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Analysis and Modelling of Massive MIMO Channels

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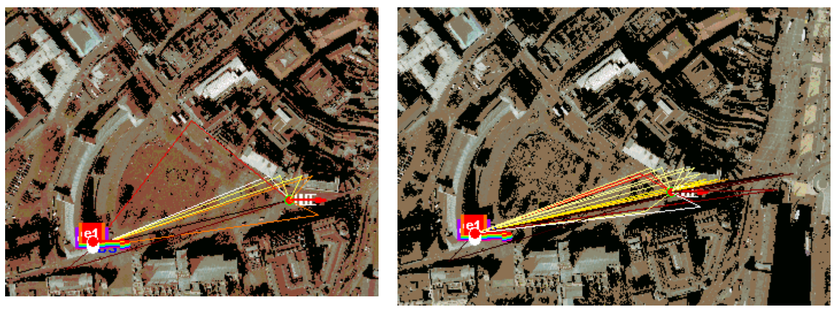
This poster presents an overview of some research in the analysis and modelling of Massive MIMO channels, with a focus on mobility analysis, wavefronts and ray-tracing. Features of the Massive MIMO channel are presented with an analysis of their properties.

Introduction

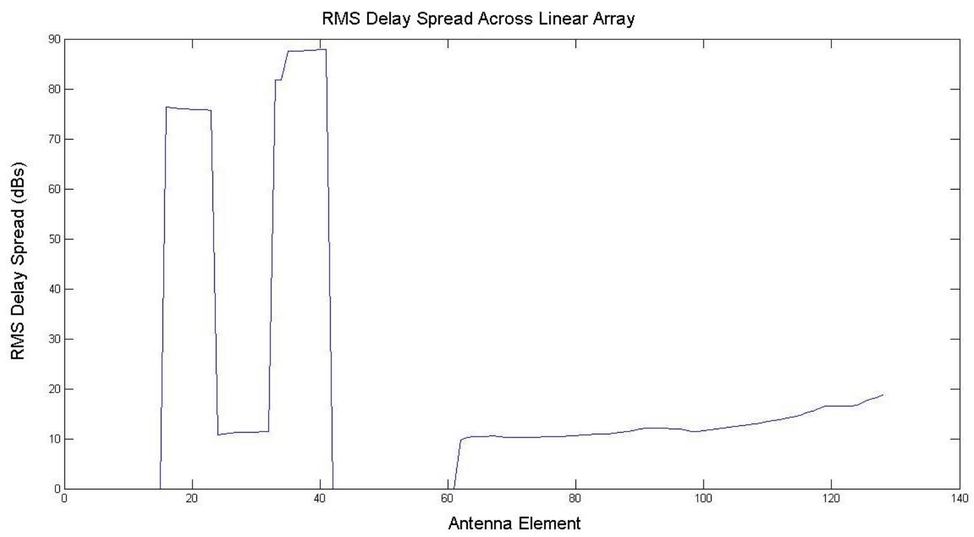
Massive MIMO within this context refers to a mobile link operating below 6GHz with a large number of base station elements relative to the number of users. The aim is to increase spectral efficiency through spatial multiplexing and spatial diversity. The results here are based on virtual campaigns using the University of Bristol Ray-Tracer and practical campaigns.

Changes over array

A linear array with 128 elements and half wavelength spacing is placed on the edge of the council building. A common feature of Massive MIMO is the change in parameters as one moves from one end of the array to the other from the perspective of a mobile user:



An example of the change in RMS Delay Spread is shown here:



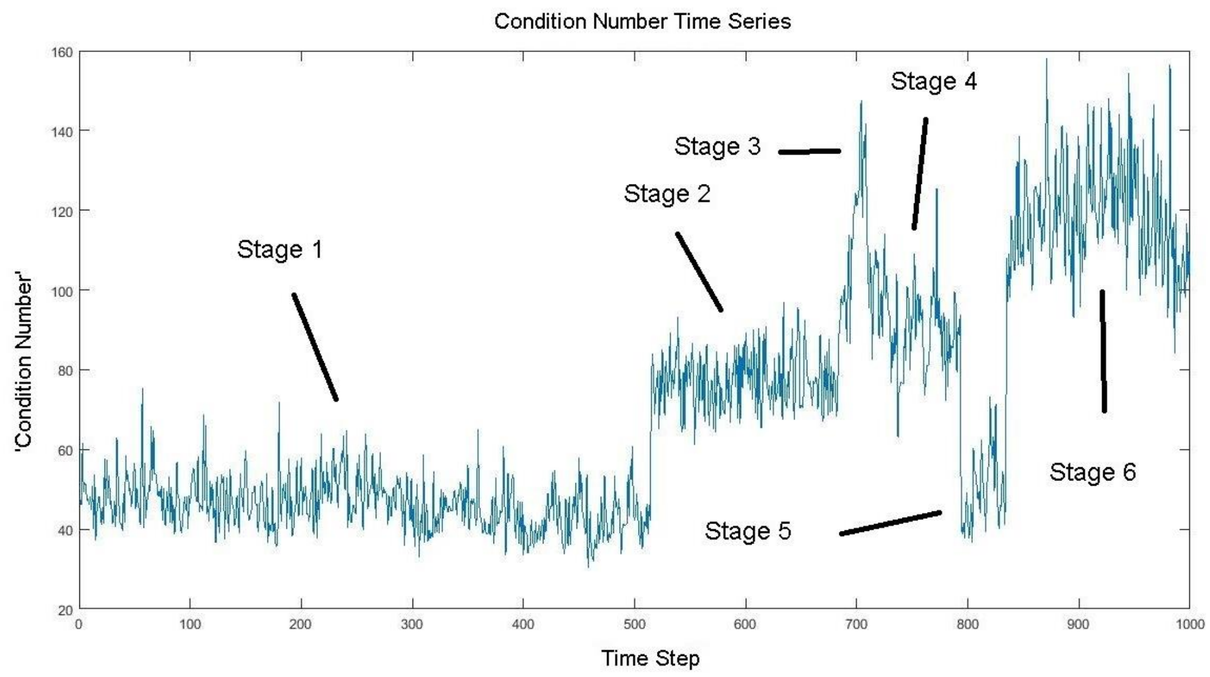
Complete Massive MIMO Channel

This can be found by summing the magnitudes of all k rays at each element multiplied by the phase components with angles θ_k

$$\boldsymbol{H}_{m,n} = \sum_{k=1}^{q} A_k \, e^{-j\theta_k}$$

Mobility Scenarios

A one-dimensional parameter for describing the channel is the Condition Number, obtained from the spread of eigenvalues of the correlation matrix and giving an indication of the rank deficiency. This parameter evolves over time in a mobility scenario (the time step is 5ms):



Change Detection

An algorithm is used to identify the edges of each stage using two sliding moving average windows. The analysis has revealed that stages are recurring within the time series and that there are stages within each of the visible stages that are also recurring.

Further Research

- Obtain more information regarding the physical significance of stages in mobility channels through analysis of ray-tracing results and creating scenarios for the investigation of the channel condition.
- Combine insights from mobility and large array analysis to create verified propagation models.

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