

NVNA Users' Forum, Washington DC, Fall 2005

The group met from 5-7 PM on Thursday November 30, 2005 at the Washington, D.C. Marriott hotel. 13 people signed up on the attendance list, with three first-time attendees: John Fendrich and Joe Gering from RF Micro Devices, and Robert Dwarkin from Epitaxial Technologies

Introductions: The meeting started with a short description of interest in large-signal measurements by each of the participants.

Discussion Topic 1 "Tips and tricks for distortion measurements":

Kate Remley of NIST showed a simple method for finding vector signal analyzer (VSA) settings that minimize spectral leakage when one is measuring a multisine signal. The method is based on acquiring an integer number of envelope periods with the VSA. It is being written up by Mike McKinley of Georgia Tech, and he hopes to publish it soon.

Patrick Roblin of Ohio State University talked about ways to stabilize LSNA modulated signal measurements by triggering the acquisition. He noted that the carrier frequency and modulation frequency should not perfectly lock, a deviation of 100 Hz is allowed. Thus there is no real need for the 'funny frequency numbers' in the current LSNA software code when performing modulated measurements. Jan Verspecht explained the reason of these funny numbers. He agrees with Patrick's statement.

Jean-Pierre Teyssier of IRCOM stated that by using two fracN's, any modulation frequency can be set. One fracN would be for the ADC's, and the second one for the downconverter (SRD sampler). Jean-Pierre also mentions that there may be issues when the source generates subharmonics. Jan Verspecht mentioned that you do not have to use FFT, there exist other techniques that eliminate the subharmonic issues. Christopher Silva of Aerospace Corp. pointed out that in the case of the MTA, the signals are commensurate.

Jean-Pierre mentioned that IRCOM has developed a hardware set-up to measure IF distortion. It consists of an arbitrary waveform generator, an I/Q modulator, the DUT, and then an I/Q demodulator (thus no RF harmonics can be measured). A dedicated IF-based calibration procedure was developed. Up to 400.000 tones can be handled. This set-up was published by Thibault (T. Reveyrand, C. Maziere, J.M. Nebus, R. Quere, A. Mallet, L. Lapierre, J. Sombrin A calibrated time domain envelope measurement system for the behavioral modeling of power amplifiers European Microwave Week, GAAS 2002, pp. 237-240, Milano, September 2002.)

Paul Hale of NIST mentioned the jitter problem, and referred to a Research Update that he presented later in this Users' Forum.

Patrick Roblin mentioned that the Maury LSNA GUI allows two-tone dynamic AM-PM measurements. Since now the group delay is included, more realistic results can be obtained. Patrick described a paper by Steve Van der Plas of NMDG that describes these issues (S. Vandenplas, J. Verspecht, F. Verbeyst, E. Vandamme, M.V. Bossche "Calibration issues for

the large signal network analyzer (LSNA)”, 60th ARFTG Conference Digest, 5-6 Dec. 2002. pp. 99-106.)

Christopher Silva of Aerospace Corporation pointed out that they have had a calibrated baseband time-domain measurement system since around 1998, mainly used for characterizing travelling-wave tube amplifiers. This system removes the linear distortion caused by the downconverter and uses an MTA to record the converted baseband data. Additionally, in order to avoid the use of windowing techniques when FFT'ing their time-domain measurements from this system, they make sure that the periodic pseudorandom sequences used to create the modulation stimulus signals are commensurate with the time interval over which they make their input/output measurements.

Discussion Topic 2 “Frequency- and Time-Domain models: How do you choose which one to use?”

It was stated that a key problem with frequency-domain models is that they give perfect results at fitted frequencies but can give terrible results at others. To get around this, one could carry out a fit at all frequencies of interest, use time-domain models, or both.

Several agreed that the choice of whether to use frequency- or time-domain models may depend on what quantities you are interested in. For example, for ACPR the frequency domain may be most appropriate, while for waveform analysis, it may be the time domain. Although one participant stated that models for systems using a broadband modulation bandwidth really need to be based in the time domain due to measurement issues.

Several participants agreed that time-domain models may be most appropriate for transistor and device level models since the output at the device level can be highly nonlinear. Frequency-domain models may be most appropriate for circuit-level simulations where nonlinear effects and harmonics are masked by bandpass filtering, matching networks, and other components.

It was pointed out that measurements at RF frequencies for model development are harder in the time domain. In the frequency domain, one can apply discrete tones to distinguish between noise and signal, and perform calibrations and mismatch correction at those frequencies. Although it was stated that the difficulty with RF time-domain modeling can also be circumvented by using a baseband model.

Researchers from NIST described a new covariance-based calibration that can be used to find the correlations between effects in the frequency and time domains. Right now it is being applied to VNA measurements, but ultimately could be used in model development, for example to find unexpected correlations. The methodology is still hard to implement and will need refinement for modeling applications, though.

PhD research

Fabien De Groote from IRCOM presented similar slides to the ones he presented at the October NVNA Users’ Forum in Paris, but he had two new questions to the attendees. See arftg_dec_2005_PhD.pdf.

Only the first question could be addressed due to time limitations. However, the second question was already indirectly touched upon during the Interactive Discussions above.

The first question concerned the measurement of a burst of pulses, and this in combination with pulsed DC bias conditions. The motivation is that the response of the DUT may be different between the second and the first pulse due to memory effects, such as thermal heating.

The general feeling by the attendees was that this set-up is very interesting, as it is important to be able to deduce information on the different memory time constants, which is possible with this type of measurement set-up. Another attendee mentioned that his lab can also do this type of measurement.

Research Updates:

Patrick Roblin of The Ohio State University

When performing high-power measurements with the LSNA, it is important to monitor the power level with a power sensor. The reason being that there may be high power levels at frequencies that are not measured by the LSNA (as not the full spectrum is measured) that may damage the hardware. Patrick has set up such a system and is happy to discuss it with others.

Paul Hale of the Optoelectronics Division of NIST

He talked about correcting time-base errors in equivalent-time sampling scopes equipped with multiple channels, and he presented a demo on the software developed at NIST. The paper explaining the theory behind the algorithm and the jitter-correction software is available for download at: http://www.boulder.nist.gov/div815/HSM_Project/Software.htm

Announcements:

Dominique Schreurs described an on-line interactive discussion forum addressing questions related to measurements of nonlinear devices and circuits (both on-wafer and coaxial), measurement-based modeling, and measurements for wireless systems. The website is <http://mtt.org/committees/mtt-11/nmf.html>. The site contains a selected bibliography with links to papers (we are still looking for additional paper ideas for the bibliography from members). Moderators are Kate Remley and Dominique Schreurs. 78 people have signed up so far! See MTT11_Forum.pdf.

NVNA Users' Forum Organizers:

- Dr. Dominique Schreurs (Dominique.Schreurs@esat.kuleuven.ac.be)
- Dr. Wendy Van Moer (wendy.vanmoer@vub.ac.be)
- Dr. Kate Remley (remley@boulder.nist.gov)

We hope to see you all at the spring meeting at IMS! This meeting will occur Thursday, June 15 from 5-7 PM. Room TBA. Please send us your ideas for discussion topics, research and PhD updates, or other items of interest.