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A Preliminary Report on
Frequency Characteristics of
Moving Targets in Sea
Clutter

Report No. R-24

22 July 1952

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Contract DA-11-022-ORD-721

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Title Page
Numbered Pages 3

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The frequency characteristics of moving ground targets have been reported in C.S.L. reports 17 and 18. Along with this data a small amount of sea return information was obtained. It is the purpose of this report to present a few sample frequency spectra of sea targets and to suggest reasons for the differences between sea and ground moving target frequency characteristics.

The data were obtained by tape recording the audio output of a Butterfly type radar⁽¹⁾ in a plane flying over Lake Michigan. The 7 1/2° beamwidth antenna was pointed along the ground track, and scanning was provided by the forward motion of the plane. Range to the target was between 2000 and 3000 yards, air speed was about 140 miles per hour, and PRF was 1600 pulses per second. From the plane, which was flying at an altitude of about 1000 feet, it was estimated that the waves were about six feet in amplitude. Approximately 2400 received pulses from the target were averaged in the analysis.

(1) See introduction of C.S.L. Reports 17, Expt. Freq. Analysis of Ground Clutter and Moving Target for Non-coherent Airborne Radar.

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The results of analyzing targets selected from the audio recordings with a harmonic wave analyzer are shown in Figures one through four. Of the four targets shown, one through three were well away from shore and were therefore definitely in a pure sea clutter background. Thus any ground clutter accidentally included in Figure four would make the spectrum sharper or at least have a sharp peak at some point. Figure five shows a typical ground moving target observed under the same conditions as the sea targets.

The striking features of all these spectra is that sea targets are considerably broader in frequency than a moving target on the ground, and also display some structure. The sea targets are of the order of 70 to 100 c.p.s. wide at half power, while the ground target is only 18 c.p.s. wide, of which 8 c.p.s. is due to beamwidth effects, and 6 c.p.s. to analyzer resolution. There are several possible reasons for this significant difference. Perhaps the most important is the motion of the water. In addition, since the moving target acts like a carrier signal to isolate the actual clutter spectrum from the inter-clutter modulation ⁽²⁾,

(2) See C.S.L. Report 18, Elementary Theory of Ground Clutter and Moving Targets Using Frequency Analysis. C.W. Sherwin

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any motion of this target will also broaden the spectrum. The small boats observed could be accelerating more than a ground vehicle on a smooth road, thus producing additional breadth of the target.

Over land it was experimentally relatively easy to aim the antenna along the ground track, by listening for minimum ground clutter. Over the water, however, this method was not as effective. It is therefore possible that part of the width of the sea target spectra is due to the antenna not being exactly along ground track.

Not enough dependable data were obtained to conclusively determine the reasons for the differences between sea and ground clutter moving target frequency characteristics.

The need for further study is obvious. However, the width of the observed spectra agrees with what is known about the frequency spectra of sea clutter⁽³⁾.

(3) A Primer of Sea Echo, Herbert Goldstein, Report 157, U. S. Navy, Electronics Laboratory, San Diego, Calif.

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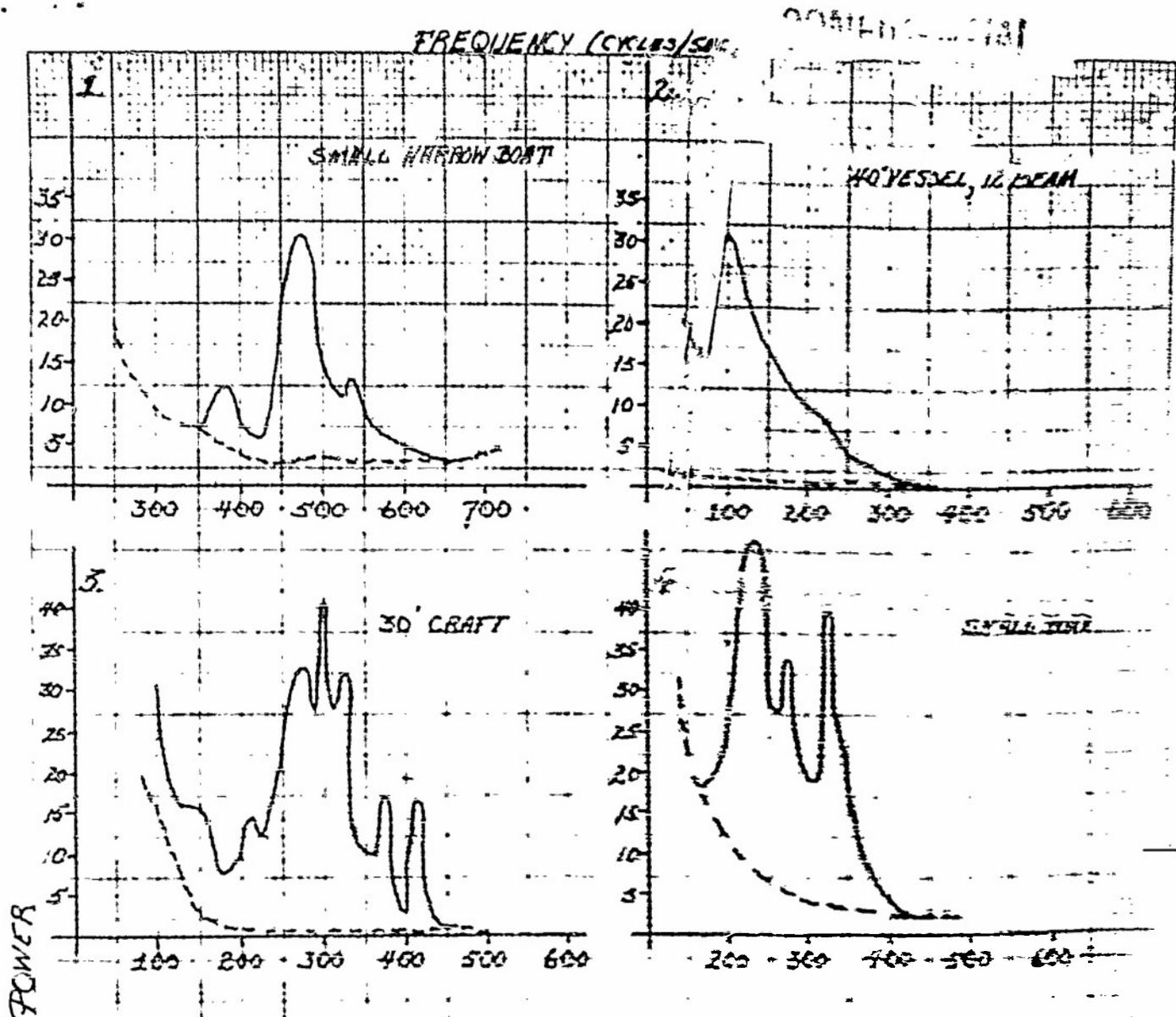


Fig 1-4. Sea Moving Targets Observed on the Ground Track with 7 1/20 Beamwidth Antenna. Air Speed, 140 mph; altitude, 1200 feet; range, 2000 to 3000 yards; The heights of the waves was estimated at 6 feet. Sample rate: 2400; PRF: 1600 pulses per second.

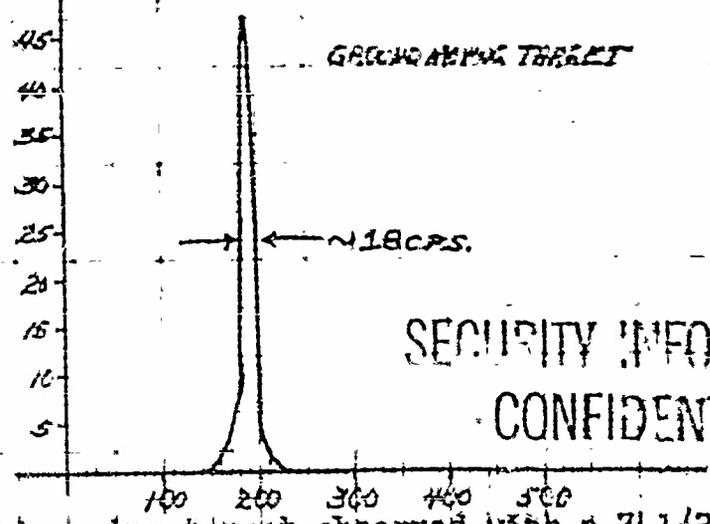


Fig. 5. Ground moving target observed with a 7 1/20 beamwidth antenna. Air Speed, 140 mph; altitude, 200 feet; range, 5500 yards.

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University of Illinois, Control Systems Lab., Urbana (Report No. R-24)

A Preliminary Report on Frequency Characteristics of Moving Targets in Sea Clutter

Kovaly, John J.; Prothe, W.C. 22 July'52 4pp. graphs

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P 179

Radar reflections, Sea
Radar reflections, Ground
Radar - Clutter elimination

Electronics (3)
Radar (2)

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University of Illinois, Control Systems Lab.,
Urbana (Report No. R-24)
A PRELIMINARY REPORT ON FREQUENCY
CHARACTERISTICS OF MOVING TARGETS IN SEA
CLUTTER, BY John J. Kovaly and W.C. Prothe.
22 July '52, 4 pp. incl. graphs. ~~CONFIDENTIAL~~

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