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| Project Id: **21045**  Project Title: **Performance Study of Massive MIMO System Using Various Detection Algorithms** | |
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| **Short description of the project:**  Massive multiple-input multiple-output (MIMO) is a key technology to meet the user demands in performance and quality of services (QoS) for next generation communication systems. Due to a large number of antennas and radio frequency (RF) chains, complexity of the symbol detectors increased rapidly in a massive MIMO uplink receiver. Thus, the research to find the perfect massive MIMO detection algorithm with optimal performance and low complexity has gained a lot of attention during the past decade. A number of massive MIMO detection  algorithms will be studied in the literature and the performance will be compared among them  in terms of BER and SNR. We will study optimal and near-optimal detection principles  specifically designed for the massive MIMO system and their performance will be analysed. | |
| **Aim/Objective of the project:**  To Explore the huge challenges being faced by wireless communications such as the increased number of users have given a chance for 5G systems to be developed and considered as an alternative solution. For this the concept of mMIMO will be studied properly in this project with its different algorithms. The Performance study of different algorithm will be done by using simulations and BER & SNR will be used for as comparative among them. | |
| **Methodology:**   * We will focus on the basic changes of massive MIMO from conventional MIMO according to its principles & algorithms used. * Different detection algorithms shall be researched for its optimal performance & efficiency improvement. * We will also study detectors based on approximate inversion, which has gained popularity among the VLSI signal processing community due to their deterministic dataflow and low complexity. * And simulation of adopting different mMIMO detection algorithms are presented using MATLAB simulation tools. * Lastly, we will compare different techniques for finding the most optimal & Efficient of them all. | |
| **Possible outcome of the project:**  We will analyze the shown Bit error rate (BER) of different algorithms under similar conditions with different Signal noise ratio (SNR). A comparison will be drawn between different techniques for the best possible outcome. We will review the mMIMO capacity and energy efficiency and also presents the recent beamforming techniques. | |
| **Importance of the project in engineering aspect:**  It will offer new views on different technologies and enhanced versions of the existing ones, as well as new features. 5G systems are going to use massive MIMO (mMIMO), which is a promising technology in the development of these systems. Furthermore, mMIMO will increase the wireless spectrum efficiency and improve the network coverage. | |
| **Innovativeness if any (why the project is different from others):**  An analysis will be carried out for massive MIMO over conventional methods in terms of capacity handling, energy efficiency and spectral efficiency which will contribute greatly towards future 5G network developments. In addition, we present recent advances of detection algorithms which are mostly based on machine learning or sparcity based algorithms. | |
| **Reference:**   1. M. A. Albreem, M. Juntti and S. Shahabuddin, "Massive MIMO Detection Techniques: A Survey," in *IEEE Communications Surveys & Tutorials*, vol. 21, no. 4, pp. 3109-3132, Fourthquarter 2019, doi: 10.1109/COMST.2019.2935810. 2. Shihab Jimaa\* and Jawahir Al-Ali, “Performance Analysis of Various Massive MIMO Detection Algorithms in 5G Wireless Technologies”, International Journal of Sensors, Wireless Communications and Control (2020) 10: 1. <https://doi.org/10.2174/2210327910666191223123059> 3. Abdelrahman, Ayatalla & Abdellatif, Mohammad. (2019). Performance of Detection Algorithms for Massive MIMO Systems. ICSIE '19: Proceedings of the 2019 8th International Conference on Software and Information Engineering. 178-182. 10.1145/3328833.3328882. | |