Dependence of radar emission spectra on measurement bandwidth and implications for compliance with emission mask criteria

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Abstract. Radar transmitter emission criteria normally include the specification of frequency−dependent emission masks. These masks specify the amount by which unwanted radar emissions (both out−of−band and spurious) must be suppressed relative to the power levels emitted at radars' fundamental frequencies. Compliance with emission masks is determined through measurements of emission spectra. The measured levels of radar unwanted emissions and fundamental−frequency emissions both vary as a function of measurement system bandwidth, B_m. But the rate of variation with B_m differs between the unwanted emissions and the fundamental−frequency emissions. Moreover, the rate of variation of unwanted emission levels varies as a function of frequency as well as B_m. This creates a problem for radar emission mask−compliance measurements.

The National Telecommunications and Information Administration (NTIA) Institute for Telecommunication Sciences (ITS) has explored this problem by performing emission spectrum measurements on a maritime surface search (navigation) radar. In the spectrum data that are presented, the radar unwanted emission levels are found to vary at rates between 10 log(B_m) to 20 log(B_m), depending upon frequency. But the measured power at the radar fundamental frequency is found to vary as 20 log(B_m) for all bandwidths that are less than or equal to 1/(radar pulse width). The result is that the level offset between the unwanted emissions and the fundamental−frequency emission level depends upon the measurement bandwidth. This result implies, at a minimum, that measurement personnel must take the effect of B_m into account when performing radar emission spectrum measurements for the purpose of determining emission mask compliance. Based upon these the results of the maritime radar spectrum data, some technical strategies for measuring radar emission spectra for emission mask compliance are proposed. Possible technical implications for future development of radar emission masks are also discussed.