# R/V Neil Armstrong

## *EM122 & EM710 Calibration (AR42)*

*Multibeam Advisory Committee*
*February 26-27, 2020*


*Report by:*
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# Executive Summary

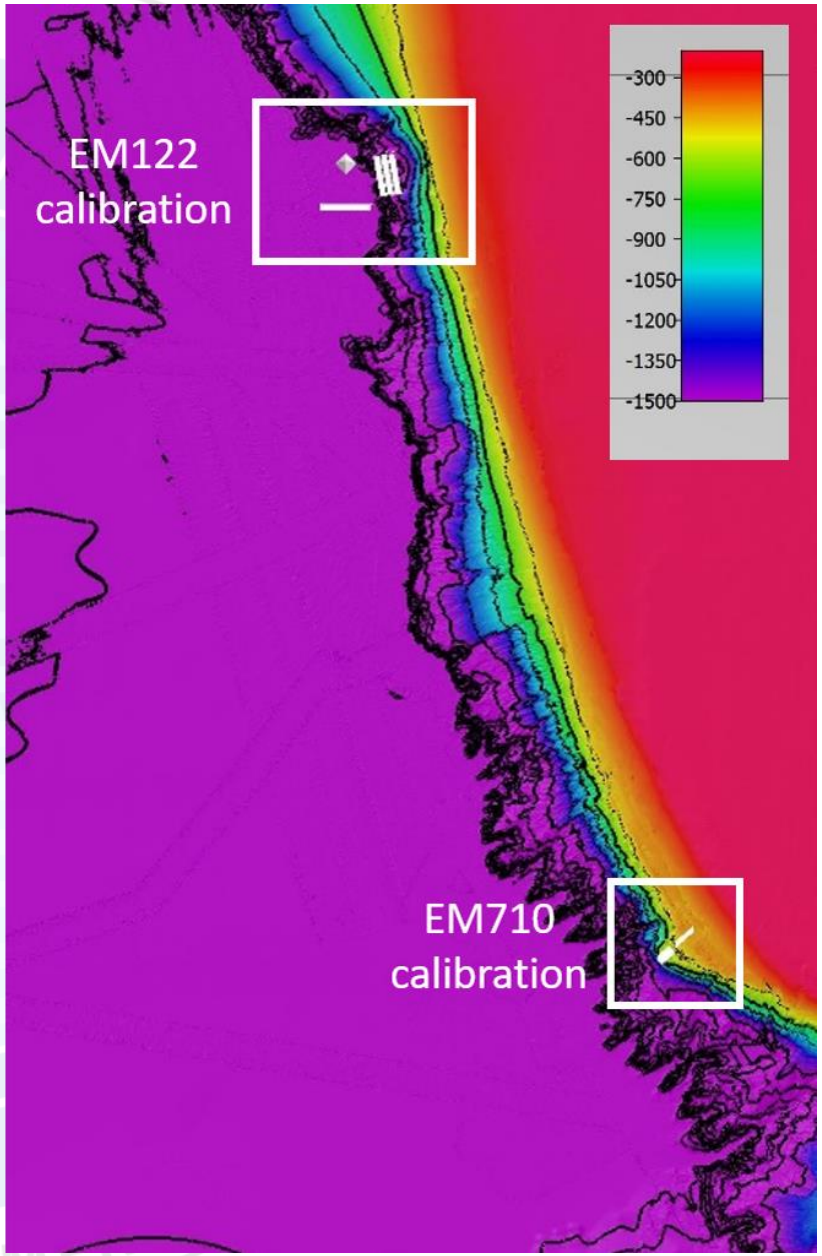
1. Calibrations ('patch tests') were planned for the EM122 and EM710 multibeam echosounders on R/V *Neil Armstrong* during AR42-02 following the winter 2019-20 maintenance period. Calibration sites were developed opportunistically along a transit route in the vicinity of the western Florida escarpment.
2. The EM710 was most recently calibrated during AR41 in November 2019; due to elevated sea state, the scope of AR41 was narrowed and the EM122 calibration planned for that cruise was removed from the schedule.
3. The AR42 calibration results were small for both systems, indicating stable system performance and no significant changes since the Sea Acceptance Testing (AR0103) for both systems in early 2016 and EM710 calibration in 2019.
4. The results presented in this report should be applied at the start of the 2020 field season and used until any sensors (arrays, GNSS antennas, or IMU) are modified or the need for additional calibration becomes apparent.
5. For additional background information, please refer to the 2016 Sea Acceptance Trials and the 2019 Quality Assurance Testing reports available on the MAC website (http://mac.unols.org/category/ships/neil-armstrong).

# Introduction

R/V *Neil Armstrong* completed opportunistic calibrations ('patch tests') of the vessel's EM122 and EM710 multibeam echosounders during a transit along the Florida escarpment on Feb 26-27, 2020

Multibeam data and sound speed profiles were collected by on-board personnel; the MAC provided calibration planning support prior to AR42-02 and data analysis after calibration files were uploaded at WHOI

This report presents the calibration results and final offsets to be applied in SIS for each system at the start of the 2020 field season



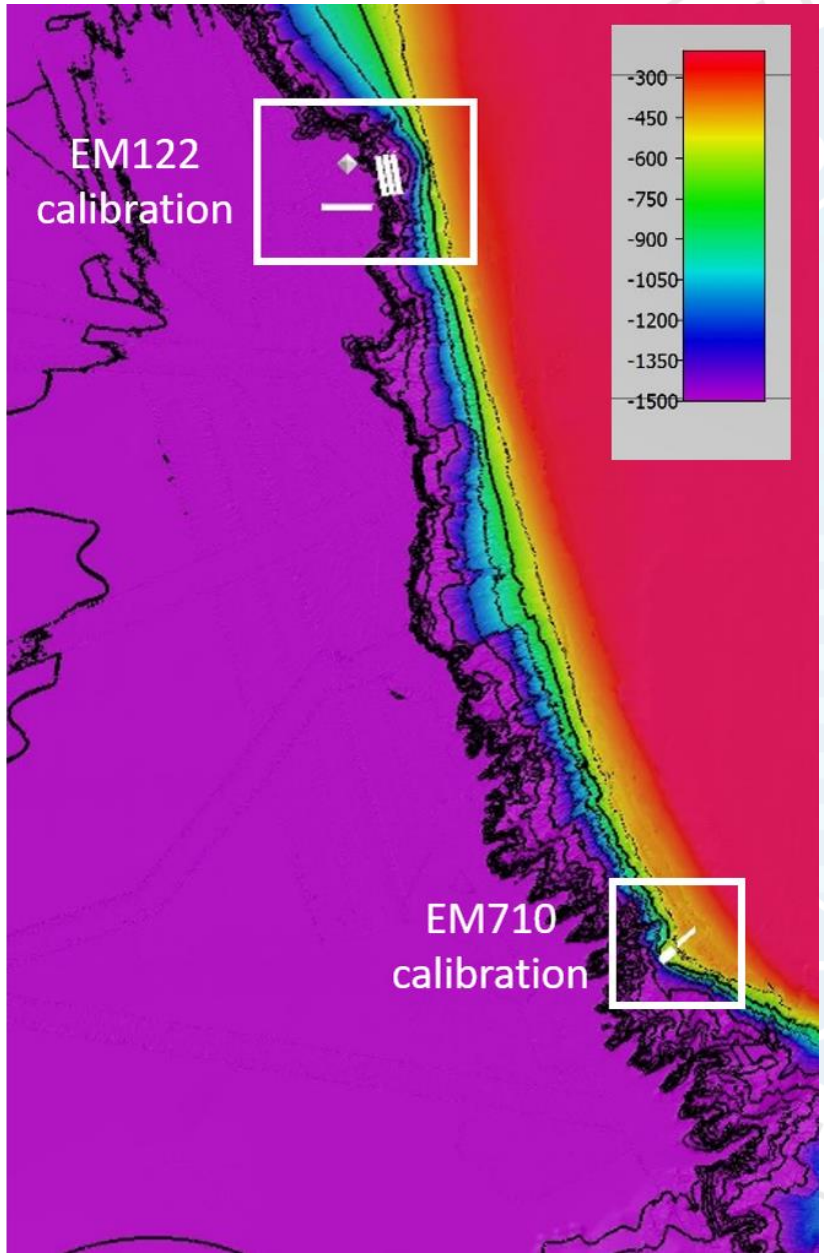
# System Geometry Review **History**

The term ‘system geometry’ means the linear and angular offsets of the primary components of the multibeam mapping systems, including the transmit arrays (TX), receive arrays (RX), GNSS antennas, and motion sensors (MRU/IMU). The following table provides an overview of major events in the history of system geometry.

No changes were made to system geometry after the AR41 POS MV and EM710 calibrations. Changes made after the AR42-02 EM122 and EM710 calibrations are limited to small adjustments of the Motion 1 installation angles in SIS.

| Date | Location | Event | References |
|---|---|---|---|
| **2015-12 to 2016-02** | Charleston, SC | IMTEC survey to establish vessel reference frame and offsets of EM122/EM710 arrays, POS MV motion sensor, GNSS and DGNSS antennas; survey conducted in IMTEC convention and reported in Kongsberg convention with origin at granite block | IMTEC survey report (final, Feb. 9, 2016) provided by R/V *Armstrong* |
| **2016-02** | Charleston, SC | Sea acceptance trials; geometric calibration of EM122 and EM710; testing for swath accuracy, platform noise, baseline transducer impedance, and swath coverage | R/V Neil Armstrong Multibeam Echosounder SAT report provided by MAC (20160217_Armstrong_EM122_EM710_SAT_AR0103_V1pt0_Optimized.pdf available at mac.unols.org) |
| **2019-11** | Woods Hole, MA | POS MV GAMS calibration; geometric calibration (‘patch test’) of EM710; testing for swath coverage and transducer impedance | R/V Neil Armstrong Multibeam Echosounder QAT report provided by MAC (AR41_Armstrong_EM710_calibration_20191219-opt.pdf available at mac.unols.org) |
| **2020-02** | Gulf of Mexico, Florida escarpment | Geometric calibration (‘patch test’) of EM122 and EM710 | This document |

# Calibration

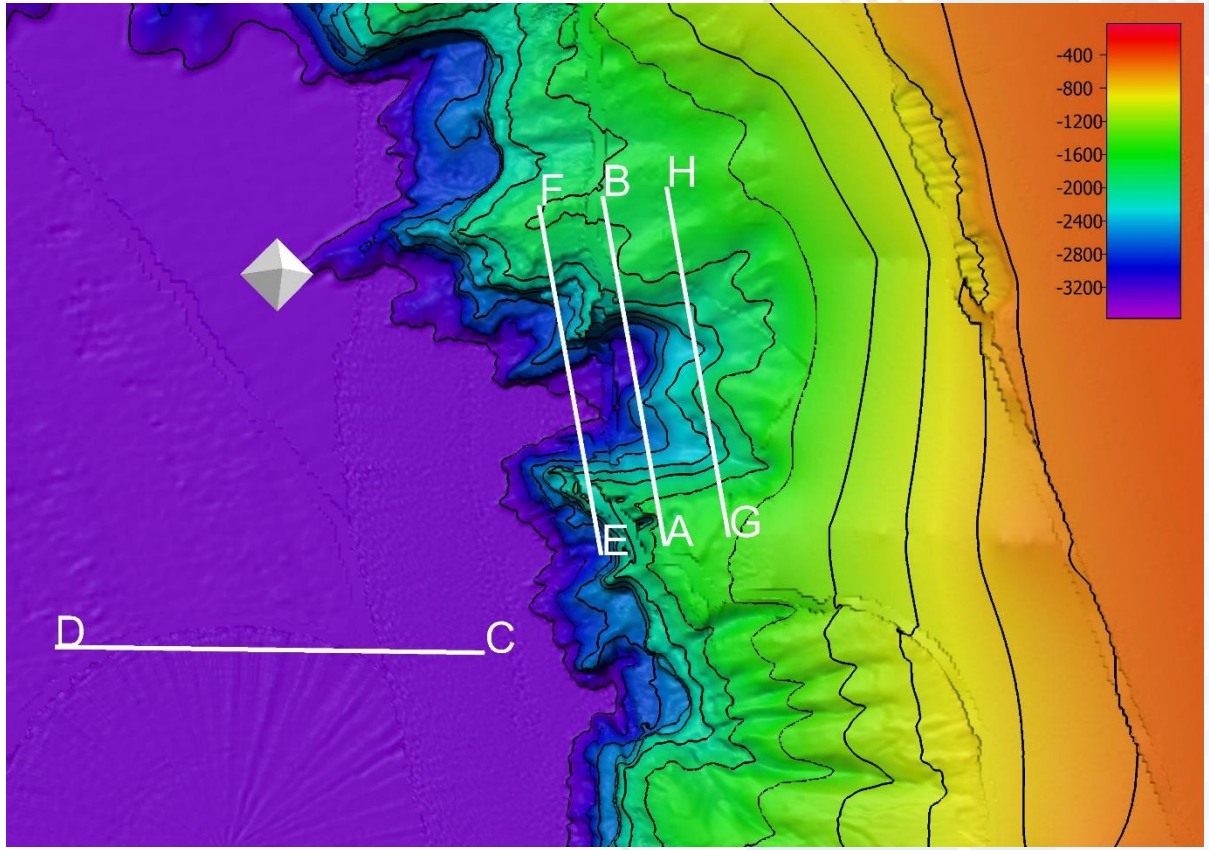



## Site Selection and Data Collection

1. The EM122 and EM710 calibration sites were selected based on availability of seafloor features with suitable slopes and bathymetric relief within reasonable distances from the transit route and a planned science deployment (white diamond)
2. The intended operational depth ranges of both systems presented challenges in locating sites along the escarpment with acceptable slopes and orientations of slope faces; the MAC developed calibration line plans for multiple sites along the transit route in Jan-Feb, and the final site selections are based on compromises of many factors
3. Lines were run in the order of pitch, roll, heading at speeds of 6 kts to increase alongtrack sounding density; no installation parameter changes were made between tests
4. Multiple XBT profiles were collected at each site throughout the calibration procedures and were quality checked and re-applied during post-processing on a ‘nearest in time’ basis

# Calibration

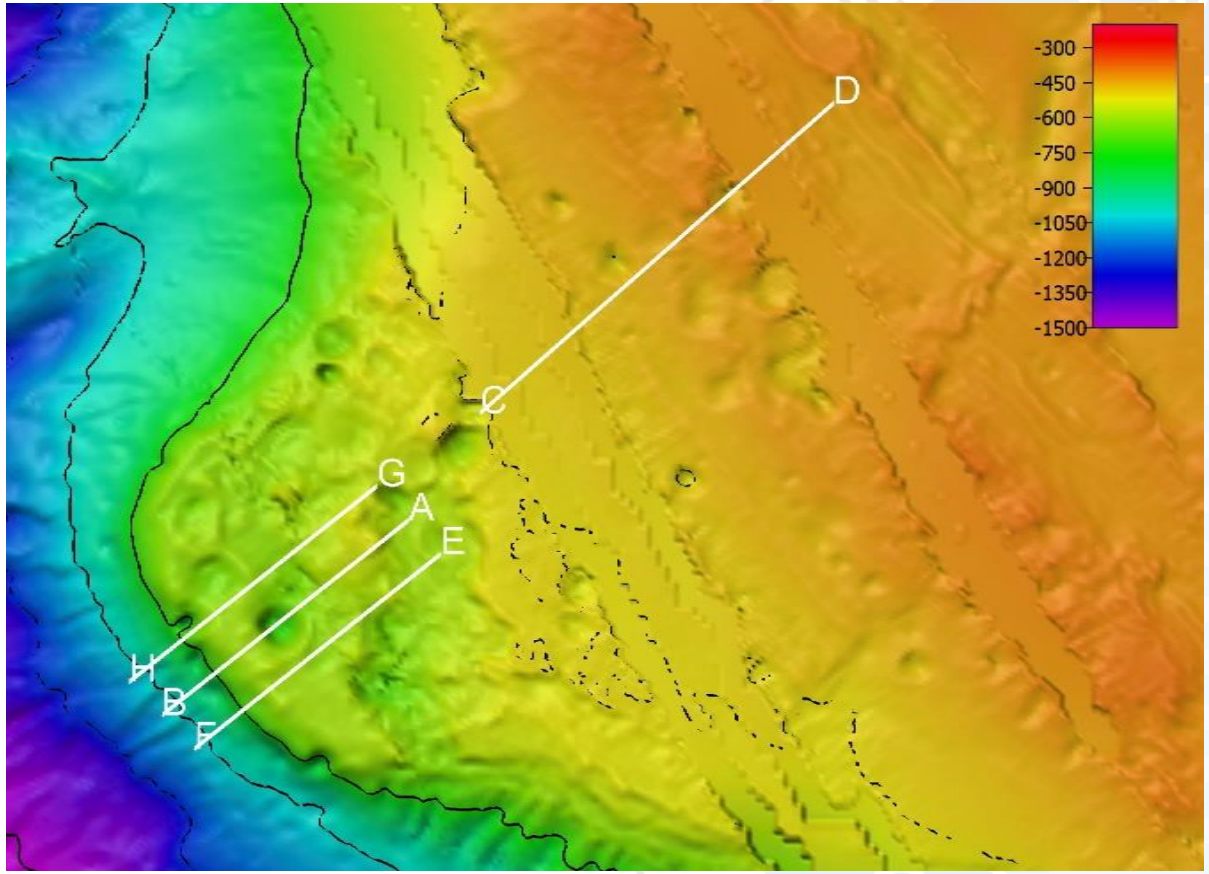
# EM122 Calibration Site




| | Waypoint | Decimal Degrees | | Degrees Decimal Minutes | | | |
|---|---|---|---|---|---|---|---|
| | | Lat. | Lon. | Lat. Deg. | Lat. Min. | Lon. Deg. | Lon. Min. |
| Pitch | A | 26.693989 | -84.961273 | 26 | 41.6393 | -84 | 57.6764 |
| | B | 26.792011 | -84.978733 | 26 | 47.5207 | -84 | 58.724 |
| Roll | C | 26.664169 | -85.011739 | 26 | 39.8502 | -85 | 0.7043 |
| | D | 26.665805 | -85.132264 | 26 | 39.9483 | -85 | 7.9358 |
| Heading 1 | E | 26.691423 | -84.979130 | 26 | 41.4854 | -84 | 58.7478 |
| | F | 26.789444 | -84.996606 | 26 | 47.3666 | -84 | 59.7963 |
| Heading 2 | G | 26.696552 | -84.943415 | 26 | 41.7931 | -84 | 56.6049 |
| | H | 26.794576 | -84.960860 | 26 | 47.6745 | -84 | 57.6516 |

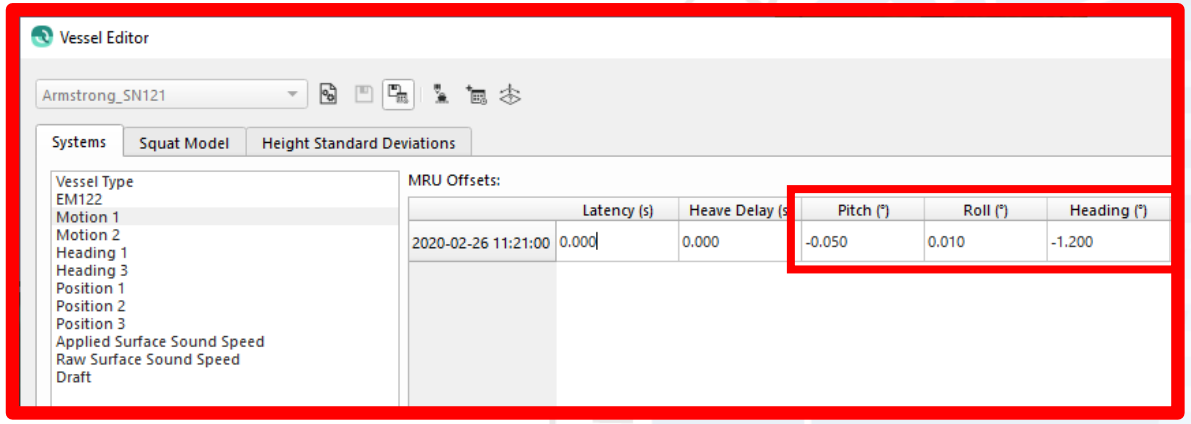
# Calibration

# EM710 Calibration Site

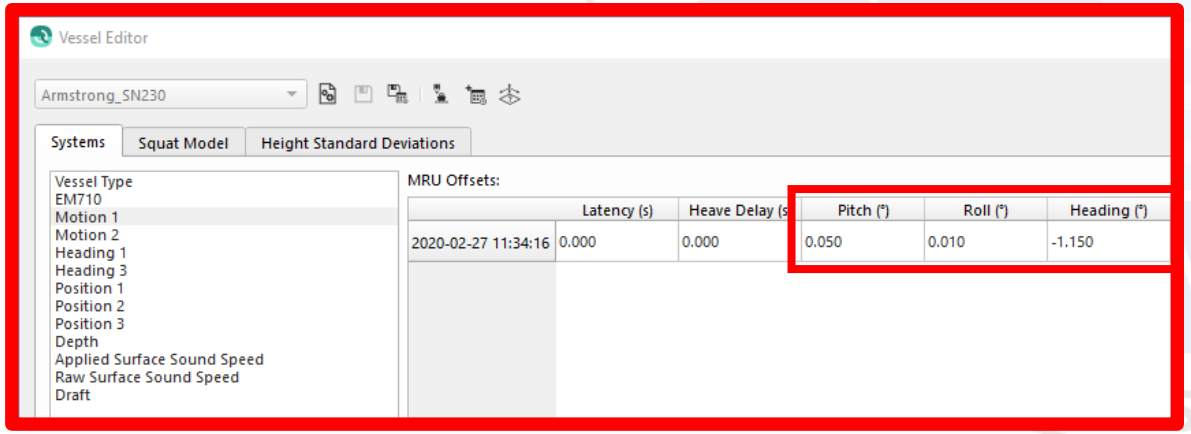



| | Waypoint | Decimal Degrees | | Degrees Decimal Minutes | | | |
|---|---|---|---|---|---|---|---|
| | | Lat. | Lon. | Lat. Deg. | Lat. Min. | Lon. Deg. | Lon. Min. |
| Pitch | A | 24.873306 | -84.285040 | 24 | 52.40 | -84 | 17.10 |
| | B | 24.849692 | -84.314957 | 24 | 50.98 | -84 | 18.90 |
| Roll | C | 24.886249 | -84.276402 | 24 | 53.17 | -84 | 16.58 |
| | D | 24.923748 | -84.233592 | 24 | 55.42 | -84 | 14.02 |
| Heading 1 | E | 24.869211 | -84.281158 | 24 | 52.15 | -84 | 16.87 |
| | F | 24.845598 | -84.311075 | 24 | 50.74 | -84 | 18.66 |
| Heading 2 | G | 24.877401 | -84.288922 | 24 | 52.64 | -84 | 17.34 |
| | H | 24.853786 | -84.318840 | 24 | 51.23 | -84 | 19.13 |

# EM122 PRE-CALIBRATION




# EM710 PRE-CALIBRATION

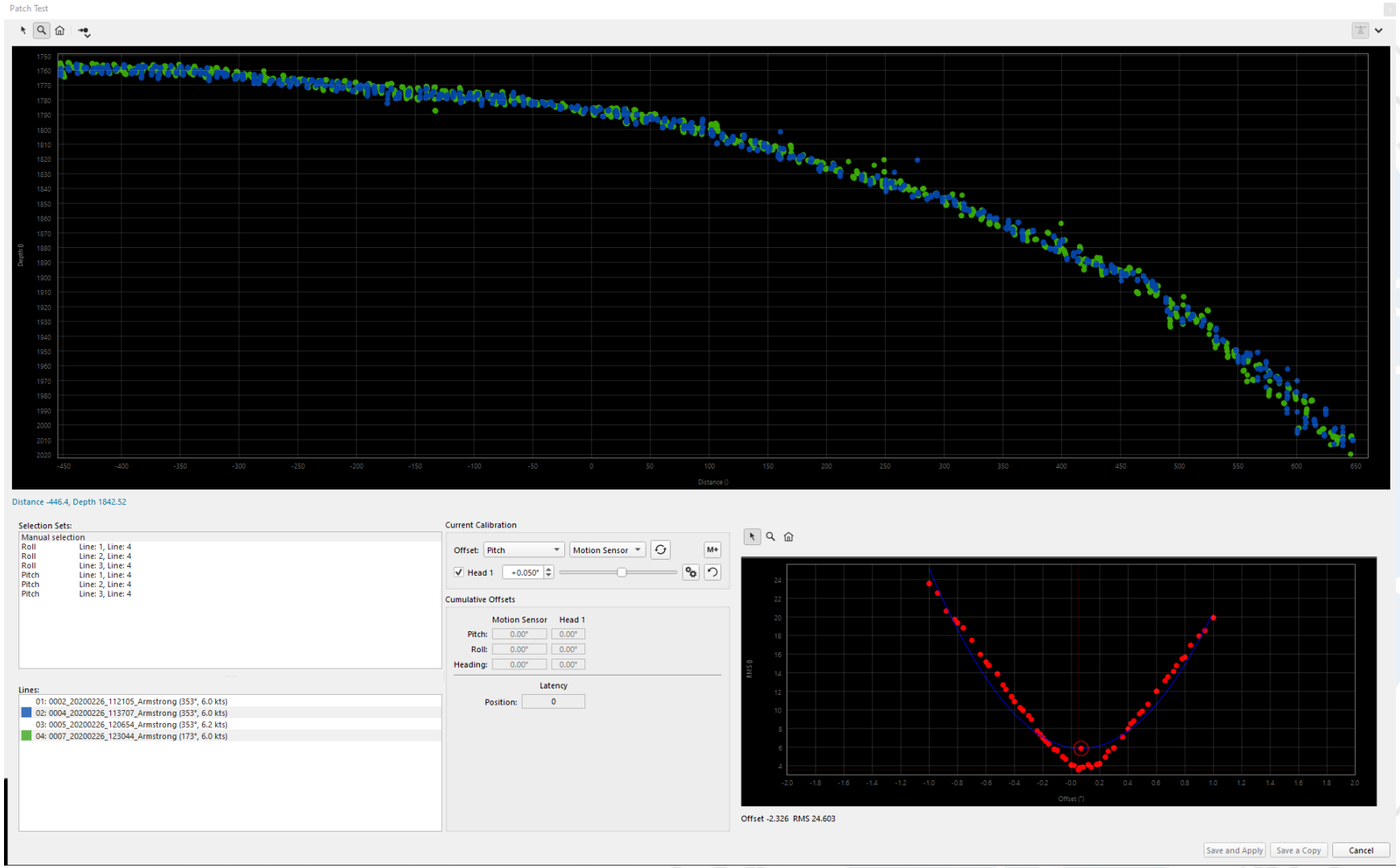



# Pre-Calibration Configurations

1. All *Attitude 1* angular offsets were left unchanged prior to data collection; pre-calibration vessel configurations in Qimera reflect the Motion 1 angles in SIS for the EM122 (top) and EM710 (bottom)
2. Calibration data were examined using the QPS Qimera patch test tool; multiple subsets of (cleaned) data were assessed visually to determine calibration adjustments, and the Qimera 'autosolver' function was used with very large subsets to confirm the mean of these results
3. The calibration results were determined after data collection and were not updated during calibration
4. The final adjustments are fairly clear and relatively small, suggesting stable motion sensor performance and no significant changes to vessel geometry since the last calibrations during AR0103 and AR41
5. No latency test was performed, as there were no latency-related artifacts and this test is inconclusive in deep water

# EM122 Calibration

## Results: Pitch (slope 1)

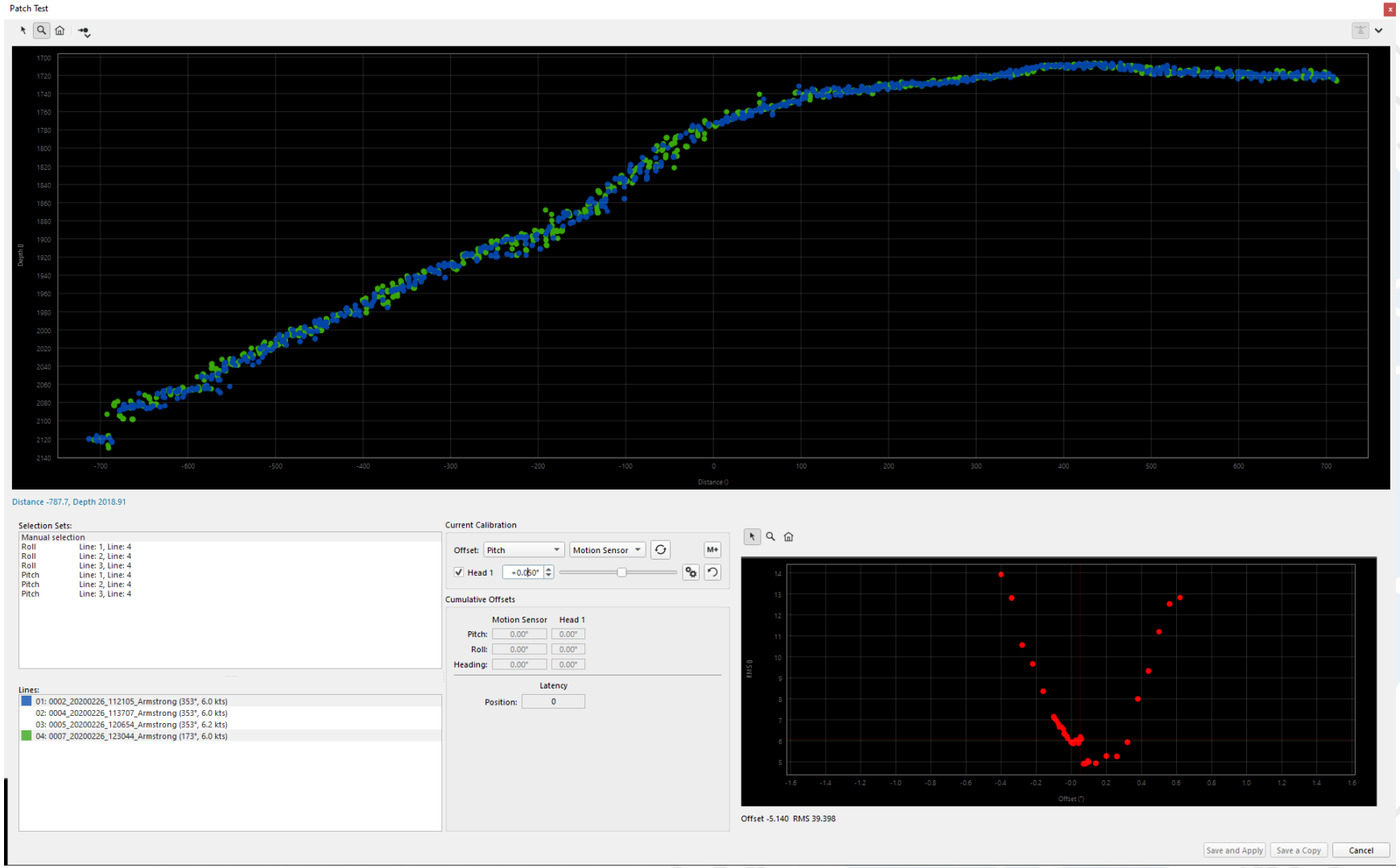



Calibration lines shown in the Qimera Patch Test Tool

1. Pre-AR42 offset: -0.05°
2. AR42 adjustment: +0.05°
3. **Post-AR42 offset: 0.00°**

# EM122 Calibration

## Results: Pitch (slope 2)

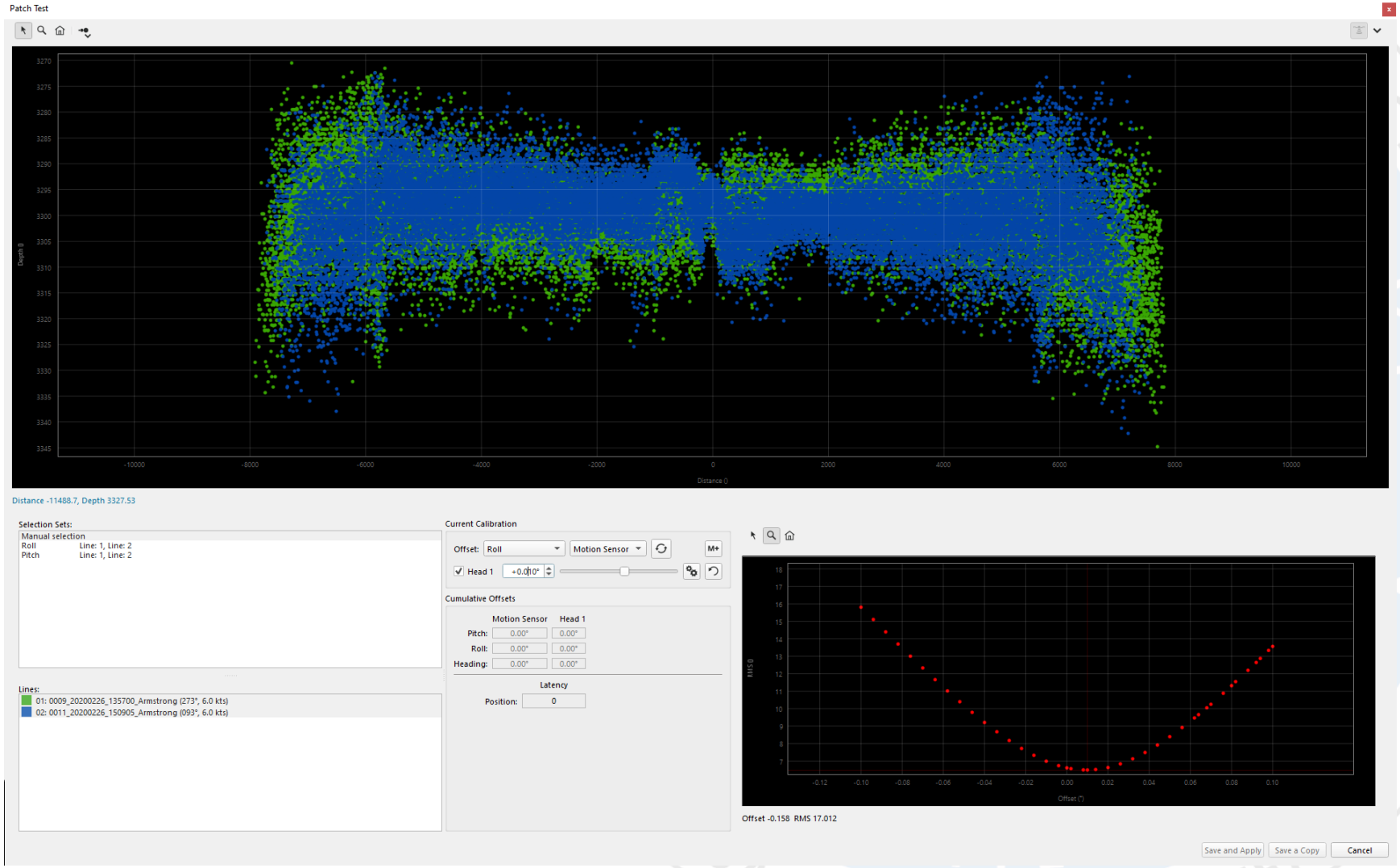



Calibration lines shown in the Qimera Patch Test Tool

1. Pre-AR42 offset: -0.05°
2. AR42 adjustment: +0.05°
3. **Post-AR42 offset: 0.00°**

# EM122 Calibration

## Results: Roll

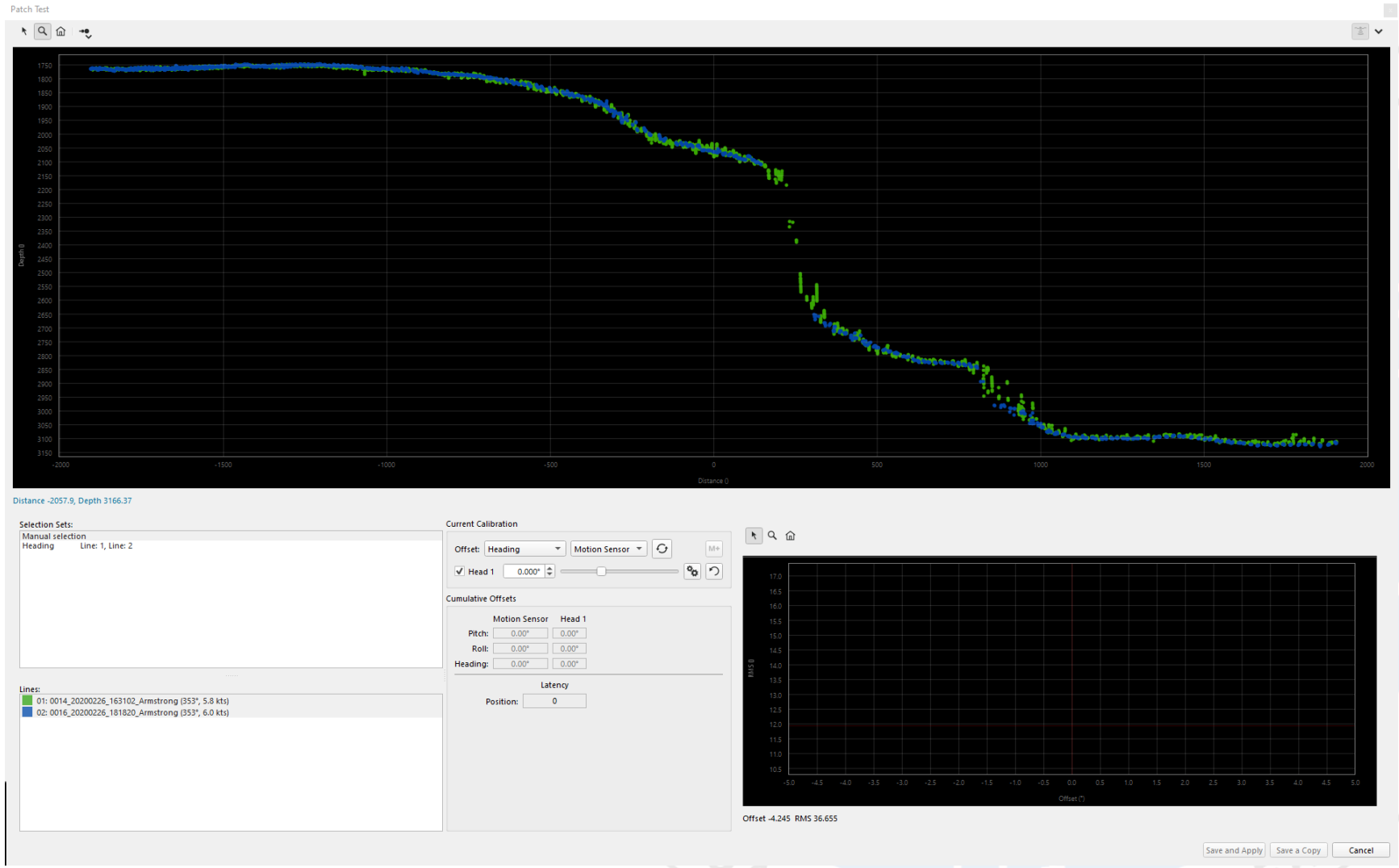



- Calibration lines shown in the Qimera Patch Test Tool

1. Pre-AR42 offset: +0.01°
2. AR42 adjustment: +0.01°
3. **Post-AR42 offset: +0.02°**

# EM122 Calibration

## Results: Heading (slope 1)

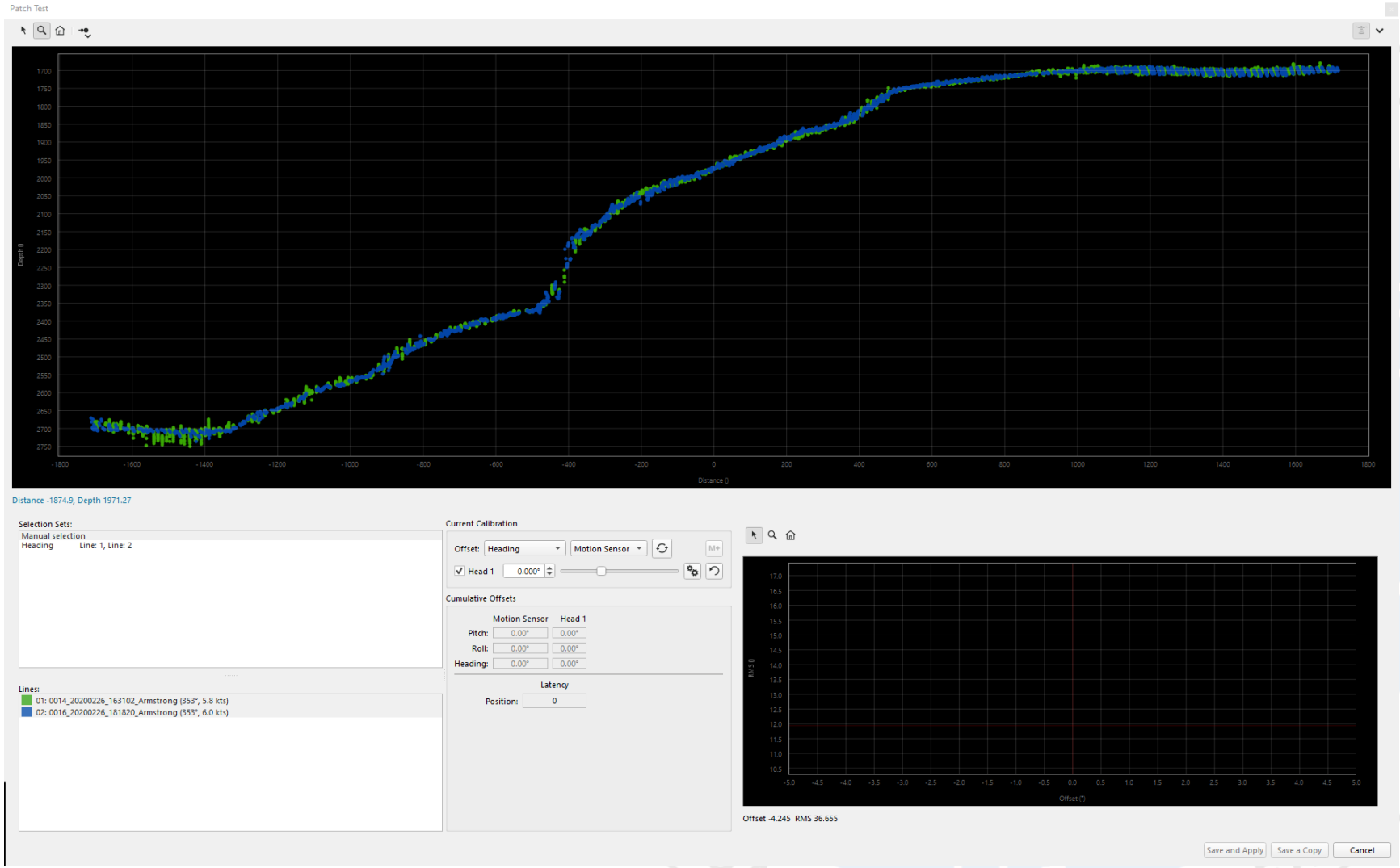



- Calibration lines shown in the Qimera Patch Test Tool

1. Pre-AR42 offset: -1.20°
2. AR42 adjustment: 0.00°
3. **Post-AR42 offset: -1.20°**

# EM122 Calibration

## Results: Heading (slope 2)

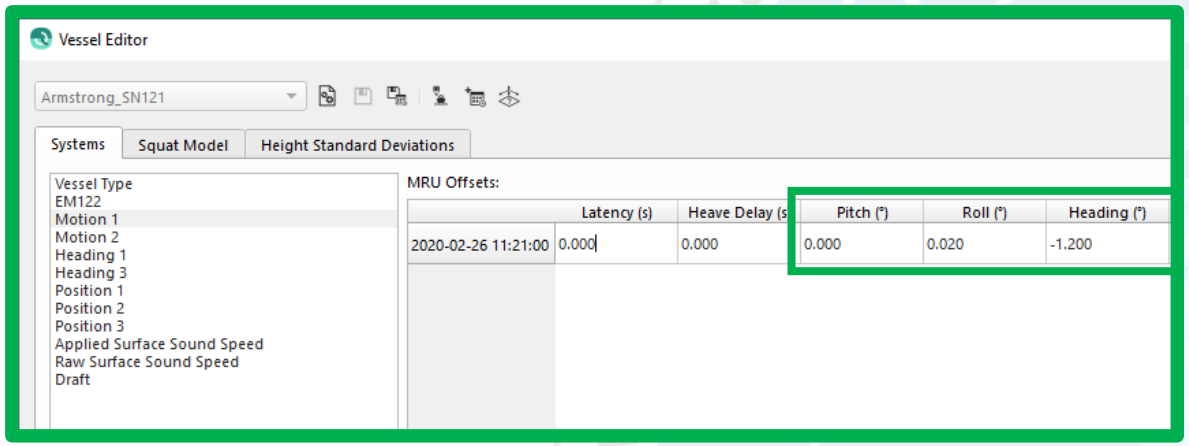



- Calibration lines shown in the Qimera Patch Test Tool

1. Pre-AR42 offset: -1.20°
2. AR42 adjustment: 0.00°
3. **Post-AR42 offset: -1.20°**

# EM122 Calibration

## EM122 POST-CALIBRATION

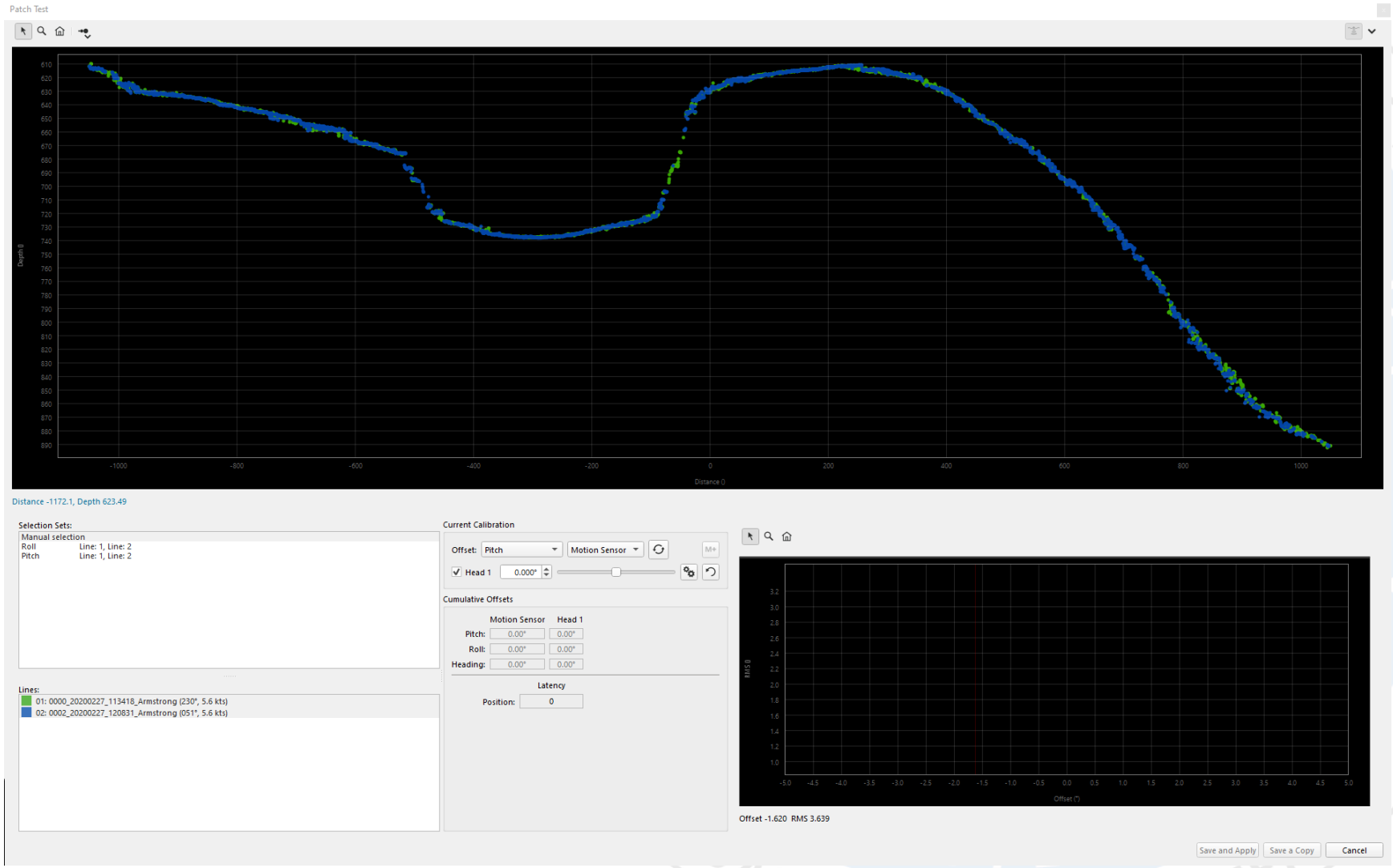



## Post-Calibration Configuration

1. Final results in Qimera are shown at left; these are to be applied in the SIS Motion 1 installation angles
2. The small calibration adjustments from AR42 data indicate a consistent integration across the POS MV and EM122
3. The results shown at left should be maintained until any modification is made to the motion sensors or arrays, or another calibration becomes necessary

# EM710 Calibration

## Results: Pitch

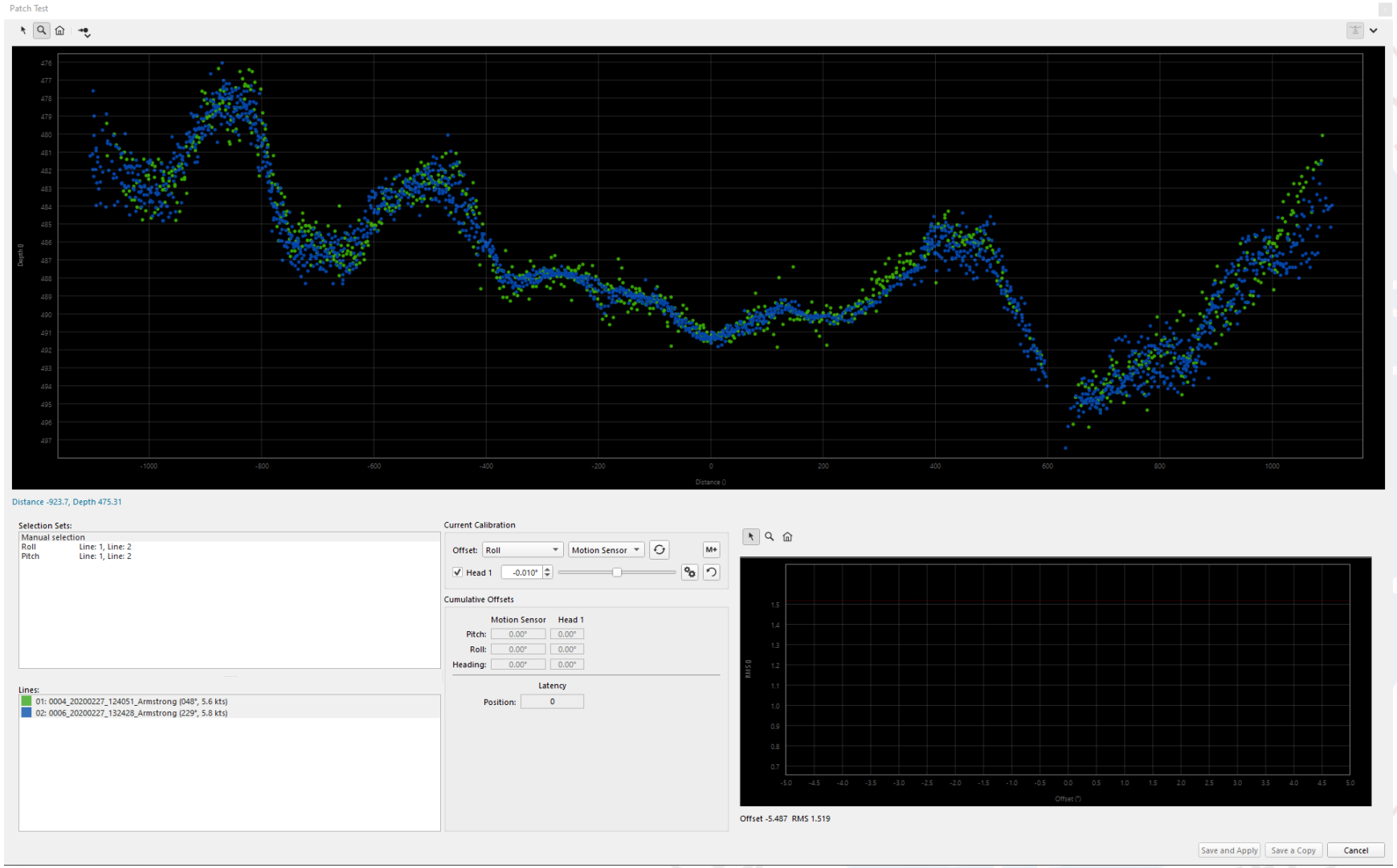



Calibration lines shown in the Qimera Patch Test Tool

1. Pre-AR42 offset: +0.05°
2. AR42 adjustment: 0.00°
3. **Post-AR42 offset: +0.05°**

# EM710 Calibration

## Results: Roll

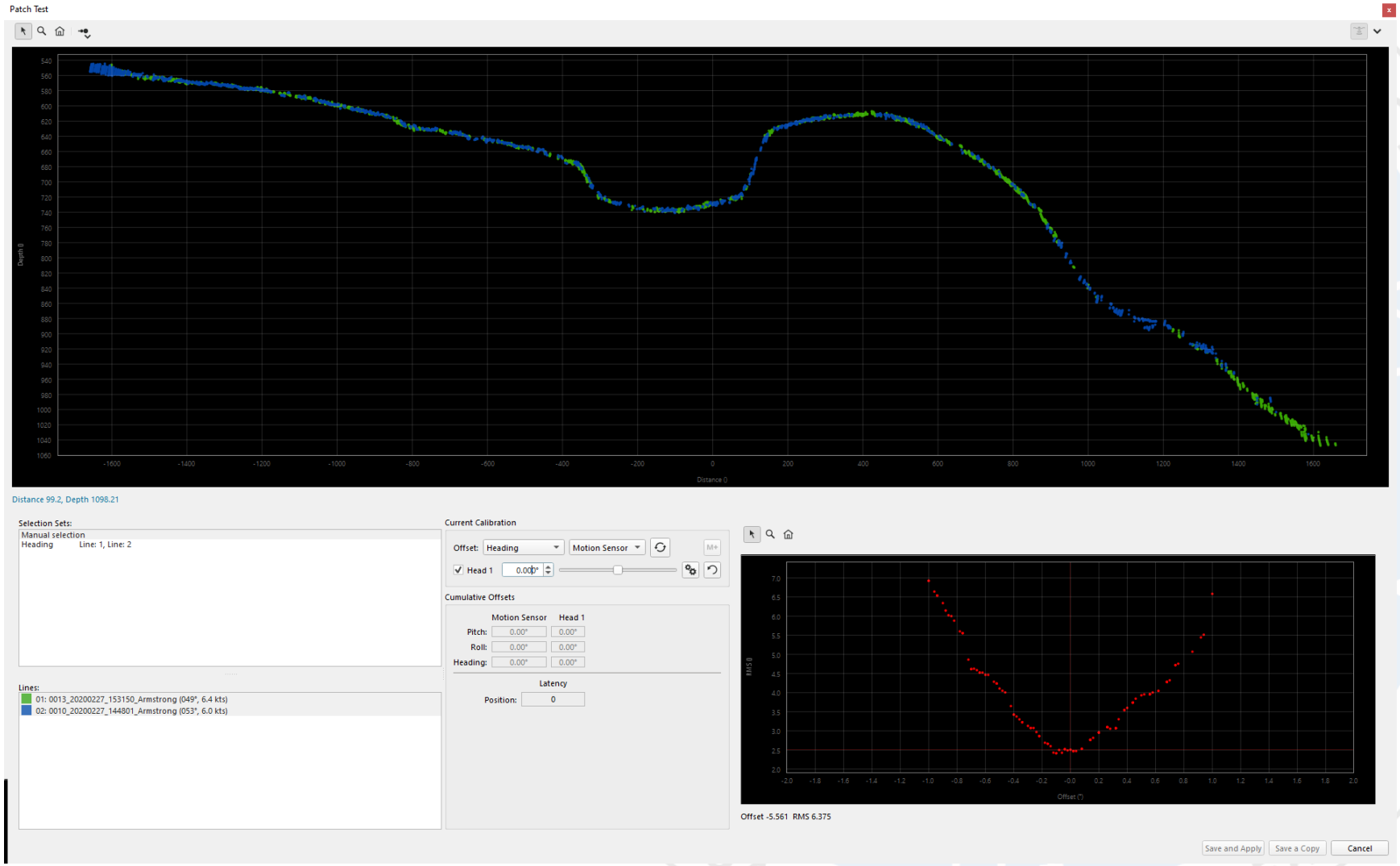



- Calibration lines shown in the Qimera Patch Test Tool

1. Pre-AR42 offset: +0.01°
2. AR42 adjustment: -0.01°
3. **Post-AR42 offset: 0.00°**

# EM710 Calibration

## Results: Heading

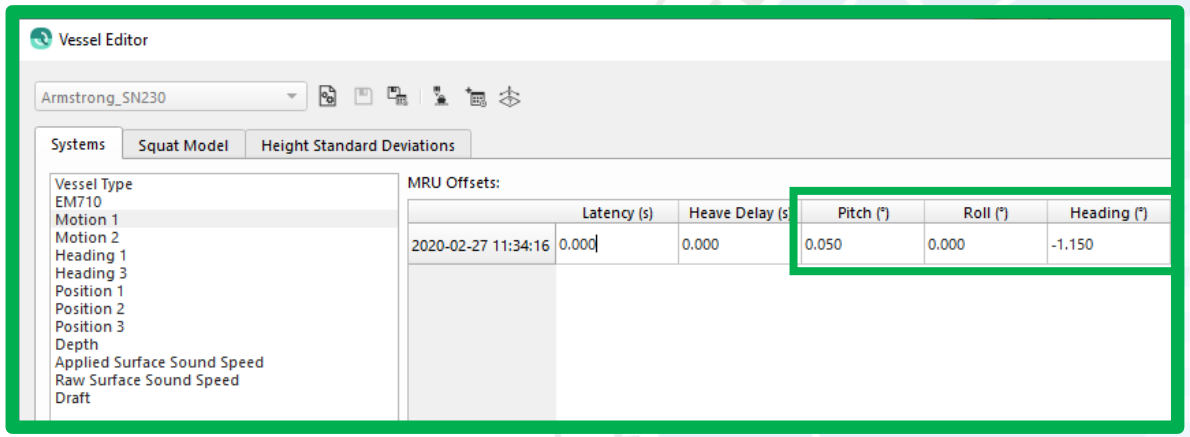



- Calibration lines shown in the Qimera Patch Test Tool

1. Pre-AR42 offset: -1.15°
2. AR42 adjustment: 0.00°
3. **Post-AR42 offset: -1.15°**

# EM710 Calibration

## EM710 POST-CALIBRATION




## Post-Calibration Configuration

1. Final results in Qimera are shown at left; these are to be applied in the SIS Motion 1 installation angles
2. The small calibration adjustments from AR42 data indicate a consistent integration across the POS MV and EM710
3. The results shown at left should be maintained until any modification is made to the motion sensors or arrays, or another calibration becomes necessary


*image credit: whoi.edu*