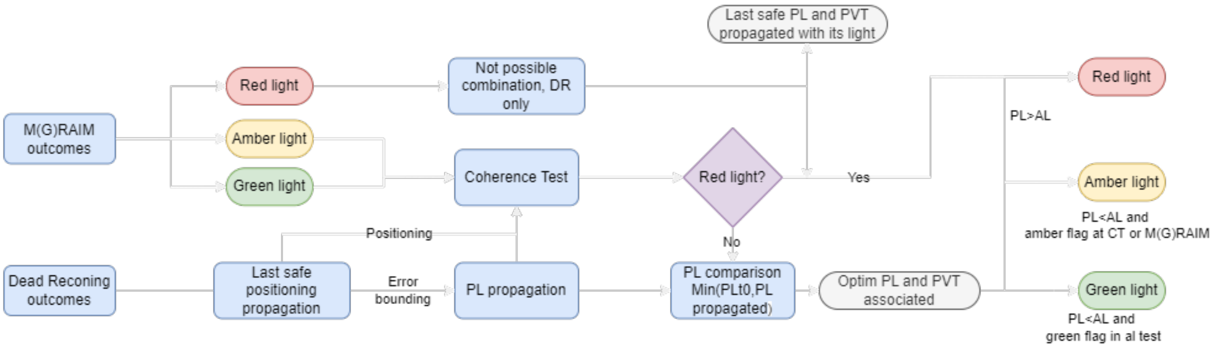


*Figure 3-1. VAIM conceptual flowchart*

Where:

- Grey bubbles are the provided outputs.
- Purple box is a decision point.
- Blue boxes are the functions involved in the integrity algorithm.
  - M(G)RAIM: computes GNSS current positioning and integrity alarms. Further details are provided in [RD.12], [RD.13].
  - Last safe positioning propagation.
  - PL propagation: function that identify the potential failure and perform additional test to measurements subsets.
  - Coherence Test: function that checks if the current solution is compatible with the information provided by the dead-reckoning sensor.
- Red, amber and green bubbles are output information provided to mariners.
- Red, amber and green bubbles are output information provided to mariners

NB Fault Detection and Exclusion (FDE) may be used by some future refinement of this process and may be a user-set option, therefore the scheme will include an iteration loop after a red light is raised, excluding the identified fault from the solution, and starting the WLSQ module again without that measurement.

# 4 SPECIFICATION OF REQUIREMENTS

Functional, non-functional, and safety requirements for the main elements of the PVT Algorithm architecture are outlined in this section. The algorithm design functional and software architecture are described in [RD.1].

## 4.1 Requirement nomenclature

For each requirement the following characteristics are specified:

- ID A unique identifier: it is composed of a string and a numeric part.
- Description The content of the requirement.

- Trace-back Points to source material from which the requirement has been derived.

**Note:** All specified requirements are to be considered mandatory unless otherwise stated.

The unique requirement ID complies with the following format:

[Category].[Group].[###]

Where:

- [Category] can be
  - FUN - functional requirements.
  - INT - interface requirements
- [Group] can be
  - ALG - requirements related to the Algorithm
  - SW - requirements related to the Software

- [###] is a numeric incremental identifier for requirements which have the same [Category]. [Group] prefix.

The requirement characteristics are presented in paragraph format, as demonstrated in Table 4-1.

*Table 4-1: Requirement specification format*

| ID | [Category].[Group].[###] |
|---|---|
| Description | A concise description of the requirement |

## 4.2 Algorithm Functional Specification

### 4.2.1 General Functional Requirements

FUN. ALG.001

The algorithm shall process the GNSS input data, as specified in the table below, prior to position and integrity calculations.

| Input data | Guidance |
|---|---|
| GNSS constellation ID | GPS, GALILEO |
| GNSS frequency ID | L1/L5, E1/E5a |
| Code Observation | Measurement |
| Carrier phase Observation | Measurement |
| Navigation Data | Decoded messages |

FUN.ALG.002

The algorithm shall Generate a snapshot weighted least squares 3D position solution using code measurements:

| Req ID | Guidance |
|---|---|
| FUN.ALG. 002.01 | Be able to do standalone solution for GPS L1/L5 and GALILEO E1/E5a individually and together (GPS + Galileo) |
| FUN.ALG. 002.02 | Be able to do an SBAS corrected GPS L1 only and GPS and Galileo L1/E1 and L5/E5 DFMC case |

FUN.ALG.003

The algorithm shall process positioning and/or velocity dead reckoning algorithm from DR sensor measurements.

FUN.ALG.004

The algorithm shall reject satellites that are flagged as ‘do not use’, while in SBAS Mode.

FUN.ALG.005

The algorithm shall use appropriate values from SBAS messages to weight orbit and clock to error budgets, while in SBAS Mode

FUN.ALG.006

The algorithm shall use DFREI values from SBAS messages to Ionosphere contribution to error budgets, while in SBAS Mode.

FUN.ALG.007

The algorithm shall use the GPS navigation message broadcast URA value to weight orbit and clock contribution to error budgets, while in GNSS Mode.

FUN.ALG.008

The algorithm shall use the GALILEO navigation message broadcast SISA value to weight orbit and clock contribution to error budgets, while in GNSS Mode.

FUN.ALG.009

The algorithm shall use Configurable values for other contributions to the error budget.

FUN.ALG.010

The algorithm shall use set weights using error budget values.

FUN.ALG.011

The algorithm shall allow the usage selection of M(G)RAIM ,MRAIM, VAIM by configuration, VAIM is only available if DR sensor is enabled.

INT. ALG.012

The algorithm shall provide the following output data:

| Req. ID | Output data | Guidance |
| --- | --- | --- |
| INT. ALG. 011.01 | 3D position | WGS84 coordinates |
| INT. ALG. 011.02 | GNSS timestamp | |
| INT. ALG.011.03 | Indicator Flags | |

FUN. ALG.013

The algorithm shall set the output integrity flag to red, if red light integrity indicator was raised at any point in the previous applicable period (configurable).

FUN. ALG.014

The algorithm shall set the current output integrity flag to the integrity indicator for the current epoch if red light integrity indicator was not raised at any point in the previous applicable period (configurable).

### 4.2.2 VRAIM Functional Requirements

FUN. ALG.015

The algorithm shall perform coherent test if amber/ green light is on from GNSS receiver with DR outcome.

FUN. ALG.016

The algorithm shall raise traffic light indicators based on the following:

| | Traffic light Flag Indicator | Guidance |
| --- | --- | --- |
| FUN.ALG. 016.01 | RED | An indicator flag is raised for that epoch if M(R)RAIM raised RED flag |
| FUN.ALG. 016.02 | RED | An indicator flag is raised if the coherence test fail |

FUN.ALG.017

The algorithm shall use Configurable values for the ISM parameters.

FUN.ALG.018

The algorithm shall perform protection level/accuracy propagation.

FUN. ALG.019

The algorithm shall output the protection level through the comparison results between propagation and estimation.

FUN. ALG.020

The algorithm shall raise traffic light indicators based on the following:

| | Traffic light Flag Indicator | Guidance |
|---|---|---|
| FUN.ALG. 025.01 | RED | An indicator flag is raised for that epoch if fault is detected and not excluded or the PL >AL |
| FUN.ALG. 025.02 | AMBER | An indicator flag is raised if the PL < AL and the M(R)RAIM raised amber flag |
| FUN.ALG. 025.03 | GREEN | An indicator flag is raised if fault detection does not raise any issues and PL≤AL and the M(R)RAIM raised GREEN flag. |

## 4.3 Software Functional Specification

FUN. SW.001

The software shall implement algorithm with functional requirements listed above.

FUN. SW.002

The software shall run in post-processing and not a Real Time data stream.

FUN. SW.003

The software shall read the configuration settings from the configuration file.

FUN. SW.004

The software shall read the RINEX Observation file.

FUN. SW.005

The software shall read the RINEX Navigation file.

FUN. SW.006

The software shall read the SBAS message.

FUN. SW.007

The software shall apply carrier smoothing of the code for single frequency measurements (the smoothing constant shall be configurable).

FUN. SW.008

The software shall read the smoothing constant from the configuration parameters.

FUN. SW.009

The software shall read the elevation mask from the configuration parameters, removing observation for the satellite below the mask.

FUN. SW.010

The software shall apply RTCA tropospheric correction model.

FUN. SW.011

The software shall form ionosphere-free pseudo-range measurement, in DFMC mode

FUN. SW.012

The software shall have allow a configurable time period to keep the RED flag.

FUN.SW.013

The software shall be capable of computing GNSS DFMC only and SBAS + DFMC solutions.

FUN.SW.014

The software shall process additional sensor to propagate the positioning

INT.SW.014

The software shall process one epoch at a time of observations and save the results. The Position Results saved should include but not be limited to the following:

| Position Results Output |
| --- |
| ▪ Time<br>▪ Estimated Position (XYZ)<br>▪ Estimated position (LLH)<br>▪ Integrity flag (Green, Amber, Red)<br>▪ HDOP<br>▪ GDOP<br>▪ Number of Satellites used<br>▪ Computed test statistics<br>▪ Horizontal Protection Levels / Uncertainty Levels |

INT.SW.016

The software shall process protection level propagation.

INT.SW.017

The software shall output the protection level through the comparison between the propagation and the current PL.

# 5 TEST PLAN

This section presents the test cases designed to evaluate the functionality of the INSPIRe algorithm architecture detailed in [RD.15]. It outlines the tests to be executed and provides a high-level overview of each test's purpose, along with the necessary data and test tools.

Each test case is independent, ensuring that they can be executed in any order without relying on the output of another test case. This approach prevents the failure of one test from hindering the execution of others, except for the Installation test procedure, which must be executed first.

## 5.1 Test Data

The data and configuration settings at all processing stages are stored in files. Sample data sets and configurations for testing will be created during the development of the algorithm. These files will be archived with documented filenames.

Test data consists of:

- GNSS RINEX version 3.04 format
  - Observation File
  - Navigation File
  - Dead Reckoning sensor measurement

## 5.2 Test Environment

The test will be carried out standalone from the GMV network and will use a PC or laptop as the "diagnostics" machine running Windows OS

## 5.3 List of Test Cases

Each test case will be defined based on a Case ID with next format:

**TC -** Prefix to indicate this is a Test Case Identifier.

**[Function] -** is the name of the software component under testing

**[ID#]** – sequential numbering for each case.

Table 5-1 below identifies a set of test cases proposed for VAIM algorithms. To demonstrate that the algorithm is compliant with its system, it is necessary to provide a trace of the system requirements in the test activities. Each requirement will be traced to the test that verifies it. In some instances, requirements may need more than one test to demonstrate compliance (e.g., if the requirement has two or more 'parts' to it). In such cases, a comment will be included in the traceability column to identify the aspects of the requirement that each test is responsible for demonstrating.

Not all functional specifications will be traceable to a functional test execution; these may require inspection of hardware and/or technical documentation.

*Table 5-1 Test Cases*

| Test CaseID | Objective/Test sets | Description | Success Criteria | Traceability Requirements |
|---|---|---|---|---|
| TC.SW.01 | To check that files are read, and a solution is generated as expected with MGRAIM, and operating as a reference when compare against MGRAIM + VAIM | Execution of the positioning software using a nominal configuration which includes:<br>• Archived real data (GPS L1/L5 Galileo E1/E5 - RINEX Observation(*.obs) and Navigation (*.nav)),<br>• Faults: = NONE,<br>• Smoothing constant: 100s | • Population of the output parameter<br>• Manually check the consistency of loaded data<br>• a valid solution, green flag, horizontal position errors < 10m<br>• Solution output can be compared with commercial/open sources PVT processing software to check that the position is as expected, (e.g., solution, number of satellites, DOP values, etc) | FUN. ALG.001<br>FUN. ALG.002.01<br>FUN. ALG.006 to FUN. ALG.013<br><br>FUN. SW.001<br>FUN. SW.002<br>FUN. SW.003<br>FUN. SW.004<br>FUN. SW.005<br>FUN. SW.010<br>FUN. SW.011<br>INT. ALG.012 |
| TC.SW.02 | To check the dead reckoning is operating properly under MGRAIM + VAIM and the performance are identical to MGRAIM only under fault free case. | Execution of the DR algorithm | • Population of the output parameter | FUN.SW.014<br>INT.SW.014<br>FUN. ALG.015 |
| TC.SW.03 | To check the additional VAIM algorithm can smooth the error and delay the RED flag under fault case. | Inject ramp error on GNSS observation | • The number of RED flag within VAIM should less than MGRAIM.<br>• The positioning accuracy shall be improved. | FUN.ALG.011<br>INT. ALG.012<br><br>FUN.SW.014<br>INT.SW.017<br>FUN. ALG.019 |
| TC.SW.04 | To demonstrate the 95% accuracy is propagated in MGRAIM + VAIM algorithm and the propagated accuracy is the condition of MGRAIM +VAIM flag | Comparing the propagated 95% accuracy in VAIM against the accuracy requirement | • The output protection level will be the lowest PL/95% accuracy value | FUN.ALG.018 |
| TC.SW.05 | To demonstrate that the MGRAIM integrity RED flag trigger the Dead reckoning process in MGRAIM + VAIM algorithm and the propagated accuracy drift in longer period. | Configure the threshold value of MGRAIM parameter to a small value to force the integrity flag is RED from MGRAIM | • The output integrity flag is red for that epoch and DR will be processed | FUN.ALG.016 |
| TC.SW.05.1 | To demonstrate MGRAIM + VAIM algorithm can improve the integrity status and always propagate from the previous GREEN flag epoch. | Configure the threshold value of MGRAIM parameter to a small value to force the integrity flag is AMBER from MGRAIM | • The output integrity flag is either AMBER or GREEN | FUN.ALG.021 |

| Test CaseID | Objective/Test sets | Description | Success Criteria | Traceability Requirements |
|---|---|---|---|---|
| TC.SW.06 | To demonstrate that the coherent test in VAIM can detect the additional fault added to Speed log sensor. | Inject an big error to the DR positioning solution | • The output integrity flag is RED | FUN.ALG.014<br>FUN.ALG.015<br>FUN.ALG.016.2 |
| TC.SW.06.1 | To demonstrate that the coherent test can detect the bias error in GNSS receiver | Inject an big error to the GNSS positioning solution | • The output integrity flag is RED | FUN.ALG.014<br>FUN.ALG.015<br>FUN.ALG.016.2 |
| TC.SW.06.2 | To demonstrate that the coherent test can detect if the speed log performance is not consistent with predefined parameters | Increase the simulated dead reckoning sensor noise variance | • The output integrity flag is RED | FUN.ALG.014<br>FUN.ALG.015<br>FUN.ALG.016.2 |
| TC.SW.7 | To demonstrate the threshold value is decided by the Probability of false Alarm $P_{fa}$. | Under fault free case, configure the $P_{fa}$ to a greater value | • The output integrity flag is RED | FUN.ALG.016.2 |
| TC.SW.8 | To check the Minimum detectable Error is decided by the Probability of Integrity risk and the MDE need to be less than the accuracy threshold value if GREEN flag raised. | Under fault case, configure the Integrity risk to a greater value | • The output integrity flag is GREEN | FUN.ALG.016.2 |
| TC.SW.9 | To demonstrate the horizontal protection level is propagated in MRAIM +VAIM. | Enable VAIM and MRAIM | • The propagated Horizontal protection level is higher than TC.SW.05 | FUN.ALG.011<br>FUN.SW.014<br>INT.SW.014<br>INT.SW.016<br>INT.SW.017<br>FUN.SW.019<br>FUN.SW.020 |

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