Music Algorithm Implementation in MIMO system

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The main goal of this work is to develop a practical solution capable of estimating the angle or Direction of Arrival (DOA) of an incoming multisine signal, using a Multi-sine technique and the MUltiple Signal Classifier (MUSIC) algorithm [1].

The estimation of direction of arrival is a technique to determine the angle of arrival of an incoming Radio Frequency (RF) wave on an antenna array. This work presents a dynamic application for the MIMO system in which the main goal is to evaluate the influence of multisine signals on the performance of the MUSIC algorithm. As shown in figure 1, the architecture of this system is composed of several elements. The transmitter is connected to the transmitting antenna to generate the RF signal. Consequently, a Uniform Linear Array (ULA) antenna is connected to several receivers to obtain the receiver signals. The ULA was configured with four and eight antenna elements. In the signal process subsystem, the MUSIC algorithm is applied, in order to estimate the angle or direction of arrival of the transmitted signal. Thus, a study is carried out to analyze the effects on the performance of the MUSIC algorithm when different multisine signals are transmitted. Figure 2 shows the estimated DOA's for the different transmitted signals at 130 degrees obtained from the MUSIC spectrum, given in (1):

$$P(\theta) = \frac{1}{a(\theta)^{H} U_N U_N^{H} a(\theta)}. \quad (1)$$

Where $a(\theta)$ denotes the array response vector for the angle θ, $\theta \in [0,180]°$, U_N represents the noise subspace and $a(\theta)^H$ and U_N^H are the Hermitian matrixes of $a(\theta)$ and U_N, respectively.

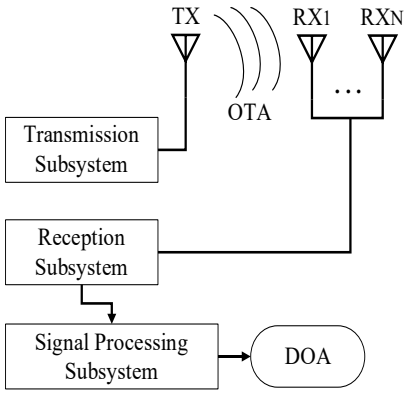

Figure 1. System architecture: TX- Transmitter Antenna. RX- [1, …, N], N=number of elements in ULA. OTA- Over the Air.

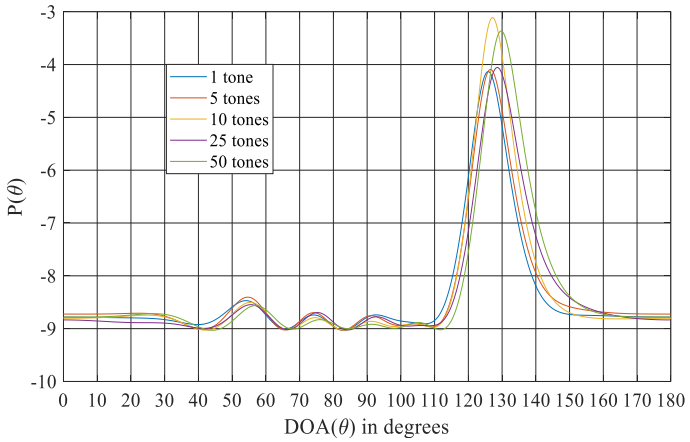

Figure 2. Measurements performed for position=130° with an 8-element ULA.

The obtained results demonstrated that the MUSIC algorithm performance was influenced by the different multisine signals. In other words, when the number of multisine increases the MUSIC algorithm performance achieved the intended position more precisely.

References

[1] R. Schmidt, "Multiple emitter location and signal parameter estimation," in *IEEE Transactions on Antennas and Propagation*, vol. 34, no. 3, pp. 276-280, March 1986, doi: 10.1109/TAP.1986.114380.