**NB 2.0 AAU Design Specification  
Tracker Retrospective Detection**

**V1.0**

|  |  |  |
| --- | --- | --- |
| **Approved by:** |  |  |
|  | *Software Engineering Manager*  *CJ Bourn* | *Date* |

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# Document Change History

|  |  |  |  |
| --- | --- | --- | --- |
| **Revision** | **Date** | **Author** | **Description** |
| 0.1 | 12/14/2017 | Oliver McDonald | Initial Draft |
| 0.2 | 2/2/2018 | Chaitra Alase G | Added unit test cases |
| 1.0 | 2/26/2018 | CJ Bourn | Remove watermarks and release |

# Overview

This document is a Design Specification that covers the RSP Tracker Retrospective Detection AAU for the NB 2.0 sensor. This AAU is utilized as part of the RSP Tracker layer.

The Tracker Retrospective Detection AAU is tasked with building clusters of qualified paired CW and FM detections records and assembling such lists for use in the initiation of tracks in the tracker layer. It is a key function within the tracker layer and is used in specifically in assisting track initiation. Figure 1 identifies the key inputs/outputs and processing performed by the Tracker Retrospective Detection AAU.



Figure Retrospective Detection Overview

## Document Scope

This document describes the NB 2.0 software component suitable for performing Tracker Retrospective Detection as part of RSP Tracking Layer.

The low-level mechanics of the Tracker Retrospective Detection process are beyond the scope of this document; for that, the reader is referred to the Tracker ADD [INT8].

## Document Management

The document source is available in [PTC](http://ALVA-MKS01.alv.autoliv.int:7001/siro/viewrevision?projectName=%23p=e:/MKSProjects/Radar/NB_Platform_2.0/NB_Platform_2.0.pj%23s=DOC/DOC.pj&selection=Designs/RSP/Tracker/NB%202.0%20Tracker%20Retrospective%20Detection%20Design%20Spec.docx) and the released versions of this document are available on the [NB Sharepoint page](http://alvteams.alv.autoliv.int/sites/aelnb/Project%20Documents/Forms/AllItems.aspx?RootFolder=%2Fsites%2Faelnb%2FProject%20Documents%2FAS151%20%2D%20NB%202%2E0&FolderCTID=0x0120003088A1510C533443A815EB05779DC6FC&View=%7B25D38ECE%2D2AD7%2D4270%2D8656%2D1887D8BC73AF%7D).

## References

This section lists all document references within this specification.

### Internal Autoliv References

| **Ref #** | **Document** | **Location** |
| --- | --- | --- |
| 1. NB 2.0 Source Code Format and Coding Conventions | | [PTC](http://ALVA-MKS01:7001/siro/viewrevision?projectName=%23p=e:/MKSProjects/Radar/NB_Platform_2.0/NB_Platform_2.0.pj%23s=DOC/DOC.pj&selection=Methods/NBM_2.0-007%20Source%20Code%20Format%20and%20Coding%20Conventions.docx) |
| 1. NB 2.0 RSP Software Architecture Specification | | [PTC](http://ALVA-MKS01:7001/siro/viewrevision?projectName=%23p=e:/MKSProjects/Radar/NB_Platform_2.0/NB_Platform_2.0.pj%23s=DOC/DOC.pj&selection=Architecture/NB%202.0%20Radar%20Signal%20Processor%20Software%20Architecture%20Specification.docx) |
| 1. NB 2.0 Data Conditioning Algorithm Description Document | | [Sharepoint](http://alvteams.alv.autoliv.int/sites/aelnb/NB%2020%20Requirements/ADD%20Library/DataConditioningADD.pdf) |
| 1. NB 2.0 RSP Requirements | | [Sharepoint](http://alvteams.alv.autoliv.int/sites/aelnb/NB%2020%20Requirements/NB20_SW_Req_RSP.pdf) |
| 1. Eiger Reference manual (Eiger\_6M\_Cut2.1\_RM\_Rev3.pdf) | | [PTC](http://ALVA-MKS01:7001/siro/viewrevision?projectName=%23p=e:/MKSProjects/Radar/NB_Platform_2.0/NB_Platform_2.0.pj%23s=DOC/DOC.pj&selection=Vendor%20Info/ST%20Eiger/Eiger_6M_Cut2.1_RM_Rev3.pdf) |
| 1. NB 2.0 Radar Execution Manager Design Spec | | [PTC](http://ALVA-MKS01:7001/siro/viewrevision?projectName=%23p=e:/MKSProjects/Radar/NB_Platform_2.0/NB_Platform_2.0.pj%23s=DOC/DOC.pj&selection=Designs/Sequencer/NB%202.0%20Radar%20Execution%20Manager%20Design%20Spec.docx) |
| 1. NB 2.0 RSP Process Manager design spec | | [PTC](http://ALVA-MKS01:7001/siro/viewrevision?projectName=%23p=e:/MKSProjects/Radar/NB_Platform_2.0/NB_Platform_2.0.pj%23s=DOC/DOC.pj&selection=Designs/RSP/Process%20Manager/NB%202.0%20RSP%20Process%20Manager%20Design%20Specifications.docx) |
| 1. NB 2.0 Tracker Algorithm Description Document | | Sharepoint |
| 1. NB 2.0 RSP Beamformer AAU design spec | | [PTC](http://ALVA-MKS01.alv.autoliv.int:7001/siro/viewrevision?projectName=%23p=e:/MKSProjects/Radar/NB_Platform_2.0/NB_Platform_2.0.pj%23s=DOC/DOC.pj&selection=Designs/RSP/Detection/NB%202.0%20RSP%20Detection%20Beamformer%20Design%20Spec.docx) |
| 1. NB 2.0 RSP Detection Peak Locator AAU design spec | | [PTC](http://ALVA-MKS01.alv.autoliv.int:7001/siro/viewrevision?projectName=%23p=e:/MKSProjects/Radar/NB_Platform_2.0/NB_Platform_2.0.pj%23s=DOC/DOC.pj&selection=Designs/RSP/Detection/NB%202.0%20RSP%20Detection%20Peak%20Locator%20Design%20Spec.docx) |
| 1. NB 2.0 RSP Detection Characterization AAU design spec | | [PTC](http://ALVA-MKS01.alv.autoliv.int:7001/siro/viewrevision?projectName=%23p=e:/MKSProjects/Radar/NB_Platform_2.0/NB_Platform_2.0.pj%23s=DOC/DOC.pj&selection=Designs/RSP/Detection/NB%202.0%20RSP%20Detection%20Characterization%20Design%20Spec.docx) |
| 1. NB 2.0 RSP Detection Support AAU design spec | | PTC |
| 1. NB 2.0 RSP Tracker Manager AAU Design Spec | | PTC(TBD) |

### External References

| **Ref #** | **Document** | **Location** |
| --- | --- | --- |
| 1. <Document Title> | | <short URL> |

## Requirements

At this time, requirements for this module are still being developed. Known requirements at this time are available in the NB2.0 Tracker ADD [INT8].

|  |  |
| --- | --- |
| **DOORS ID** | **Summary** |
|  |  |

### Derived Requirements

Following are the derived requirements uncovered by this design. These requirements will have to be added to DOORS by Requirements Engineers. Requirements that are struck out are no longer in effect. They are still listed here to preserve traceability.

|  |  |
| --- | --- |
| **ID** | **Summary** |
|  | |

## Architecture

This AAU is described in the NB2.0 RSP Software Architecture Specification [INT2].

## Definitions

|  |  |
| --- | --- |
| **Term** | **Definition** |
| Channel | CW/SFM data stream corresponding to a single receiver/transmitter pair |
| DMEM | Eiger microcontroller high-speed *data* memory associated with a single processing core. [INT5] |

## Abbreviations

|  |  |
| --- | --- |
| **Item** | **Definition** |
| AAU | Atomic Architectural Unit |
| ADD | Algorithm Description Document |
| API | Application Programming Interface |
| CW | Continuous Wave |
| FFT | Fast Fourier Transform |
| IQ | In-phase and Quadrature |
| NB | Narrow Band |
| UT | Unit Test |

## Source Files

In accordance with the naming convention NAM\_004 in [INT1], the unique short name of the Tracker Retropsective Detection AAU will be RetroDetect in upper CamelCase and retroDetect in lower camelCase. The source code will be contained in Tracker\_**RetroDetect.c** and **RetroDetect.h** and other files as needed, located in folder …/Software/**SigProc**/**Tracking**.

Figure 2 depicts the interaction between this AAU and other RSP components.



Figure Retrospective Detection Component Interactions

## Retrospective Detection parameter and Waveform Updates

The retrospective detection AAU will obtain its parameters such as tracker parameters and waveform segment parameters as pointers passed to its function argument from the tracker manager. These parameters are obtained by execution of a notional Tracker\_Initialize function i.e. Tracker\_Init() which is spelled out in the Tracker Manager AAU Design Specifications [INT13].

## Retrospective Detection Operation

Figure 3 provides a notional overview of the Retrospective Detection AAU as it operates within the context of tracking.



Figure Tracker Retrospective Detection Context and Sequence

A few key details about the processing overseen by this AAU.

* The basis for the retrospective detection process are historical detection records for both CW and SFM detections for a total of a specified integer number of radar sweeps as determined by a point.
* The number of sweeps for Retrospective Detection is obtained from the Tracker Parameters data structure that is populated by the Tracker Manager and passed as a pointer to the Tracker Retrospective Detection AAU.
* The Retrospective Detection AAU produces qualified detection clusters that are used in Track Initiation AAU.
* The memory foot print of Retrospective Detection is relatively insignificant and can be subsumed under the memory requirements of the Tracker Manager AAU. It is:
  + History Buffers – (752\*L Bytes) where L is the number of sweeps use for the depth of the history buffer. For example, if 4 sweeps are used, then the memory requirement of the history buffer is 3008 Bytes.
* Scratch
  + Scratch Memory estimates is about (752\*L)
* Output
  + Detection Cluster Indices (CW and SFM)– 8 Bytes

# Application Programming Interface

## Types and Macros

### Error Codes

| **Code** | **Notes/Definition** |
| --- | --- |
| NB\_OK | Indicates successful operation |
| RETRODETCT\_E\_ARG | Invalid input argument detected |

## Function Definitions

| **Function** | **Description** |
| --- | --- |
| Tracker\_RetroDetect | Provides qualified clusters of detections to be further examined in track initiation as possible new tracks. |

### Tracker\_RetroDetect

Caches detection parameters for use in target and clutter detection. This function should be called as part of initialization process and in response to a mode change.

Prototype:

PUBLIC\_API (Nb\_Status\_t) Tracker\_RetroDetect()

Parameters:

| **Name** | **Purpose** |
| --- | --- |
| WaveformInfo | Pointer to CW & FM Segment Parameters  (Type: \*RspCmn\_WaveformInfo\_t) |
| TP | Pointer to Tracker Parameters  (Type: RspCmn\_TrackerBasicParams\_t\* |
| DetectHistory | Pointer to CW and FM Detection History Buffer  (Type: RspCmn\_TrackerDetectionHist\_t\*) |
| DetectCluster | Pointer to Candidate Cluster  (Type: RspCmn\_TrackClusterArray\_t\*) |
| VehData | Pointer to vehicle data  (Type: RspCmn\_VehicleData\_t\*) |

Returns:

| **Name** | **Purpose** |
| --- | --- |
| NB\_OK | Initialization was successful |
| RETRODETECT\_E\_ARG | Invalid argument detected |

# Unit Test Considerations

## Environment

All unit tests will be implemented within the Visual Studio environment and run automatically with the nightly builds. No other equipment is required to run the unit tests.

## Use Case Details

|  |  |  |
| --- | --- | --- |
| Test Case ID | Tracker\_RetroDetect\_BadParams | |
| Purpose | Demonstrate the ability of Tracker\_RetroDetect() function to detect invalid input parameters. | |
| Requirement |  | |
| Setup | NA | |
| Test Preconditions | NA | |
| Description | Provide invalid input parameters to Tracker\_RetroDetect() function and check for error code RETRODETECT\_E\_ARG reflecting invalid input arguments are detected. | |
| Input(s) | Scenario 1:  \*WaveformInfo = NULL  \*TP = valid pointer  \*DetectHistory = valid pointer  \*DetectCluster = valid pointer  \*VehData = valid pointer | Scenario 2:  \*TP = NULL  \*WaveformInfo = valid pointer  \*DetectHistory = valid pointer  \*DetectCluster = valid pointer  \*VehData = valid pointer |
| Scenario 3:  \*DetectHistory = NULL  \*WaveformInfo = valid pointer  \*TP = valid pointer  \*DetectCluster = valid pointer  \*VehData = valid pointer | Scenario 4:  \*DetectCluster = NULL  \*TP = valid pointer  \*WaveformInfo = valid pointer  \*DetectHistory = valid pointer  \*VehData = valid pointer |
| Scenario 5:  \*VehData = NULL  \*DetectCluster = valid pointer  \*TP = valid pointer  \*WaveformInfo = valid pointer  \*DetectHistory = valid pointer |  |
| Expected Output(s) | Return value RETRODETECT\_E\_ARG | |

|  |  |
| --- | --- |
| Test Case ID | Tracker\_RetroDetect\_Success1 |
| Purpose | Demonstrate successful operation of Tracker\_RetroDetect() function. |
| Requirement |  |
| Setup | NA |
| Test Preconditions | NA |
| Description | Provide valid input parameters to Tracker\_RetroDetect() function and verify expected output matches with actual output. |
| Input(s) | TP.SigmR = 6.4343f  TP.SigmRdot = 1.0f  TP.SigmTh = 3.0f  TP.SigmCent = 1.0f  TP.C1 = 1.036716937742782f  TP.C2 = -6.59515815062187f  TP.ZeroVInitiationGate = 1.5f  TP.InitiationGate = 5.0f  WaveformInfo.FrameTime = 0.0626f  WaveformInfo.FMSweepTime = 0.040960f  VehData.SensorLocation = SENSOR\_POS\_REAR\_LEFT  Initialize CW detection history  Velocity   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 0.99157598006511 | 0.6445620411495 | 0.22869111041127 | 0 | | 1 | -18.607991080949 | 1.8333306332917 | -0.3333132028546 | 0 | | 2 | -0.3524871585719 | -2.202173427560 | 0 | 0 | | 3 | 0 | -0.337160787192 | 0 | 0 |   IsPaired   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 0 | 1 | 1 | 0 | | 1 | 1 | 0 | 1 | 0 | | 2 | 1 | 0 | 0 | 0 | | 3 | 0 | 1 | 0 | 0 |   PairedIndex   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 255 | 0 | 0 | 255 | | 1 | 0 | 255 | 1 | 255 | | 2 | 1 | 255 | 255 | 255 | | 3 | 255 | 1 | 255 | 255 |   Ndet   |  |  |  |  | | --- | --- | --- | --- | | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 3 | 4 | 2 | 0 |   Initialize FM detection history  Velocity   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist[0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | -0.148576481759902 | -0.24256396327312 | -0.156426420954384 | 0 | | 1 | -0.423006844225422 | -0.15831249530747 | -0.545119189907977 | 0 | | 2 | 0 | -1.32215945493863 | 0 | 0 |   Bearing   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 274.224261152670 | 273.49468287601 | 274.776520616534 | 0 | | 1 | 181.381499838433 | 182.244015828933 | 182.244042532287 | 0 | | 2 | 0 | 179.171412494820 | 0 | 0 |   Centroid   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 2.82863930342175 | 3.0960813370515 | 4.86369052686822 | 0 | | 1 | 36.3999879576512 | 36.324859598362 | 36.2630748194518 | 0 | | 2 | 0 | 87.063451692582 | 0 | 0 |   IsPaired   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 1 | 1 | 1 | 0 | | 1 | 1 | 1 | 1 | 0 | | 2 | 0 | 0 | 0 | 0 |   PairedIndex   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 1 | 0 | 0 | 255 | | 1 | 2 | 3 | 1 | 255 | | 2 | 255 | 255 | 255 | 255 |   IsAssigned: false (for all entries)  AssignedTrack: 255 (for all entries)  Ndet   |  |  |  |  | | --- | --- | --- | --- | | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 2 | 3 | 2 | 0 | |
| Expected Output(s) | Return value NB\_OK  Expected ClusterArray[0]  TrackCandidCw[4] = [255,255,255,255]  TrackCandidFm[3] = [1, 31, 61]  IsZeroV = false |

|  |  |
| --- | --- |
| Test Case ID | Tracker\_RetroDetect\_Success2 |
| Purpose | Demonstrate successful operation of Tracker\_RetroDetect() function. |
| Requirement |  |
| Setup | NA |
| Test Preconditions | NA |
| Description | Provide valid input parameters to Tracker\_RetroDetect() function and verify expected output matches with actual output. |
| Input(s) | TP.SigmR = 6.4343f  TP.SigmRdot = 1.0f  TP.SigmTh = 3.0f  TP.SigmCent = 1.0f  TP.C1 = 1.036716937742782f  TP.C2 = -6.59515815062187f  TP.ZeroVInitiationGate = 1.5f  TP.InitiationGate = 5.0f  WaveformInfo.FrameTime = 0.0626f  WaveformInfo.FMSweepTime = 0.040960f  VehData.SensorLocation = SENSOR\_POS\_REAR\_LEFT  Initialize CW detection history  Velocity   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | -0.4533116231273 | 0.59111895832843 | -0.4690520866006 | -0.5028249607325 | | 1 | 1.93924886430746 | -0.4386949119523 | 0 | 0 |   IsPaired   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 1 | 0 | 1 | 1 | | 1 | 1 | 1 | 0 | 0 |   PairedIndex   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 4 | 255 | 1 | 1 | | 1 | 2 | 0 | 255 | 255 |   Ndet   |  |  |  |  | | --- | --- | --- | --- | | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 2 | 2 | 1 | 1 |   Initialize FM detection history  Velocity   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist[0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | -0.29677142171404 | -0.5410231359898 | 15.112301172521 | -0.1493452652871 | | 1 | 0.637995470808412 | -0.6902819472036 | -0.247958666186 | -0.5308878823395 | | 2 | -0.52900594882798 | 0.87215157142294 | -1.337895274879 | -0.3119653231265 | | 3 | -3.07923799954172 | 0 | 1.8870859998217 | 0 | | 4 | -0.82631943441213 | 0 | 0 | 0 |   Bearing   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 274.563980102626 | 179.978737131805 | 202.436674258806 | 272.820632505077 | | 1 | 267.807299708783 | 184.426600285844 | 181.039569607604 | 180.849634522057 | | 2 | 178.502386467562 | 179.758828080888 | 184.416013796994 | 179.135314830188 | | 3 | 182.826320531665 | 0 | 177.602935399091 | 0 | | 4 | 179.524172501790 | 0 | 0 | 0 |   Centroid   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 4.21915430104952 | 36.4218974670321 | 40.8530836156098 | 2.70706260655751 | | 1 | 124.073381620671 | 38.9375567699915 | 36.4129447171256 | 36.9054309186080 | | 2 | 36.4249624964908 | 86.9519719540425 | 71.3511971725361 | 86.9493556454479 | | 3 | 70.5454535039285 | 0 | 86.9737826625702 | 0 | | 4 | 86.9087924634773 | 0 | 0 | 0 |   IsPaired   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 0 | 1 | 0 | 0 | | 1 | 0 | 0 | 1 | 1 | | 2 | 1 | 0 | 0 | 0 | | 3 | 0 | 0 | 0 | 0 | | 4 | 1 | 0 | 0 | 0 |   PairedIndex   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 255 | 1 | 255 | 255 | | 1 | 255 | 255 | 0 | 0 | | 2 | 1 | 255 | 255 | 255 | | 3 | 255 | 255 | 255 | 255 | | 4 | 0 | 255 | 255 | 255 |   IsAssigned:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 0 | 1 | 0 | 1 | | 1 | 0 | 1 | 1 | 1 | | 2 | 1 | 0 | 0 | 0 | | 3 | 0 | 0 | 0 | 0 | | 4 | 0 | 0 | 0 | 0 |   AssignedTrack:   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 255 | 0 | 255 | 2 | | 1 | 255 | 1 | 0 | 0 | | 2 | 0 | 255 | 255 | 255 | | 3 | 255 | 255 | 255 | 255 | | 4 | 255 | 255 | 255 | 255 |   Ndet   |  |  |  |  | | --- | --- | --- | --- | | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 5 | 3 | 4 | 3 | |
| Expected Output(s) | Return value NB\_OK  Expected ClusterArray[0]  TrackCandidCw[4] = [255 255 255 255]  TrackCandidFm[4] = [4 32 63 92]  IsZeroV = false |

|  |  |
| --- | --- |
| Test Case ID | Tracker\_RetroDetect\_Success3 |
| Purpose | Demonstrate successful operation of Tracker\_RetroDetect() function. |
| Requirement |  |
| Setup | NA |
| Test Preconditions | NA |
| Description | Provide valid input parameters to Tracker\_RetroDetect() function and verify expected output matches with actual output. |
| Input(s) | TP.SigmR = 6.4343f  TP.SigmRdot = 1.0f  TP.SigmTh = 3.0f  TP.SigmCent = 1.0f  TP.C1 = 1.036716937742782f  TP.C2 = -6.59515815062187f  TP.ZeroVInitiationGate = 1.5f  TP.InitiationGate = 5.0f  WaveformInfo.FrameTime = 0.0626f  WaveformInfo.FMSweepTime = 0.040960f  VehData.SensorLocation = SENSOR\_POS\_REAR\_LEFT  Initialize CW detection history  Velocity   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | -0.3996045485302 | -0.3781349611914 | -18.435168432372 | -0.3963919661801 | | 1 | -1.4136051747472 | -1.1439639836320 | -0.4024970479667 | 0 | | 2 | 0 | 0 | -1.0934800826241 | 0 | | 3 | 0 | 0 | 0 | 0 |   IsPaired   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 1 | 1 | 0 | 1 | | 1 | 1 | 1 | 1 | 0 | | 2 | 0 | 0 | 1 | 0 | | 3 | 0 | 0 | 0 | 0 |   PairedIndex   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 3 | 0 | 255 | 4 | | 1 | 5 | 2 | 2 | 255 | | 2 | 255 | 255 | 3 | 255 | | 3 | 255 | 255 | 255 | 255 |   Ndet   |  |  |  |  | | --- | --- | --- | --- | | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 2 | 2 | 3 | 1 |   Initialize FM detection history  Velocity   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist[0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | -0.20745971552169 | -0.5119476097832 | -0.139553768714 | -0.2180119912826 | | 1 | -1.10970653676527 | 0.17439879613093 | -2.456684107172 | -1.1009050345867 | | 2 | 1.00596402385111 | -1.5303048065858 | -0.472842274350 | -0.3515452195244 | | 3 | 0.204281876370945 | 0 | -2.127442445268 | -1.4517985090652 | | 4 | -0.15072234565123 | 0 | 0 | -0.9401337681543 | | 5 | -1.64882207152067 | 0 | 0 | 0 |   Bearing   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 274.444041218103 | 177.872133549095 | 272.735390978758 | 274.593074680337 | | 1 | 276.311796016117 | 183.188523441708 | 187.963681333013 | 178.632044529126 | | 2 | 185.725698838490 | 179.416182285605 | 178.354371873475 | 184.602120848809 | | 3 | 178.643636962837 | 0 | 182.314792035792 | 179.18820987149 | | 4 | 182.254931983787 | 0 | 0 | 179.495469181104 | | 5 | 180.651147917955 | 0 | 0 | 0 |   Centroid   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 4.18993765992322 | 35.9418669576704 | 2.88856721771699 | 2.80263631939136 | | 1 | 5.55314129519493 | 37.5942063118600 | 39.7569953269927 | 35.8499728251565 | | 2 | 36.9346725211567 | 86.0233805404491 | 35.7655501517420 | 37.6928648380040 | | 3 | 35.7392605197494 | 0 | 87.2109878831034 | 87.9371909255216 | | 4 | 37.6576233852406 | 0 | 0 | 85.4717424506535 | | 5 | 87.0943406057691 | 0 | 0 | 0 |   IsPaired   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 0 | 1 | 0 | 0 | | 1 | 0 | 0 | 0 | 0 | | 2 | 0 | 1 | 1 | 0 | | 3 | 1 | 0 | 1 | 0 | | 4 | 0 | 0 | 0 | 1 | | 5 | 1 | 0 | 0 | 0 |   PairedIndex   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 255 | 0 | 255 | 255 | | 1 | 255 | 255 | 255 | 255 | | 2 | 255 | 1 | 1 | 255 | | 3 | 0 | 255 | 2 | 255 | | 4 | 255 | 255 | 255 | 0 | | 5 | 1 | 255 | 255 | 255 |   IsAssigned   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 1 | 1 | 1 | 1 | | 1 | 0 | 0 | 1 | 1 | | 2 | 0 | 0 | 1 | 1 | | 3 | 1 | 0 | 0 | 0 | | 4 | 0 | 0 | 0 | 0 | | 5 | 0 | 0 | 0 | 0 |   AssignedTrack   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 2 | 0 | 2 | 2 | | 1 | 255 | 255 | 1 | 0 | | 2 | 255 | 255 | 0 | 1 | | 3 | 0 | 255 | 255 | 255 | | 4 | 255 | 255 | 255 | 255 | | 5 | 255 | 255 | 255 | 255 |   Ndet   |  |  |  |  | | --- | --- | --- | --- | | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 6 | 3 | 4 | 5 | |
| Expected Output(s) | Return value NB\_OK  Expected ClusterArray[0]  TrackCandidCw[3] = [1,31,62]  TrackCandidFm[3] = [5,32,63]  IsZeroV = false  Expected ClusterArray[1]  TrackCandidCw[4] = [255,255,255,255]  TrackCandidFm[3] = [5,32,94]  IsZeroV = false |

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| --- | --- |
| Test Case ID | Tracker\_RetroDetect\_InvalidClusterCandidates |
| Purpose | Demonstrate successful operation of Tracker\_RetroDetect() function with invalid cluster candidates. |
| Requirement |  |
| Setup | NA |
| Test Preconditions | NA |
| Description | Provide valid input parameters to Tracker\_RetroDetect() function and verify that cluster array is set to invalid index. |
| Input(s) | TP.SigmR = 6.4343f  TP.SigmRdot = 1.0f  TP.SigmTh = 3.0f  TP.SigmCent = 1.0f  TP.C1 = 1.036716937742782f  TP.C2 = -6.59515815062187f  TP.ZeroVInitiationGate = 1.5f  TP.InitiationGate = 5.0f  WaveformInfo.FrameTime = 0.0626f  WaveformInfo.FMSweepTime = 0.040960f  VehData.SensorLocation = SENSOR\_POS\_REAR\_LEFT  Initialize CW detection history  Velocity   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | -0.35881891013 | -18.6079910809494 | -2.202173427560 | 0.228691110411 | | 1 | 0 | 0.991575980065110 | 1.8333306332917 | -0.33331320285 | | 2 | 0 | -0.35248715857191 | 0.6445620411495 | 0 | | 3 | 0 | 0 | -0.337160787192 | 0 |   IsPaired   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 1 | 0 | 1 | 1 | | 1 | 0 | 1 | 0 | 1 | | 2 | 0 | 1 | 0 | 0 | | 3 | 0 | 0 | 1 | 0 |   PairedIndex   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 1 | 255 | 0 | 0 | | 1 | 255 | 0 | 255 | 1 | | 2 | 255 | 1 | 255 | 255 | | 3 | 255 | 255 | 1 | 255 |   Ndet   |  |  |  |  | | --- | --- | --- | --- | | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 1 | 3 | 4 | 2 |   Initialize FM detection history  Velocity   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist[0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | -16.923783216822 | -0.148576481759 | -0.2425639632731 | -0.15642642095438 | | 1 | -0.9147923548244 | -0.423006844225 | -0.1583124953074 | -0.54511918990797 | | 2 | 1.19752692350578 | 0 | -1.3221594549386 | 0 |   Bearing   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 235.623709355264 | 274.224261152670 | 273.49468287601 | 274.776520616534 | | 1 | 181.537784865332 | 181.381499838433 | 182.24401582893 | 182.244042532287 | | 2 | 183.698371844599 | 0 | 179.17141249482 | 0 |   Centroid   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 88.0016277877593 | 2.82863930342175 | 3.09608133705159 | 4.95605821474587 | | 1 | 36.3870644935018 | 36.3050232153994 | 36.1962635396967 | 36.1292079031731 | | 2 | 38.9592160802455 | 0 | 87.0172041893814 | 0 |   IsPaired   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 0 | 1 | 1 | 1 | | 1 | 1 | 1 | 1 | 1 | | 2 | 0 | 0 | 0 | 0 |   PairedIndex   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 255 | 1 | 0 | 0 | | 1 | 0 | 2 | 3 | 1 | | 2 | 255 | 255 | 255 | 255 |   IsAssigned   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 0 | 0 | 0 | 0 | | 1 | 1 | 1 | 1 | 1 | | 2 | 0 | 0 | 0 | 0 |   AssignedTrack   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 255 | 255 | 255 | 255 | | 1 | 0 | 0 | 0 | 0 | | 2 | 255 | 255 | 255 | 255 |   Ndet   |  |  |  |  | | --- | --- | --- | --- | | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 3 | 2 | 3 | 2 | |
| Expected Output(s) | Return value NB\_OK  Expected ClusterArray[0]  TrackCandidCw = TRACKER\_INVALIDIDXVAL  TrackCandidFm = TRACKER\_INVALIDIDXVAL  IsZeroV = false |

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| --- | --- |
| Test Case ID | Tracker\_RetroDetect\_ZeroVelocity |
| Purpose | Demonstrate successful operation of Tracker\_RetroDetect() function with IsZeroV bit set. |
| Requirement |  |
| Setup | NA |
| Test Preconditions | NA |
| Description | Provide valid input parameters to Tracker\_RetroDetect() function and verify that IsZeroV bit is set and verify expected output matches with actual output. |
| Input(s) | TP.SigmR = 6.4343f  TP.SigmRdot = 1.0f  TP.SigmTh = 3.0f  TP.SigmCent = 1.0f  TP.C1 = 1.036716937742782f  TP.C2 = -6.59515815062187f  TP.ZeroVInitiationGate = 1.5f  TP.InitiationGate = 5.0f  WaveformInfo.FrameTime = 0.0626f  WaveformInfo.FMSweepTime = 0.040960f  VehData.SensorLocation = SENSOR\_POS\_REAR\_LEFT  Initialize CW detection history  Velocity   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 1.6536307481559 | -0.4432402959660 | -0.4233644190974 | 0.20753717015506 | | 1 | 0.6785092382242 | 0 | 0 | -0.41280734501656 | | 2 | -0.428762171187 | 0 | 0 | 0 |   IsPaired   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 1 | 1 | 1 | 0 | | 1 | 0 | 0 | 0 | 1 | | 2 | 1 | 0 | 0 | 0 |   PairedIndex   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 0 | 0 | 1 | 2 | 255 | | 1 | 255 | 255 | 255 | 1 | | 2 | 1 | 255 | 255 | 255 |   Ndet   |  |  |  |  | | --- | --- | --- | --- | | CWDetHist[0] | CWDetHist[1] | CWDetHist[2] | CWDetHist[3] | | 3 | 1 | 1 | 2 |   Initialize FM detection history  Velocity   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist[0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | -0.0532833459459 | -0.140505802221 | -0.6125440283042 | -17.8850556522169 | | 1 | -0.5121476258200 | -0.491481189973 | -1.4760524291769 | -0.23966729672765 | | 2 | 0 | -2.940773489838 | -0.4876507802242 | -1.05610887800940 | | 3 | 0 | 0 | -0.3568394582354 | -2.80040962945605 |   Bearing   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 274.289184827114 | 273.031920504908 | 273.80199793240 | 245.380719055982 | | 1 | 181.625073392983 | 181.916126395892 | 275.74440957512 | 182.061159413418 | | 2 | 0 | 180.506278213561 | 182.19675915625 | 184.230356164324 | | 3 | 0 | 0 | 179.02538931133 | 177.763847253804 |   Centroid   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 2.95741537635444 | 2.80718063785407 | 4.01938718961828 | 76.1152399938160 | | 1 | 36.8792207557982 | 36.9491694422237 | 8.09656747041494 | 36.5887381410767 | | 2 | 0 | 87.0266715244126 | 36.9089019120167 | 38.9314065756834 | | 3 | 0 | 0 | 86.9858842560017 | 87.0642841820610 |   IsPaired   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 1 | 0 | 0 | 0 | | 1 | 1 | 1 | 0 | 1 | | 2 | 0 | 0 | 1 | 0 | | 3 | 0 | 0 | 0 | 0 |   PairedIndex   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 0 | 255 | 255 | 255 | | 1 | 2 | 0 | 255 | 1 | | 2 | 255 | 255 | 0 | 255 | | 3 | 255 | 255 | 255 | 255 |   IsAssigned   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 0 | 0 | 0 | 0 | | 1 | 1 | 1 | 0 | 1 | | 2 | 0 | 0 | 1 | 1 | | 3 | 0 | 0 | 0 | 0 |   AssignedTrack   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Idx | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 0 | 255 | 255 | 255 | 255 | | 1 | 0 | 0 | 255 | 0 | | 2 | 255 | 255 | 0 | 1 | | 3 | 255 | 255 | 255 | 255 |   Ndet   |  |  |  |  | | --- | --- | --- | --- | | FMDetHist [0] | FMDetHist [1] | FMDetHist [2] | FMDetHist [3] | | 2 | 3 | 4 | 4 | |
| Expected Output(s) | Return value NB\_OK  Expected ClusterArray[0]  TrackCandidCw[4] = [255 255 255 255]  TrackCandidFm[3] = [0 30 60]  IsZeroV = true |