Estimation of Channel Parameters in the Frequency Domain

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Because the original sliding- and stepping-correlator wideband channel sounders dating back almost forty years were based on time-domain measurements, post-processing of channel measurement data are also traditionally conducted in the time domain. With the advent of VNA-based channel sounders for channel characterization in short-range indoor environments, the focus has switched to frequency domain measurement. Nevertheless, the vast majority of channel measurement data are transformed to the time domain before the data are post processed and channel parameters are estimated. Although time and frequency domain representations of the channel are nominally equivalent, the presence of phase noise in the frequency domain measurements, a growing issue as measurements are conducted in increasingly higher frequency bands, can introduce significant distortion into the time domain representations and reduce the fidelity of channel parameter estimates.

Here, we demonstrate the dramatic improvement in channel parameter estimation accuracy and dynamic range that can be achieved by estimating channel parameters using only the amplitude component of frequency response data when the phase component of the data is corrupted by noise. We show that path loss, Ricean K-factor, noise threshold, coherence bandwidth and fading cross-correlation can all be estimated with far greater accuracy and much higher dynamic range – in many cases tens of dB - than would otherwise be possible in the time domain. The advantage is particularly apparent when characterizing millimetre-wave channels given the relatively high phase noise present in such measurements. We conclude by presenting a MATLAB-based frequency domain processing toolkit that we have developed in order to promote the application of such techniques.