ITS Publications and Presentations in FY 2008

NTIA Publications

D.J. Atkinson and A.A. Catellier, "Intelligibility of selected radio systems in the presence of fireground noise: Test plan and results," NTIA Technical Report TR-08-453, Jun. 2008.

> This report describes an experiment conducted to measure the intelligibility of selected radio communication systems when those systems are employed in high-background-noise environments experienced by firefighters. The test plan for a Modified Rhyme Test (MRT) is detailed, including requirements for source material preparation and listening test conduct. Finally, the results of the test are presented, along with the data analysis. The results indicate that in some environments analog radios performed better than digital radios, and in some environments no radios performed well. This information should be considered whenever an agency is preparing to purchase and deploy a new communications system.

J.E. Carroll, J.R. Hoffman, and R.J. Matheson, "Measurements to characterize land mobile channel occupancy for Federal bands 162–174 MHz and 406–420 MHz in the Denver, CO area," NTIA Technical Report TR-08-455, Sep. 2008.

> This report describes field measurements to characterize Land Mobile Radio (LMR) channel occupancy of Federal bands 162–174 megahertz (MHz) and 406–420 MHz at a single location overlooking the Denver, Colorado metropolitan area. This is part of the National Telecommunications and Information Administration effort to improve the spectrum efficiency of Federal radio usage. Measurements of the received radio traffic levels in these LMR frequency bands were performed over an 8-day period for the purpose of determining radio channel usage within the receiver spatial coverage of approximately 100-kilometer (km) radius for base stations, 50-km radius for mobile units, and 25-km radius for handheld units. The measurements were made using newly developed techniques that digitize as much as a 5-MHz segment of spectrum and process it to obtain simultaneous signal levels of up to 400 individual LMR channels. These techniques provided faster measurements, but also allowed enhanced post-processing of the data to remove effects of impulsive noise-like sources.

J.J. Lemmon, J.E. Carroll, F.H. Sanders, and D. Turner, "Assessment of the effects of wind turbines on air traffic control radars," NTIA Technical Report TR-08-454, Jul. 2008.

> This technical report describes the results of a study exploring the effects of power-producing wind turbines on Federal Aviation Administration (FAA) air traffic control (ATC) radars. The study was performed to identify the extent to which these effects exist, and to identify mitigation techniques and parameters for such effects. The topics addressed in this report are: review of the current state of the literature on wind turbine effects on ATC radar performance; determination of criteria for recommended no-interference radii between ATC radars and wind turbines; determination of methodology for assessing effects of wind turbines on radars that are within no-interference radii; analysis of the potential for desired targets to be lost in azimuths other than those of wind turbine farms; and consideration of the effects of wind turbines on secondary radar (i.e., ATC beacon interrogator, or ATCBI) performance. The study results indicate that documented cases of deleterious effects from wind turbines do exist and are numerous. Due to the large number of parameters that enter the analysis, a simple, universally applicable set of guidelines for siting of wind turbines near radars is not feasible. However, this study shows that, by making nominal assumptions about turbine characteristics and siting parameters such as local topography, it is possible to develop a universally applicable methodology for assessing potential interference between wind farms and ATC radars.

P.J. Raush and K.E. Davis (Eds.), "Proceedings of the International Symposium on Advanced Radio Technologies/ClimDiff 2008, June 2-4, 2008," NTIA Special Publication SP 08 452, Jun. 2008.

No abstract available.

Outside Publications

Articles in Conference Proceedings

K. Brunnström, D. Hands, F. Speranza, and A. Webster, "Evaluation of video quality models for multimedia," in *Proc. Electronic Imaging 2008*, San Jose, California, Jan. 27-31, 2008.

The Video Quality Experts Group (VQEG) is a group of experts from industry, academia, government and standards organizations working in the field of video quality assessment. Over the last 10 years, VQEG has focused its efforts on the evaluation of objective video quality metrics for digital video. Objective video metrics are mathematical models that predict the picture quality as perceived by an average observer. VQEG has completed validation tests for full reference objective metrics for the Standard Definition Television (SDTV) format. From this testing, two ITU Recommendations were produced. This standardization effort is of great relevance to the video industries because objective metrics can be used for quality control of the video at various stages of the delivery chain.

Currently, VQEG is undertaking several projects in parallel. The most mature project is concerned with objective measurement of multimedia content. This project is probably the largest coordinated set of video quality testing ever embarked upon. The project will involve the collection of a very large database of subjective quality data. About 40 subjective assessment experiments and more than 160,000 opinion scores will be collected. These will be used to validate the proposed objective metrics. This paper describes the test plan for the project, its current status, and one of the multimedia subjective tests.

A. Catellier and S. Voran, "Speaker identification in low-rate coded speech," in *Proc. 7th International Conference on Measurement of Audio and Video Quality in Networks (MESAQIN)*, Prague, Czech Republic, May 2008.

While useful speech communication systems must be intelligible, most systems aim to transmit secondary information, such as attributes of a speaker's voice, as well. This secondary information can allow a listener to identify the speaker and his emotional state. Testing speech communications systems for the delivery of intelligible speech is common, but testing for human perception of the delivery of this secondary information is less common, though some prior work has been done. Building on this prior work, we describe the design, implementation, analysis and results of a new listening experiment that characterizes the listener identification of six different speakers using six different low-rate digital speech communication systems.

We display these experimental results along with results from our prior work to quantify listener detection of dramatized speaker urgency and word intelligibility in sentence context for the same six speech communication systems. We conclude that the speaker identification task used in this experiment is about three times more robust to communication system degradations than word intelligibility in sentence context.

M. Cotton, "A methodology for approximating BPSK demodulator performance in the presence of various undesired signals," in "Proceedings of the International Symposium on Advanced Radio Technologies/ClimDiff 2008," P.J. Raush and K.E. Davis, Eds., NTIA Special Publication SP 08 452, Jun. 2008, pp. 36-42.

This paper describes a methodology for analyzing binary phase-shift keyed demodulator performance in the presence of various types of undesired signals. It utilizes models of the underlying random processes to determine the probability of a bit error. The basic calculation involves integrating the probability distribution function of the internal receiver noise (assumed to be Gaussian) plus the undesired signal. When this integral cannot be solved analytically, a sample-function analysis is utilized. Results are

given that compare the effects of various undesired signals (i.e., continuous-wave, MPSK, impulsive noise, and gated noise) to those of Gaussian noise.

N. DeMinco and P. McKenna, "A comparative analysis of multiple knife-edge diffraction methods," in "Proceedings of the International Symposium on Advanced Radio Technologies/ClimDiff 2008," P.J. Raush and K.E. Davis, Eds., NTIA Special Publication SP 08 452, Jun. 2008, pp. 65-69.

This report describes the comparative analysis of four alternative methods to a rigorous method for computing multiple knife-edge diffractions in non-line-of-sight scenarios. These alternative methods are candidates for use with the short-range mobile-to-mobile radio-wave propagation model under development at the Institute for Telecommunication Sciences. The results of this analysis show where alternative methods that reduce computation time can be used for analyzing knife-edge diffractions while maintaining suitable accuracy.

R.T. Johnk, "High-resolution propagation measurements using conventional EMC test antennas—A numerical study," in "Proceedings of the International Symposium on Advanced Radio Technologies/ClimDiff 2008," P.J. Raush and K.E. Davis, Eds., NTIA Special Publication SP 08 452, Jun. 2008, pp. 133-138.

This paper explores the possibility of using common types of electromagnetic compatibility (EMC) test antennas to perform high-resolution time-domain propagation measurements. The objective of this research is to provide wireless engineers with a tool to perform propagation measurements using a combination of commercial-off-the-shelf EMC test antennas and a stepped-frequency measurement system such as a vector network analyzer. Numerical simulations are used to model propagation path transmission with biconical antennas, log-periodic dipole arrays, and dipoles. A two-step measurement procedure and an efficient data processing sequence are used to generate high-resolution time-domain waveforms. The results are promising, and demonstrate that high-resolution waveforms can be obtained using models of conventional, low-frequency EMC antenna types.

R.T. Johnk, "High-resolution time-domain site attenuation measurements using conventional EMC test antennas—A numerical study," in *Proc. 2008 IEEE EMC Symposium*, Detroit, Michigan, Aug. 18-22, 2008.

This paper explores the possibility of using common types of electromagnetic compatibility (EMC) test antennas to perform high-resolution time-domain site attenuation measurements. The objective of this research is to provide EMC engineers with a tool to perform evaluations of radiated emissions test sites. Numerical simulations are used to site attenuation behavior using biconical antennas, log-periodic dipole arrays, and dipoles. A two-step measurement procedure and data processing sequence are used to generate high-resolution time-domain waveforms. The results are promising, and demonstrate that high-resolution waveforms can be obtained using models of conventional EMC antenna types.

R.T. Johnk, P. McKenna, P. Papazian, N. DeMinco, G. Sanders, H. Ottke, B. Arment, J. Shankel, and D. Strouse, "A mobile-to-mobile propagation measurement system," in "Proceedings of the International Symposium on Advanced Radio Technologies/ ClimDiff 2008," P.J. Raush and K.E. Davis, Eds., NTIA Special Publication SP 08 452, Jun. 2008, pp. 28-35.

This paper describes a mobile-to-mobile propagation measurement system that is currently being developed at the Institute for Telecommunication Sciences under the sponsorship of the Office of Spectrum Management. This system uses a fixed transmitter truck and a moving receiver van to characterize radio-frequency channels of selected urban and rural environments. The transmitter and receiver architectures are described, and selected time- and frequency-domain measurement results are presented. The results obtained so far are very promising and demonstrate the versatility and effectiveness of this measurement system.

K.A. Remley, G. Koepke, C.L. Holloway, C. Grosvenor, D.G. Camell, and R.T. Johnk, "Radio communications for emergency responders in high-multipath outdoor environments," in "Proceedings of the International Symposium on Advanced Radio Technologies/ClimDiff 2008," P.J. Raush and K.E. Davis, Eds., NTIA Special Publication SP 08 452, Jun. 2008, pp. 106-111.

> We present measurement data to support development of technology and standards for broadband, digitally modulated radio communications used by emergency responders. Measurements were conducted at an oil refinery having extensive outdoor piping and other metal components. This structure represents a class of high-multipath, outdoor propagation environments that includes electrical generation facilities, chemical plants, and other outdoor, heavy industrial environments where reliable emergency responder communications is critical. The measurement results presented here quantify the extent of the multipath, loss, and other propagation effects in such high-multipath outdoor environments.

S. Voran, "Lossless audio coding with bandwidth extension layers," in *Proc. 2007 IEEE Workshop on Applications of Signal Processing to Audio and Acoustics*, New Paltz, New York, Oct. 2007.

> Layered audio coding typically offers reduced distortion as bit rate is increased, but that distortion is spread across the entire band until the lossless coding bit rate is reached and distortion is eliminated. We propose a layered audio coding paradigm of bandwidth extension, rather than distortion reduction. For example, a core layer can provide lossless coding of a 24 kHz bandwidth signal (f_s=48 kHz), then first and second bandwidth extension lossless layers can extend that signal to losslessly coded 48 and then 96 kHz bandwidths (f_s=96 and 192 kHz).

S. Voran, "Listener detection of talker stress in low-rate coded speech," in *Proc. 2008 International Conference on Acoustics, Speech, and Signal Processing (ICASSP)*, Las Vegas, Nevada, Mar.-Apr. 2008.

> We describe an experiment where listeners were asked to detect two specific forms of stress in talkers' recorded voices heard via six different simulated communication systems. Both task-induced stress and dramatized urgency were used. Communication systems included low-rate digital speech coding combined with bit errors, packet loss, and packet loss concealment. Twenty-four listeners participated in a total of 11,520 detection trials. A parallel investigation of word intelligibility in sentence context used 576 trials. Intelligibility results showed wide variance due to communication system and stress detection results showed less variance. More specifically, we found that listener detection of dramatized talker urgency was 4.7 times more robust to communication system degradations than word intelligibility in sentence context.

Journal Articles

A. Thiessen, "Rethinking 4.9 GHz broadband," *MissionCritical Communications*, vol. 23, no. 2, pp. 14-16, Feb. 2008.

> With the advent of 700 MHz broadband on the horizon, the public safety community is in a position to take stock and rethink its use of the 50 MHz of spectrum at 4.9 GHz granted by the FCC in 2002. For the last three and a half years, public safety has been defining its requirements for 4.9 GHz broadband and dovetailing with the APCO Project 25 Interface Committee's Broadband Task Group. This public safety/industry effort takes public safety's requirements and compares these with the two technologies being proposed for the band: IEEE 802.11-2007 and 802.16e-2005.

J.B. Allen, G. Chan, and S.D. Voran, "Perceptual models for speech, audio, and music processing," *EURASIP Journal on Audio Speech, and Music Processing*, Vol. 2007, 2007.

> No abstract available.

Book Chapters

S. Voran, "Estimation of speech intelligibility and quality," Ch. 28 of *Handbook of Signal Processing in Acoustics*, D. Havelock, S. Kuwano, and M. Vorländer, Eds., Vol. I, Part V (Speech, D.D. O'Shaughnessy), Springer Science+Business Media, LLC, 2008, pp. 483-520.

> No abstract available.

Unpublished Presentations

N. DeMinco, "Propagation model development considerations for close-in distances and low-antenna height applications," presented at the USNC-URSI National Radio Science Meeting, Boulder, Colorado, Jan. 5, 2008.

M. Ossmann, "Software radio and the future of wireless security," presented at Black Hat Briefings, Las Vegas, Nevada, Aug. 6, 2008.

F.H. Sanders, "Broadband spectrum surveys: Approaches and results," presented at International Symposium on Advanced Radio Technologies (ISART), Boulder, Colorado, Jun. 2008.

A. Webster, "Progress and future plans for VQEG," Keynote presentation at ETSI STQ Workshop on Multimedia Quality of Service, Prague, Czech Republic, Jun. 2008.

Conferences Sponsored by ITS

International Symposium on Advanced Radio Technologies (ISART 2008)

The International Symposium on Advanced Radio Technologies (ISART 2008) was held June 2-4, 2008, in Boulder. This symposium explores the current state of the radio art with an eye towards forecasting the use of wireless technology in the future. The keynote was given by Karl Nebbia, Director of NTIA's Office of Spectrum Management. The proceedings were produced in an electronic DVD format as NTIA Special Publication SP-08-452.

ISART 2008 was held in conjunction with ClimDiff 2008, which covers topics in radio-climatological and diffraction effects on radio propagation.

ISART brings together people from academia, business, and government agencies to discuss the interplay between technological "how-to," the possibilities and restrictions created by regulation and policy, and the economic motivation of the business world.

The ITS Radio Spectrum Measurement Science (RSMS) vehicle set up to perform measurements at the Table Mountain Field Site (photograph by J.W. Allen).