Compressive Two Dimensional Beamforming of MIMO Data Collected in a Refractive Environment
USNC-URSI National Radio Science Meeting

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The phenomenon of ducting is caused by abnormal atmospheric refractivity conditions, and is known to allow electromagnetic (EM) waves to propagate over the horizon with unusually low propagation loss by creating abnormally strong propagation channels. It is unknown what effect ducting has on multiple input multiple output (MIMO) channels, which allow for the detection of the angle of arrival (AoA) and angle of departure (AoD) of transmitted and received signals. Because ducting is known to cause abnormalities in the single input single output (SISO) propagation channel, it is reasonable to believe that ducting will cause abnormalities in MIMO channels, particularly in the AoA/AoD of communications signals which could convey important information about the properties of the duct.

We propose the use of a high accuracy angle of arrival (AoA) and angle of departure (AoD) estimation technique for MIMO communications known as compressive two dimensional beamforming to analyze the multipath characteristics of MIMO channels in refractive environments. The proposed processing technique is first tested in simulation and shown to accurately identify path angles taken by MIMO signals. Error rates are found experimentally to further solidify the validity of compressive two dimensional beamforming. Experimental data was collected from a 4x4 MIMO communications array located in a ducting hotspot on the coast of southern California over a period of eighteen days. The data was processed using the proposed method and the evolution of the multipath environment was analyzed.

Ducting events were delineated as events where the received power was significantly greater than average. Regardless of ducting, the path angles taken by the signal were more or less identical at all points, though the stability of the channel was slightly lower during ducting periods. It was found that path angles are not very representative of duct characteristics, at least for the particular dataset in question. Further measurements taken in different locations are necessary to fully confirm the results.