

YarCom Improves Radio Reception for the Department of Defense with MathWorks Tools

Unimpaired radio communications between commanders and front-line troops is crucial to success on the battlefield. Communications engineers strive to remove noise and other interference that would prevent military personnel from establishing essential command and control.

YarCom® Inc., a professional engineering services firm with expertise in radio frequency (RF) engineering, implemented new techniques to identify and locate noise interference for its Department of Defense (DoD) client. YarCom engineers used MATLAB® to quantify the impact of noise and interference on advanced U.S. military communications links.

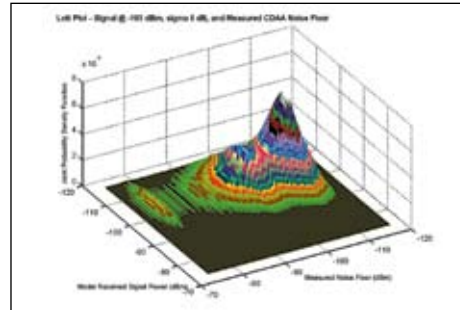
“When a victim radio receiver cannot hear a target signal, the mission is unsuccessful,” explains Dr. Gus Lott, principal engineer at YarCom. “MathWorks tools help us measure and identify subtle noise or changes in interference, so we can mitigate problems before the mission is seriously affected.”

THE CHALLENGE

To curb costs, YarCom needed to improve its data collection and analysis methods. Its manual approach required five to eight engineers and technicians to visit multiple field sites for two weeks with 20 large cases of equipment.

To make the process more efficient, YarCom would need a measurement, instrument control, and computational environment that would provide rapid script development and testing with minimal code rewrites for job customization.

YarCom sought to develop a system that worked with hardware devices from



The Lott Plot.

multiple manufacturers to remotely monitor conditions at the victim radio receiver and alert engineers of communication changes. To do this, they needed to control RF instruments, perform data acquisition and analysis, and display the results via the Web.

To control instruments at distant locations, it would be necessary to connect serial ports to GPS receivers at remote locations. These would enable the measurement systems to be synchronized and located when deployed on mobile platforms. Locating the clearest reception would require switching between multiple antennas and inserting filtering and amplification, while covering frequency bands.

THE SOLUTION

With MathWorks tools, YarCom used various hardware devices to continually monitor and detect immediate and long-term noise interference. This enabled a small expert team to return to the victim receiver sites only when problems were detected.

“MATLAB lets us accomplish 300% of what we could have done seven to ten years ago,” says Dr. Lott. “Now we instrument a site with two to three people, spend a few days

THE CHALLENGE

To identify and remove noise and interference from military communications systems

THE SOLUTION

Use MATLAB and related toolboxes to design an automated data collection, analysis, and alert system

THE RESULTS

- Data automation time reduced from years to months
- Critical field data gathered automatically
- Deployment costs reduced by thousands of dollars

on site to set up, and return to the site only when a problem is detected with just three to five equipment cases.”

YarCom engineers first used Instrument Control Toolbox™ and Data Acquisition Toolbox™ in a stimulus-response test setup. They used Data Acquisition Toolbox to sample signals in the victim receiver’s IF and AF spectrums via acquisition hardware, and Instrument Control Toolbox to sample the overall RF spectrum. They controlled stimulus transceivers using MATLAB serial port commands. “With the combination of MATLAB tools, we can measure RF, IF, and AF from one software control and analysis platform.”

With Instrument Control Toolbox, YarCom engineers quickly wrote custom scripts for the Agilent ESA-E 440xB family of spectrum analyzers to observe transient noise and interference. Using the scripts with the analyzers enabled them to obtain more than 25 1024-point observations per second with the fastest instrument internal numeric formats, which minimize data transfer times over the GPIB (IEEE-488) bus.

Next, Dr. Lott and his team used Statistics Toolbox™, Communications Toolbox™, and Signal Processing Toolbox™ to analyze the collected data and identify interference. Mapping Toolbox helped them place the results from the report within a geographic context and locate sources of interference.

YarCom realized an additional benefit of the project by developing a new method for quantifying the critical Probability of Mission Success metric. Implemented in MATLAB as a 3-D image, the “Lott Plot” represents the probability density functions for expected signal values compared with measured noise statistics.

“ It used to take us weeks to identify the interference source. With MATLAB, we can now identify and resolve noise and interference problems in a matter of hours. ”

Dr. Gus Lott, YarCom Inc.

A subcontractor to Integrated Engineering Concepts Inc., YarCom continues its work through the DoD’s Signal to Noise Enhancement Program (SNEP).

THE RESULTS

▪ **Data automation time reduced from years to months.** Previous DoD contractors worked for more than ten years to automate only a small portion of the application. Working in MATLAB, YarCom automated the measurement functionality and most of the analysis in fewer than nine months.

▪ **Critical field data gathered automatically.** The YarCom team is now free to leave equipment behind to gather critical data. “It’s remarkable,” Dr. Lott says. “Because we can collect so much data so quickly, we’re able to handle short-term transient analysis as well as multiseasonal trend analysis. That lets us identify slowly developing trends that we were unable to see before. We’re providing our customer with hard numbers for mission decisions—not speculation and conjecture.”

▪ **Deployment costs reduced by thousands of dollars.** Dr. Lott says, “Now we only need to take one instrument, a GPIB-controlled switch and filters, and a notebook computer with MathWorks software into the field. That alone has saved us thousands for each deployment.”

To learn more about YarCom, visit www.yarcom.com

APPLICATION AREAS

- Data acquisition
- Data analysis
- Signal processing
- Test and measurement

PRODUCTS USED

- MATLAB®
- Instrument Control Toolbox™
- Data Acquisition Toolbox™
- Communications Toolbox™
- Statistics Toolbox™
- Signal Processing Toolbox™
- Mapping Toolbox™

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