Comparison of Array Configurations for Optimum Beamforming in Terms of Signal Spatial Signature Angle Difference, Angle of Arrival Difference, and Polarization Angle Difference

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The optimum beamformer output signal to interference-plus-noise ratio (SINR) with one desired and one interfering signal can be expressed in terms of signal spatial signatures and noise power (Dietrich, et al., *AP-S Int'l Symposium*, 640-643, 2002). The expression can be written as a function of the angle between the spatial signature vectors of the desired and interfering signals. This presentation expands on that work with applications to typical array configurations used for beamforming and radio channels of practical interest.

First, we present an analytical and simulation-based evaluation of canonical co- and multi-polarized array configurations in terms of the SINR achieved in a variety of single-interferer scenarios. Free-space and multipath channels are considered, as are multiple cases of angle of arrival relative to array geometry.

Next, we present measurement results for specific physical angles of arrival, polarization angles, and array geometries, and compare these with the modeled cases. Measurements conducted at 2.05 GHz in Virginia Tech's anechoic chamber and in rural and campus multipath channels are presented. In the multipath channels, the effect of variations in both angle of arrival and polarization angle on beamformer performance are significantly reduced.

Based on the above analytical, simulated, and measured results, the interrelationships between SINR, spatial signature angle, physical angle of arrival, polarization angle, and element spacing are investigated. Spatial signature angle is shown as a function of physical angle for several array configurations and element spacings. This provides a particularly useful and intuitive measure for comparison of array configuration performance.

Finally, the implications of the spatial signature-based approach for, and potential for extending it to model, multiple-interferer cases and wideband signals are discussed.