Imaging Science Research, Inc.

www.isr-sensing.com

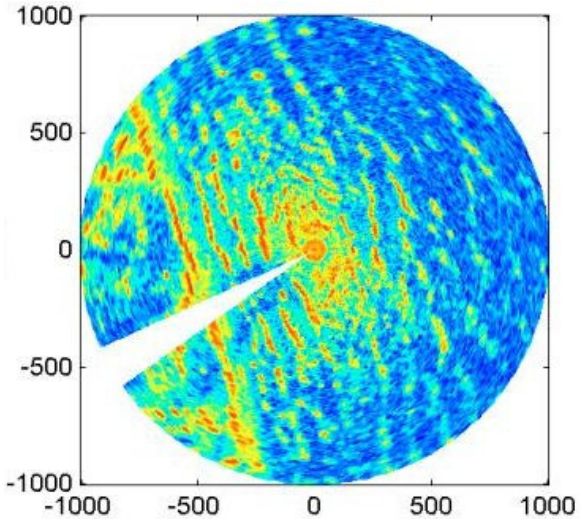
ISR Coherent Marine Radars

Our coherent marine radar (CohRad) offers new technology to measure surface currents and wave spectra by means of orbital wave velocity measure, a first. Backscatter intensity is used by other systems with standard marine radar approaches that require an empirical MTF to scale spectral echo strength to wave height spectra, which is sensitive to a number of environmental parameters. Our Doppler measure is direct and does not suffer from this environmental dependence.

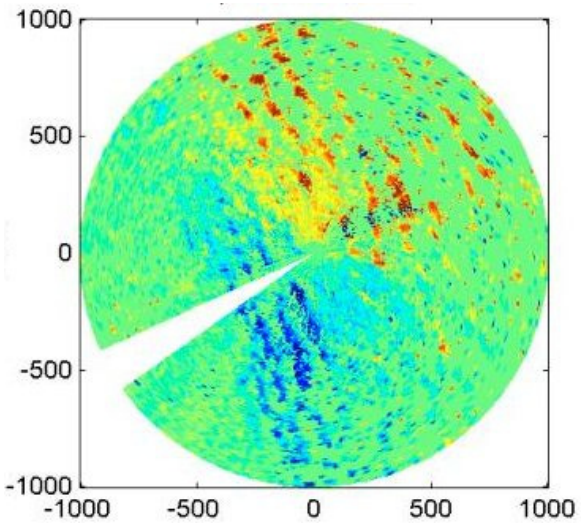
The radar is based on a marine radar pedestal and antenna, but with internal RF components replaced with our transceiver and a 5-watt solid state power amplifier. Rather than a 25 kW simple pulse, we use an FM chirp pulse at very high PRF with pulse summing and pulse compression to achieve similar sensitivity. Range resolution of up to six times higher than standard marine radars is possible with the ISR transceiver system.

The radar produces a standard video image (upper right), and a Doppler image (mid right). Using a 1 or 2-kHz PRF, Doppler measures radial velocities of ~ 8-16 m/s unambiguously, as shown here. The Doppler shift is a result of mean currents + Bragg phase speed + orbital wave modulations. For the data on the mid-right there was a mean current that caused the color offset.

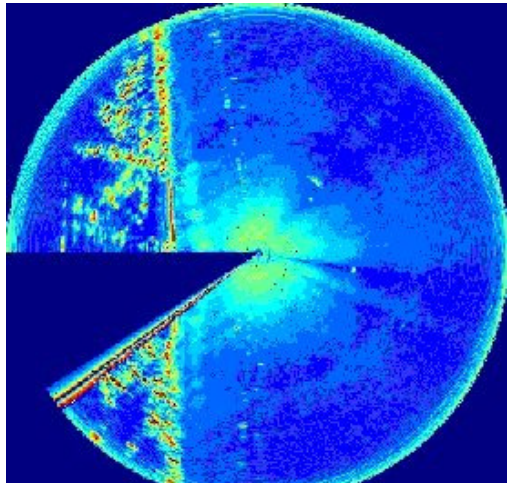
On the far right are summed video and Doppler images (64 rotations) that show bar structure and mean wind direction at the top, and the radial velocity vs azimuth below. Note fixed surface echoes show up better in Doppler than in magnitude



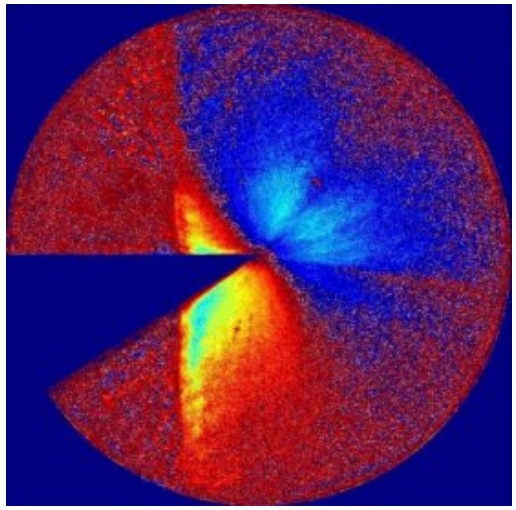
Intensity 512-rotation sum, ocean wave patterns



New Doppler image of radial velocity pattern of waves.



Intensity 512-rotation sum, ocean wave patterns averaging to a mean value. The nearshore bar can be mapped due to enhanced wave breaking



Radial velocity summed image, blue approaching and red receding. Here mean drift current of the wave field dominates the image. Comparisons with ADCP's in the area show good comparisons.

Imaging Science Research, Inc

Dennis B Trizna, PhD, President

15 Sixth Avenue

Southern Shores, NC, 27949

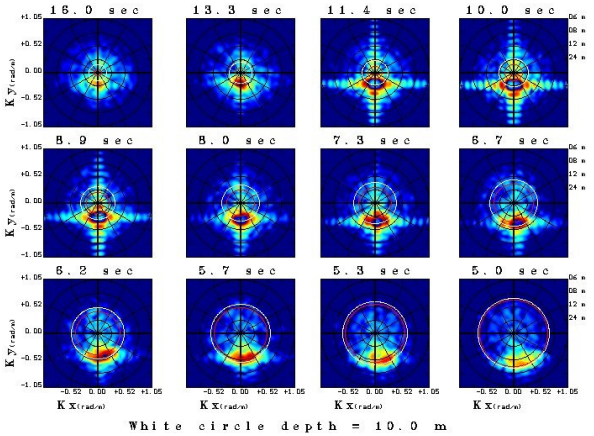
Tel: 703-801-1417

sales@isr-sensing.com

ISR Coh-Rad Standard Products

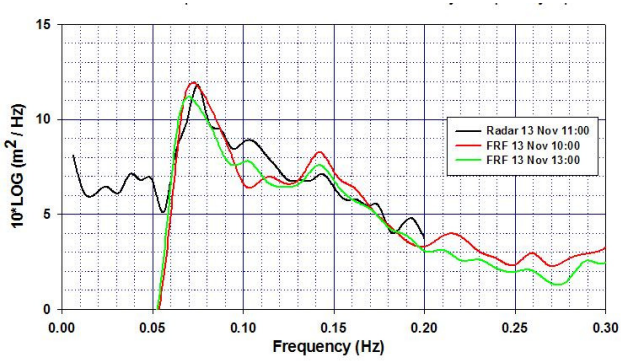
Wave Number Spectra

Ocean wave spectra are derived from 3D-FFT processing of 64x64 windows (user placed) using 64 consecutive rotations to produce Ω-K spectra, examples of which are shown below for 12 of 32 frequencies available to the user.



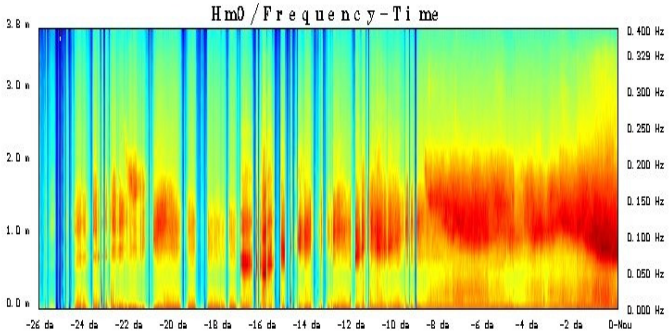
Ocean Wave Frequency Spectra

If the energy is summed around three peaks found in each K-spectrum, then a frequency spectrum is generated, an example of which is plotted below. This is a frequency spectrum derived from Doppler image data from the 2009 Veteran's Day storm during the passage of Hurricane Ida off the Outer Banks, NC. Surface truth comparison is made with FRF pressure array frequency spectra collected over three hour periods each surrounding the 10-min radar data collection.



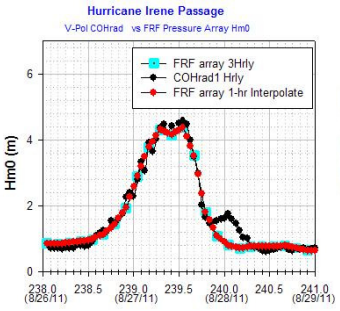
Frequency Time Series—Spectrograph

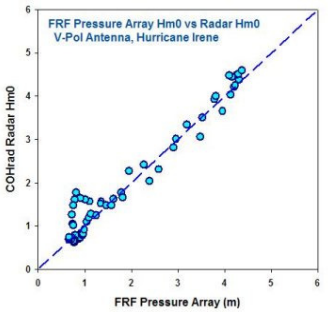
A sequence of such time series covering 26 days using hourly acquisitions produces a frequency spectrograph, shown below. Gaps in the data that show as vertical blue streaks represent times when the wind has dropped below 3 to 4 m/s, and insufficient radar echo was available to conduct an analysis.



Hm0 comparison with FRF pressure array

The passage of Hurricane Irene in August of 2011 offered an opportunity for up to 4.2-m Hm0 values for comparison with FRF pressure sensory array time series, using a vertically polarized antenna. Outliers that occurred in previous tests for 3-m waves and higher no longer appeared, and these are thought to be due to strongly breaking waves offshore that influence the accuracy of a radar using horizontal polarization. For deepwater usage where 3-m and higher waves are expected, we suggest the V-pol antenna. For coastal applications, where small scale breaking is important for bar mapping applications, H-pol is preferred.





Components of the CohRad Package

The CohRad system is a turn-key package, which will produce all of the standard products every hour. It is based on a rugged rackmount PC, the ISR Quadrapus Transceiver card, and the coherent marine radar described earlier. The system comes with pre-programmed Task Scheduler that contains a series of batch files to load programs and parameters for the standard setup. A 10, 20, or 30-m cable is available for selection and priced accordingly.

Radar processing programs run after the acquisition is completed to do pulse compression and phase-difference Doppler. This produces a Video (amplitude) and phase-difference (Doppler) file in radial co-ordinates, which is-then transformation to Cartesian co-ordinates for either video or Doppler file for post processing using 3D-FFT analysis. A summary JPG file provides both the 12-set K-spectra and frequency spectrograph shown at left, with a sample Cartesian plot. A sequence of such files can be used to create a movie file that allows the user to review data over extended periods of a week or two. As new data are added, the older data to the left are flushed out of the spectrograph plot.

The CohRad system is priced competitively, costing less than other marine radar wave processing systems. A service plan can be purchased, which provides replacement of all system components, and software updates. The latter are provided free for the first three years. Write or email us below for a quote for your wave measurement program.

We are offering a 25% discount to attendees of Ocean Sciences 2012. Use "OcnSciMtgPromo "in your order to

Imaging Science Research, Inc

Dennis B Trizna, PhD, President
15 Sixth Avenue
Southern Shores, NC, 27949
Tel: 703-801-1417
sales@isr-sensing.com