Submission Title: [Removing the effect of the antenna beam pattern from the angular-temporal measurements]
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Re: [Response to the TG3c channel model subgroup call for channel models]
Abstract: [Removing the antenna effect from the NICT measurement data]

Purpose: [Contribution to 802.15 TG3c at the Jan. 2007 meeting in London, UK]

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Measurement Process

The measured data at the receiver is affected by the:

- Transmitted pulse and limited bandwidth of the receiver (windowing, pulse shaping, etc)
- Receiver antenna beam patterns
- Rotation of the receiver antenna
Angular & Temporal Response

Example antenna pattern used at NICT measurement (62.5GHz center frequency and 15° beamwidth)
The measurement process can be modeled as a collection of point sources blurred by Point Spread Function (PSF) and corrupted by additive noise. This reduces the problem of identifying exact times and angles of arrival to a two-dimensional (2-D) deconvolution.
The PSF or impulse response of the system was generated by setting up the data acquisition system in a line-of-sight (LOS) environment with a high SNR and no reflections in the vicinity of the direct path.
Possible Methodologies

- **Blind deconvolution**
  - This technique deconvolves the measured data with an initial PSF using the maximum likelihood algorithm

- **Lucy-Richardson deconvolution**
  - It is based on maximizing the likelihood of the resulting cleaned arrivals under the assumption of Poisson noise statistics in the original data

- **CLEAN algorithm**
  - CLEAN algorithm is essentially a recursive subtraction of the shifted PSF from the original data
  - Need to fine tune and locally normalize the noise floor for constant false alarm detection
  - A good approach when the PSF is known with reasonable accuracy
Example of the CLEAN-ed Data

Original Image (Tx-360, Rx-15, Residetial-LOS Threshold -35 dB)

Cleaned Image (Tx-360 Rx-15 Residetial- LOS -35 dB threshold)
Example of the CLEAN-ed Data (2)
Conclusions

• Effect of the receiver antenna gain pattern can be removed by using a deconvolution algorithm such as CLEAN

• By cleaning the measured data, we can have a better estimate in:
  – Detecting the actual arrivals
  – Removing the false arrivals

• Cleaning the measured 2D data reduces the size of the observed clusters (lower cluster angular and delay spread)

• Cleaning the measured 2D data could in general increase or decrease the number of the observed clusters
References

- Hirokazu Sawada, Yozo Shoji, Hiroyo Ogawa, “Angle of Arrival Measurement in Home and Office Environments”, National Institute of Information and Communications Technology (NICT), Japan, doc# IEEE 802.15-06-0012-01-003c


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