SeaSonde AutoAPM Kit™

CODAR Product Code: SSDA-APM

- Product Overview

The SeaSonde AutoAPM Kit automatically tests the quality of an existing antenna pattern (AP) as well as generates autonomous SeaSonde APs. AP quality metrics are calculated using Doppler echoes from passing vessels as a signal source and their AIS transponder data for a reference bearing. The automated output is useful in system calibration, routine system monitoring and maintenance for maximizing quality assurance of your SeaSonde data products. AP data is collected in real time on the site and updated pattern data produced when the quality of the existing pattern drops. This technology may reduce the need for additional transponder measurements, or be used to identify times when a new transponder measurement or hardware inspection is necessary.

FUNCTIONALITY

The AutoAPM Kit works to automatically:

Monitor Existing (Installed) Antenna Pattern Quality

The software assesses how well the existing installed pattern running at the site is working by several different methods:

• Testing for error in bearing assignment, by comparing the MUSIC-assigned bearing vs. AIS-matchup bearing of same target, generating a quantified estimate of the actual error. For this the software looks in the cross spectra to find peaks of possible vessel echoes. Once those peaks are tagged they are matched with the AIS tracks to assign them a bearing and matched through range and velocity at a given time;

• Calculating the correlation between the direction-finding (DF) MUSIC bearing solution and AIS bearing lookup of same target;

• Comparing radial distribution from one time frame to the next, and measuring the divergence of the distribution at each time step. A change in radial distribution can indicate a change in the real AP or another site issue that requires attention. The system creates a new comparison radial distribution automatically once per day using all radial vectors from the previous five days. This feature can be initiated manually or set for auto-repeat at a custom time interval.

Look for Antenna Rotation

The system also monitors for signs of the receive antenna rotation. The correlation between DF MUSIC bearing and AIS bearing lookup can remain good when an antenna rotation has taken place, so the software also looks for evidence of antenna rotation by looking for a vertical shift in the bearing error of the antenna pattern. The system calculates the average degree to which the bearing has been shifted. Antenna rotation also impacts validity of the pattern running at the site and bearing angle settings in software as well as indicator the antenna may need to be re-secured to its mount.

Generate New Antenna Patterns

When vessel DF bearings reach correlation threshold with AIS bearings, or when a change in correlation is detected, the system automatically generates a new AP. The user can also choose to process a new pattern at any time. The amount of time needed to create a new pattern is based on the level of local vessel traffic, which may vary by direction or time. The bearing coverage is also dependent upon path of passing AIS vessels. New pattern will only cover the bearing sectors in which AIS peaks are collected. The pattern may or may not cover enough bearing sectors to be used as a site's active installed pattern but can always be used as an ongoing quality comparison tool.

Calculate Optimal Pattern Smoothing

Before recommending a particular level of smoothing for a new pattern, the software tests new AIS pattern using different degrees of smoothing ($0 - 30^0$) to see which gives the best DF results.

Compare Installed Antenna Pattern with New AIS & Ideal Patterns

The software automatically compares installed pattern with both AIS-derived and ideal patterns to assess which would perform best.

Output New Pattern Recommendations

All findings are presented in an **Antenna Status Report** - updated daily - that also includes a summary recommendation whether or not an installed AP should be replaced with a new pattern. If the software can generate a new pattern covering enough bearing sectors to be used as a replacement pattern then the location of new pattern within system is noted along with the recommended degrees of smoothing to which should be optimally applied.

Above: 1-page excerpt from multi-page Antenna Status Report

Kit hardware and software can be easily added to new and existing SeaSonde radar units.

The native AIS messages are stored on board the SeaSonde computer and archives can be accessed on real-time data streamed in parallel for other uses. All calibration data is archived in time-stamped files for later analysis of changes in APs over time.

COMPATIBILITY & REQUIREMENTS

• The AutoAPM Kit software package (called AISPattern Suite™) is designed to run in parallel with all other SeaSonde software on the SeaSonde radar unit computer and does not affect traditional current or wave measurement processing.

• AISPattern Suite runs with SeaSonde Radial Suite. Check user guide for latest on computer, O/S and Radial Suite requirements for compatibility with AutoAPM Kit.

• Can be used at any SeaSonde operating frequency.

• Requires presence of passing vessels transmitting AIS messages and ability to utilize vessel's AIS echo is subject to local RF noise conditions.

SSDA-APM KIT INCLUDES

•AIS Receiver, VHF AIS Antenna & Antenna Cable
•AISPattern Suite Software single-use software license

AISPattern Suite Contents and Software Toolchain

AISRecorder → AISWebServer → AISTracker
PeakFilter → AISPatterner
Radial Distribution Tool →

Tools shown in blue work only with data obtained from the AIS receiver.
Tool in green uses the cross spectra.
Tool in gray uses radial vectors.
Tool in yellow monitors the output from all the rest.

"PeakFilter" outputs peaks from the cross spectra that are matched with AIS tracks. The latest "PeakFilter" - in Release 4 - does what all PeakPicker, PeakAssociation & PeakFilter together used to do (in previous software versions).

"RadialDistributionTool" Looks at distribution of the radial current vectors within 1D current maps to see if that distribution has changed over time (to see if a new pattern need be created).

In the radial distribution tool, once a pattern is created then it takes 5 days of data from the radials and looks at the distribution of the bearing assignments. If the AP being used is still valid (aka "good") then the radial distributions will be consistent across time.

FREQUENTLY ASKED QUESTIONS (FAQs)

Q: What are the recommended threshold settings for monitoring antenna pattern quality and antenna rotation?
A: A divergence coefficient at or near to 0.0 indicates no change. CODAR scientists have found that a threshold value (default set at 0.2) if reached then warrants at least a closer look at the radials and antenna patterns. Aim for a correlation value of 0.9 (min. 0.8) when making a new AP. Threshold limit can be set in the configs file. Antenna rotation of 0 - 5^0 does not seem to have major impact upon data but if rotation jumps beyond above that the pattern and system need a closer look. More details about settings can be found in the AutoAPM User Guide.

Q: Can the system generate alerts?
A: At present it is necessary to manually open the Antenna Status Report folder to see results. Integration with SeaSonde alerts is coming soon.

Q: Does the AutoAPM Kit display AIS ships?
A: AIS vessel location and tracks (location over time) are not displayed in the radar site computer or in the Combine Suite software however this is an optional add-on feature in the PORTUS Marine Information System (purchased separately).

Q: What AP parameters are monitored and are they saved or overwritten?
A: These AP parameters are monitored: DF and AIS Bearing correlation; DF and AIS Bearing root mean squared error (RMSE); DF and AIS Bearing mean error or bias (this is the measure of rotation); Radial distribution divergence. Also saved are the average and minimum number of AIS CS peak matchups in the current data set. Time history of AP parameters is stored in CODAR Tabular Format (CTF) format for review of variation over time, in the SeaSonde DiagDisplay app, which can be useful in system forensics.

AISPattern Suite Existing Software License Upgrade to Release 22

Those already owning an AutoAPM Kit and running an earlier version of the AISPattern Suite (Release versions 1-3) can purchase an upgrade to the latest AISPattern Suite Release 22.

Contact CODAR or local authorized distributor for purchase details.

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