Revisiting Smart Antenna Array Design for Multiple Interferers with Some Useful Adaptive Beamforming Algorithms: Comparative Performance Study

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Abstract

Smart antennas are becoming popular in the cellular wireless communication for capacity enhancement while reducing multipath effect and interference from undesired direction and to be useful for both base station and mobile handset antennas. The demands for smart antenna is even increasing widely as 5G cellular communication evolves to support higher data speed and bandwidth. The fundamental principle of smart antenna design is the adaptive beamforming using any best suited adaptive algorithm such as Least Mean Square (LMS), Normalized Least Mean Square (NLMS), Sample Matrix Inversion (SMI) and Recursive Least Square (RLS) each having its own pros and cons. Among the four, the LMS and NLMS are iterative approaches while SMI is block adaptive and RLS is a recursive method. Though there are many discrete research works using these algorithms, but comprehensive investigations considering all for smart antenna design is not available to the best of our knowledge. Thus, in this paper, exhaustive comparative performance studies of LMS, NLMS, SMI, RLS are performed in antenna array beamforming with multiple interference rejection using null steering. The contribution of this paper includes implementation methods of adaptive beamforming algorithms in presence of multiple interferers through flow charts illustration. Then exhaustive comparative results are analyzed for all four algorithms in terms of beamwidth, null depth, maximum sidelobe level, rate of convergence and error variation with respect to number of antenna elements and spacing. Finally, a comparative look up table is prepared which observes the pros and cons of all the algorithms listed. This paper will be a good ready reference for researcher in smart antenna design using these adaptive algorithms.

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