Table Mountain Research

Outputs

- Digital television field strength and video quality study.
- Radar emission spectrum measurements performed using new ITS-developed measurement system.
- Software for the simulation of non-Gaussian noise processes typically observed in urban and residential environments.
- Software to compute and plot the third- and fourth-order statistics of noise processes.

The Table Mountain Field Site and Radio Quiet Zone supports fundamental research into the nature, interaction, and evaluation of telecommunication devices, systems, and services. To achieve this goal, the Table Mountain Research Project actively solicits research proposals both from within ITS and from external organizations. This research serves to expand the knowledge base available to ITS, helps identify emerging technologies, and provides for the development of new measurement methods needed to study the characteristics of new devices and systems based on this technology. The results of the Table Mountain work are disseminated to the public via technical reports, journal articles, conference papers, web documents, and computer programs. Some highlights of the technical program in FY 2003 are presented below.

DTV Field Strength and Video Quality Study

In 2003, concerns that existing power limits placed on the broadcast industry might limit the availability of digital television (DTV) formed the basis for a DTV field strength and video quality study. In this study, a simulated home mounted on a flat bed trailer (see figures below) was used to compare the quality of a video signal received inside the structure at various locations around the area. The simulated home was used to eliminate the variability inherent in multiple structures, limiting the results to effects due to location and incident signal level. A DVD recording of the video signal was made with field strength levels included, and the results were summarized in an NTIA Technical Memorandum (see **Recent Publications** on next page).

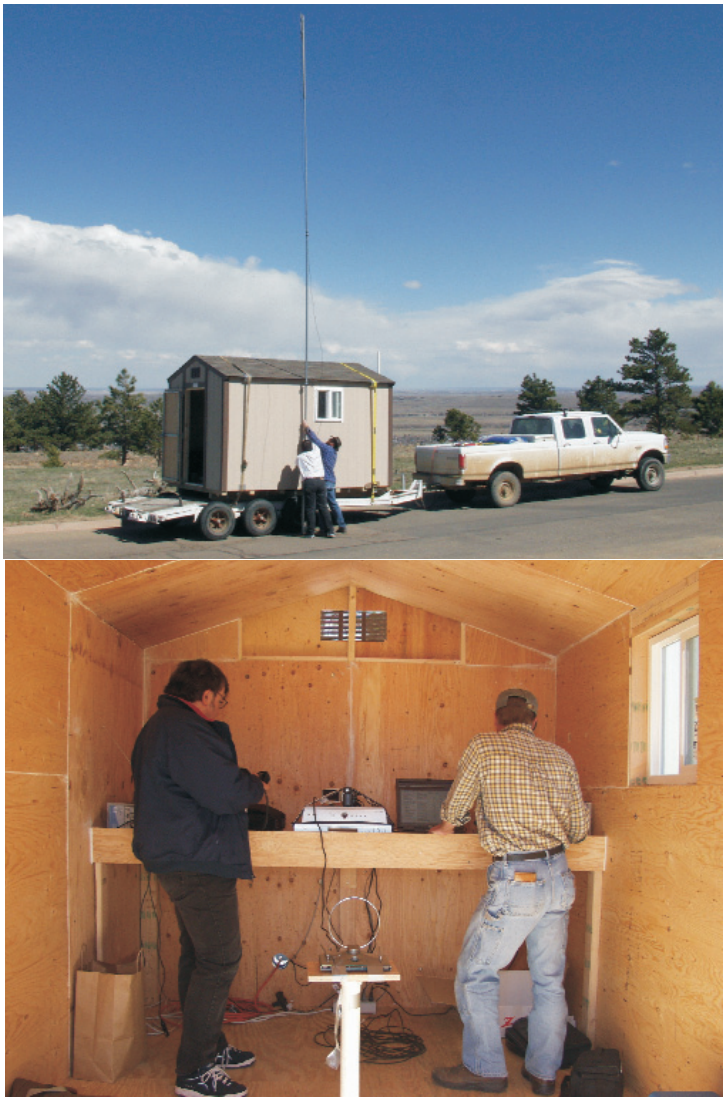

Figure 1. Outside (top) and inside (bottom) of the ITS "Tool Shed Measurement System," used in the DTV field strength and video quality study (photographs by W.A. Kissick).

Characterization of Man-made Noise

Since the late 1960's, ITS has characterized man-made noise from measurement results. The first approach estimated amplitude statistics with hardware detectors, which were designed and built to measure average amplitude, root mean square amplitude, peak amplitude, and average logarithmic amplitude. Subsequent systems made use of an instrument to measure the complementary cumulative distribution or amplitude probability distribution (APD) with hardware circuitry. This instrument provided an estimate of first-order amplitude statistics that could be used to calculate amplitude statistics difficult to detect with hardware, such as the median amplitude. Today this instrument is routinely emulated in software using amplitude samples measured with a spectrum analyzer.

Unfortunately, for complete characterization, even the simplest Gaussian random process needs second-order statistics, e.g., those found in the auto-correlation function and corresponding power spectral density, in addition to the first order statistics of the APD. Man-made noise processes, often much more complex, need even higher-order statistics such as third- and fourth-order cumulants and corresponding poly-spectra. These higher-order statistics are based on complex noise voltage samples such as those obtained with a modern vector signal analyzer.

In FY 2003, the Table Mountain Research project completed several tasks to help engineers understand the importance of higher-order statistics in characterizing man-made noise. First, software was written to generate non-Gaussian noise processes previously observed in urban/residential environments. Next, software was written that calculated and plotted the third- and fourth-order statistics of these simulated random processes.

Currently there is much interest in evaluating methods to share the radio spectrum. Ultrawideband modulation and "junk bands" based on spectrum sharing etiquettes are but two examples. Since interference due to these methods is likely to be non-Gaussian, it is expected that knowledge of the higher-order statistics will be useful to both designers building demodulators and regulators writing emission specifications. In FY 2004, the Table Mountain Research project plans on measuring noise in existing junk bands to further the study of the importance of higher-order statistics.

Radar Emission Spectrum Measurements

Radar transmitters produce some of the highest effective radiated power levels in the entire radio spectrum. Therefore it is critical that radar emission spectra be accurately measured for conformance with emission masks such as the NTIA Radar Spectrum Engineering Criteria (RSEC). With that goal in mind, a program for the development of radar emission spectrum measurements has been established at the Table Mountain research facility. Although it is necessary to coordinate such temporary high-power measurements with other "quiet zone" users, this coordination is usually easily accomplished. Advanced measurement techniques (both hardware and software) are used to measure emissions from actual radar transmitters.

In FY 2003, an X-band maritime surface search navigation radar was brought to Table Mountain and a set of measurements were performed using the new ITS RSMS-4. Additional radars are expected to be brought there for measurement, and additional research into radar emission measurements will be performed in FY 2004.

Recent Publications

J. W. Allen and T. Mullen, "Digital television (DTV) field strength and video quality study," NTIA Technical Memorandum TM-03-405, Aug. 2003.

F. Sanders, "Dependence of radar emission spectra on measurement bandwidth and implications for compliance with emission mask criteria," in "Proceedings of the International Symposium on Advanced Radio Technologies," J. W. Allen and T. X Brown, Eds., NTIA Special Publication SP-03-401, Mar. 2003.

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