Synergistic Framework for 6G: Integrating Partial LIS and Learning-based Interference Cancellation

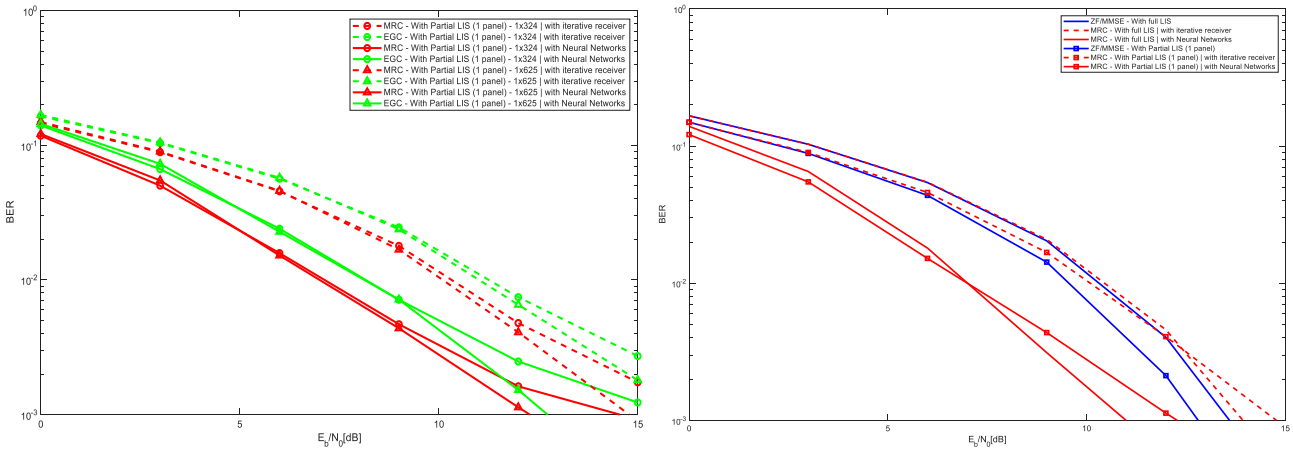
M. Marques da Silva[1, 2, 3, 4] **and R. Dinis**[3, 4, 5]

[1]Universidade Autónoma de Lisboa, Portugal
[2]Ci2 — Centro de Investigação em Cidades Inteligentes, Portugal
[3]Autonoma Techlab, Portugal
[4]Instituto de Telecomunicações, Portugal
[5]Faculdade de Ciências e Tecnologias, Universidade de Lisboa, Portugal

Abstract— The deployment of Large Intelligent Surfaces (LIS) is a cornerstone for 6G networks, yet the practical implementation is hindered by the massive computational overhead and power consumption required to process thousands of antenna elements. This paper proposes a synergistic framework that integrates the hardware efficiency of Partial LIS with the advanced detection capabilities of Neural Networks (NN).

The proposed architecture operates by selectively activating only the antenna panels in the immediate vicinity of the user terminal, significantly reducing the number of active RF chains and overall power consumption. To compensate for the inherent performance loss and increased multi-user interference (MUI) resulting from the reduced physical aperture, a specialized Multilayer Perceptron (MLP) is implemented at the receiver stage. Unlike traditional Zero-Forcing (ZF) or Minimum Mean Squared Error (MMSE) detectors, which rely on energy-intensive matrix inversions, the proposed NN-based receiver, associated to either Maximum Ratio Combiner (MRC) or Equal Gain Combiner (EGC) leverages non-linear mapping to suppress residual interference with low computational complexity.

Simulation results demonstrate that the proposed hybrid solution provides a scalable and "green" alternative for 6G uplink scenarios. Notably, the MLP-based Partial LIS configuration is shown to outperform traditional linear benchmarks, even when operating with a significantly reduced number of active elements. This confirms that computational intelligence can effectively substitute for physical hardware, maintaining high link quality while drastically reducing the system's hardware and energy footprint.



(a) (b)

Figure 1: Performance analysis of the proposed hybrid architecture: (a) BER results comparing antenna densities, demonstrating that the MLP-based stage with 625 antennas compensates for a 50% reduction in physical elements compared to iterative benchmarks; (b) Comparative evaluation between Full LIS and Partial LIS using NN-based detection, highlighting the 7 dB crossover point where selective panel activation effectively reduces noise accumulation.