NAB Radio TechCheck

The Weekly NAB Newsletter for Radio Broadcast Engineers

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Graceful Degradation in Digital Radio Systems

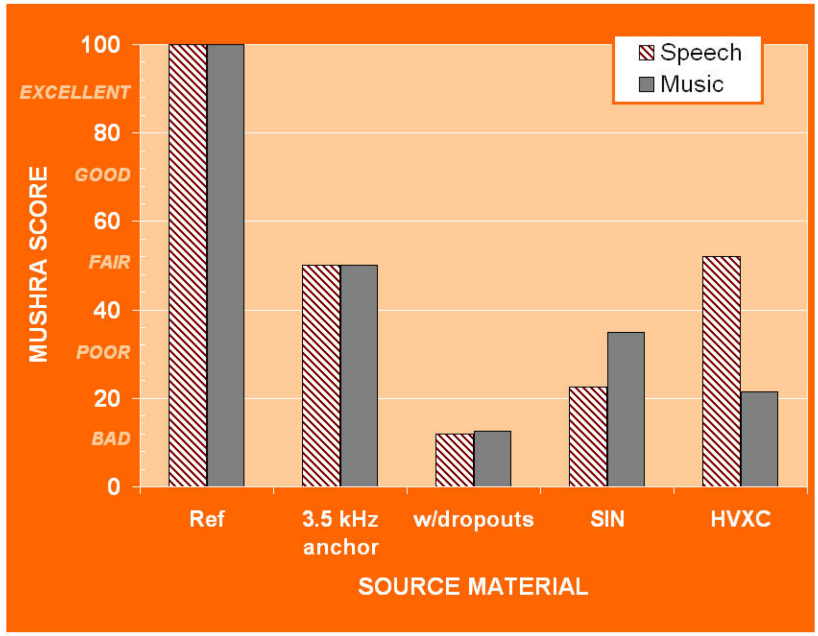
While digital broadcasting systems are a significant improvement over analog in almost every regard, one aspect which is often seen as less than desirable is the so-called “cliff effect” manner by which digital system performance degrades. This refers to the behavior whereby the digital system (be it digital radio or TV) works perfectly up to a certain point (for example, to a threshold level of interference or receivable signal level), but just beyond that point, the picture freezes or the audio mutes. A paper presented at the 125th Audio Engineering Society (AES) convention (October 2-5, 2008, in San Francisco, Calif., www.aes.org) describes a method of *graceful* degradation recently developed for the Digital Radio Mondiale (DRM) digital radio system, and includes some interesting test data indicating how graceful degradation is perceived by listeners.

Graceful degradation has been one of the hallmarks of the iBiquity HD Radio digital radio system (developed by iBiquity Digital Corporation, Columbia, Md, www.ibiquity.com) and perhaps one of its most distinguishing features. For both the AM and FM hybrid HD Radio systems (these are the systems currently authorized for use in the U.S. by the FCC), the main channel audio signal is simulcast on both the analog and digital portions of the signal. At the point of digital signal degradation, these systems “blend” from the digital to the analog version of the audio signal and consequently the listener continues to hear the audio programming instead of silence as would happen with other (non-HD Radio) digital radio systems under similar circumstances.

The HD Radio system design also provides for graceful degradation when operating in an “all-digital” mode that is not yet authorized by the FCC but which may some day be allowed when the HD Radio receiver penetration in the marketplace is sufficiently high. The all-digital mode offers additional benefits including expanded digital coverage and increased digital payload capacity. In all-digital mode, the main channel audio signal is sent in separate parts, as “core” and “enhanced” bit streams, with the core part being the more robust of the two, that is, better able to survive impairments due to noise and/or interference, or weak signal strength. As the signal degrades, the receiver will first lose the enhanced portion of the audio but continue to receive the core portion, providing for a graceful degradation under impaired or low signal level conditions.

In the graceful degradation method being proposed for DRM, a separate, redundant audio stream with a very low bit rate is sent along with the full rate digital audio signal. According to the AES paper, this method was chosen over more sophisticated hierarchical coding and modulation schemes (such as the one used in the all-digital HD Radio systems) because it requires a lesser amount of change to the DRM standard to be accommodated. This very low bit rate redundant stream is sent with a time delay (with respect to the full rate stream), creating “time diversity” in the audio transmission such that short duration impairments will affect each of these streams at different points in the audio material. When degradation is detected in the full rate stream, the receiver will attempt to replace the degraded portion with the corresponding (and presumably undegraded) portion from the low rate stream. For impairments (or low signal level conditions) of very long duration, both streams will ultimately be impaired and in this case the system will end up in a muted condition, but for short duration events, muting can be avoided.

Two different audio coding methods were tested for use with the DRM low bit rate redundant audio stream, one optimized for speech (Harmonic Vector Excitation Coding or HCVX), and the other for music (a sinusoidal audio codec, denoted SIN, developed especially for this project). The results of some subjective audio testing using these two methods are presented in the graph. For these tests the “Multi Stimulus Test with Hidden Reference and Anchor” (MUSHRA) methodology was used; listeners rated the audio quality of a series of audio cuts on a scale of 0 (bad) to 100 (excellent).



By design (in a MUSHRA test), the reference signal (“Ref”) and anchor signal (“3.5 kHz anchor) are set to full- and mid-scale, respectively. As seen in the graph, the results for the impaired audio samples without graceful degradation (“w/dropouts”) are “BAD” for both speech and music. With the graceful degradation scheme enabled, the audio quality is improved, with the speech material experiencing more improvement when the HVCX codec is used, and likewise for the music material with the SIN codec.

The AES paper is entitled “Graceful Degradation for Digital Radio Mondiale (DRM)” and is co-authored by Ferenc Kraemer and Gerald Schuller, both of Fraunhofer IDMT, Ilmenau, Germany. A copy of the complete AES paper will soon be available for purchase on the AES Web page. Go to www.aes.org/publications/preprints/ and look for the link to the AES 125th Convention, San Francisco, Calif.

The FCC Adopted Computer Modeling for AM Antenna Proof of Performance on September 24, 2008

Attend NAB’s AM Antenna Computer Modeling Seminar and Learn How

Computer modeling for AM Antenna proof of performance was adopted by the FCC on September 24. To learn the basics needed to utilize modeling software, such as MININEC and nodal analysis – used for designing performance-optimized AM directional antenna phasing and coupling systems and proving the performance of directional antenna patterns –- plan on attending NAB’s AM Antenna Computer Modeling Seminar in Washington, D.C. November 20 and 21.

You will learn about:

- Moment Method Modeling Basics
- DA Proofing Using Moment Method Modeling
- Overcoming Limitations of Using Field Strength Measurements for DA Proofs
- State of the Art in Phasing System Design Nodal Analysis of AM DA Phasing and Coupling Systems
- Pattern Design Considerations for Optimum Performance

AM antenna experts Ron Rackley and Ben Dawson, along with antenna modeling software specialist Jerry Westberg, will lead the seminar demonstrating how moment method modeling makes analysis of actual tower current distributions possible and how a model can be used to proof an array provided the proper criteria are considered. All instructors are well known in the radio industry as experts in the field of directional antenna design and maintenance. Their decades of experience offer station engineers an opportunity to learn techniques, tips and tricks that can be immediately useful.

Seminar fee: $395.00 (NAB members) and $495.00 (non-members). For more information on the curriculum, how to register or housing go to AM DA Seminar on the NAB Web site or call Sharon Devine at (202)-429-5338. Register now for the NAB AM Antenna Computer Modeling Seminar!

DEADLINE EXTENDED FOR 63rd NAB BROADCAST ENGINEERING CONFERENCE CALL FOR PAPERS

NAB Show will host the 63rd NAB Broadcast Engineering Conference on April 18 – 23 at the Las Vegas Convention Center in Las Vegas, Nev.

The NAB Broadcast Engineering Conference is a highly technical conference where presenters deliver technical papers ranging over a variety of topics relevant to the broadcast and allied industries. We invite you to submit a proposal to present a technical paper at our conference. The deadline for submitting your proposal is **October 27, 2008**.

To submit a technical paper proposal, click here and complete the electronic form. If you have questions regarding the NAB Broadcast Engineering Conference, please contact John Marino.

It's Not Too Late to Register for the 58th ANNUAL IEEE BROADCAST SYMPOSIUM

The IEEE Broadcast Technology Society
Managing the Transitions
15 - 17 October 2008
The Westin Alexandria
Alexandria, Va.

Keynote Speakers to include: Richard E. Wiley, Wiley Rein, LLP and Peter Fannon, Panasonic Corporation. Please visit the Registration page for additional information.