

Fishers Island Mile Range : Measurement Method Synopsis

The measurement system at the Mile Range at the NUWC Fishers Island Antenna Test Complex uses a technique known as groundwave correction to determine the gain of an unknown antenna relative to that of an ideal quarter-wave resonant monopole.

In conventional antenna gain measurements, a standard reference antenna with known gain is measured first, and then the unknown antenna is measured. Comparison between the two data sets allows the gain of the unknown to be determined from the gain of the standard. For HF measurements, that standard is typically a resonant quarter-wave monopole antenna. However, at the low end of the HF band it is not practical to use a quarter-wave antenna due to its unwieldy size. Furthermore, in order to take a swept frequency measurement, one would need to be able to adjust the length of this antenna easily – also something that is not practical or economical with a very long whip. The goal of the groundwave correction approach is to use a “virtual” reference antenna - an ideal, theoretical quarter-wave monopole. This eliminates the need for a physical standard and greatly speeds the measurement process, making it possible to collect large amounts of data over many frequency steps in a short amount of time.

The method works because it is possible to accurately and repeatably calculate the electric field strength that an ideal quarter-wave monopole would produce at a distance of one mile over seawater. (Note that the one mile distance was chosen due to the shape of the coastline at Fishers Island and the need to remain in the far field zone down to 2 MHz.) To do this, though, one needs to compensate for the groundwave attenuation that is present on the propagation path. This groundwave correction factor is known and may be readily determined at the frequency of interest.

The measurement process begins by transmitting a fixed amount of power at a given frequency into the unknown antenna; the measurement system measures the forward power delivered to the unknown antenna by means of a directional coupler. A calibrated receive loop at the far end of the Range one mile away samples the electric field produced by the unknown antenna, which registers as a voltage on a level meter. Knowing the effective height of the loop, it is possible to back-calculate to get the electric field strength that was produced by the unknown antenna. Now, since we know the amount of transmit power at this frequency, we can calculate the field strength that an ideal quarter wave monopole would produce. By applying the groundwave correction factor, we can determine the field that would arrive at the Mile Site if it were in place of the unknown antenna. The ratio of the two field strengths gives the gain of the unknown antenna relative to that of an ideal quarter-wave monopole.

All quantitative measurement equipment used on the Range is calibrated in accordance with the requirements of the Navy Metrology and Calibration (METCAL) program, using NIST traceable standards were required.

Reference :

1. Tonn, D., Mileski, P. and Gilles, P., “A Groundwave Correction Technique for Low Frequency Antenna Measurements over a Seawater Ground”, *Proc. Of the 24th Annual Meeting of the Antenna Measurement Techniques Association (AMTA '02)*, pp. 421-425.