CHAPTER 9

RESULTS AND CONCLUSION

The main purpose of this thesis was to make an in-depth study of the adaptive algorithms used in smart antennas. Two adaptive algorithms, the *Least Mean Square* (LMS) and the *Sample Matrix Inversion* (SMI) were discussed in detail. Simulation results were also provided to understand various aspects of the algorithm such as the convergence, the stability, the method of adaptation, etc. The results obtained from the simulations showed that the LMS had poor convergence rate compared to the SMI. This can be observed by comparing weighted response of the algorithms shown in figure 6.6 and 7.4. The fast convergence of SMI is attributed to direct optimum weight computation using computationally intensive matrix inversions. The thesis also presents another adaptive algorithm referred to as the SMI/LMS algorithm, which is a combination of SMI and LMS. The adaptive algorithm based on the new approach had the simplicity of the LMS and the convergence speed, superior to that of the LMS. In the new approach, the initial weights were computed using SMI and the adaptation was achieved by using LMS's iterative procedure. The algorithm is less computationally intensive since it uses matrix inversion only at the start of the algorithm. The superior convergence capability of the combined algorithm was quite evident in figure 8.4.

Additional results are provided below to demonstrate the ability of the combined approach to perform better than the LMS algorithm when the interfering signals are changing their directions. The graphs shown in figure 9.1 and 9.2 are the weighted responses for the LMS and the SMI/LMS algorithm respectively. The simulation conditions here are similar to that used in the earlier simulations. However, the interfering angles are changed every 500 samples to simulate the changing interfering environment. The weighted responses indicate that the SMI/LMS approach provides a better tracking capability with less error when compared to the LMS approach.

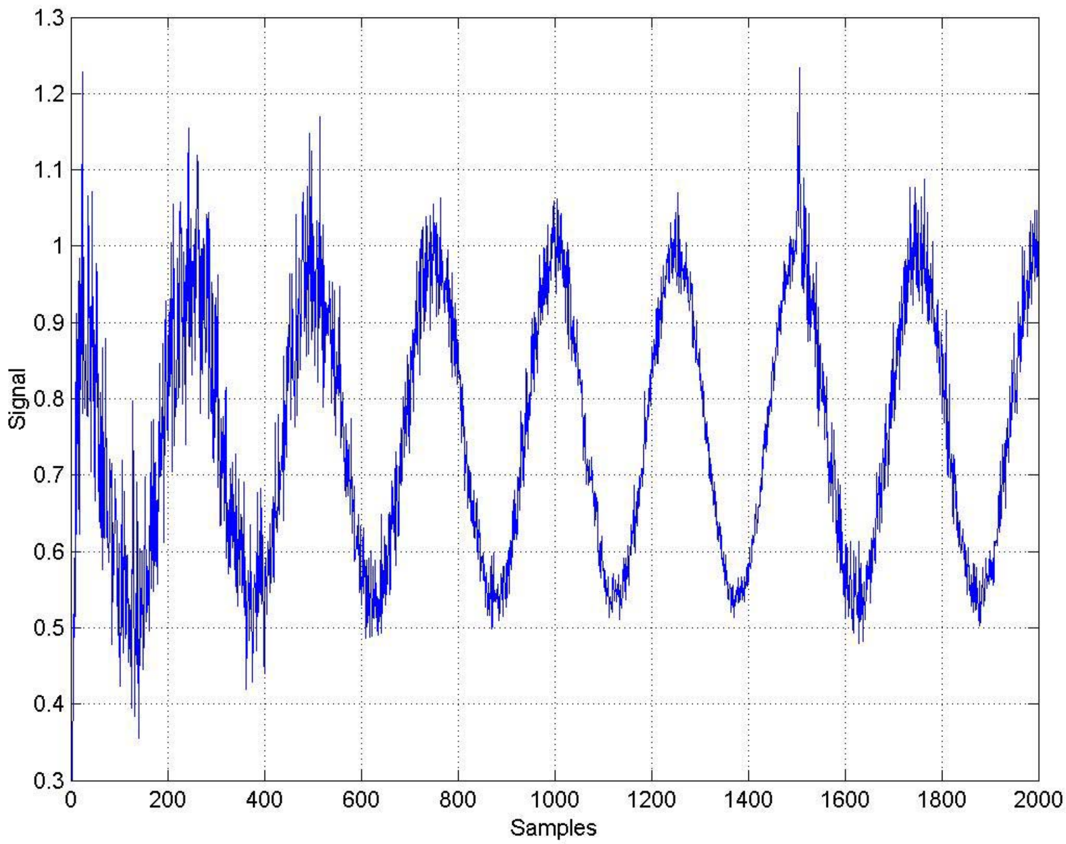

Figure 9.1 Weighted output signal response obtained using LMS algorithm

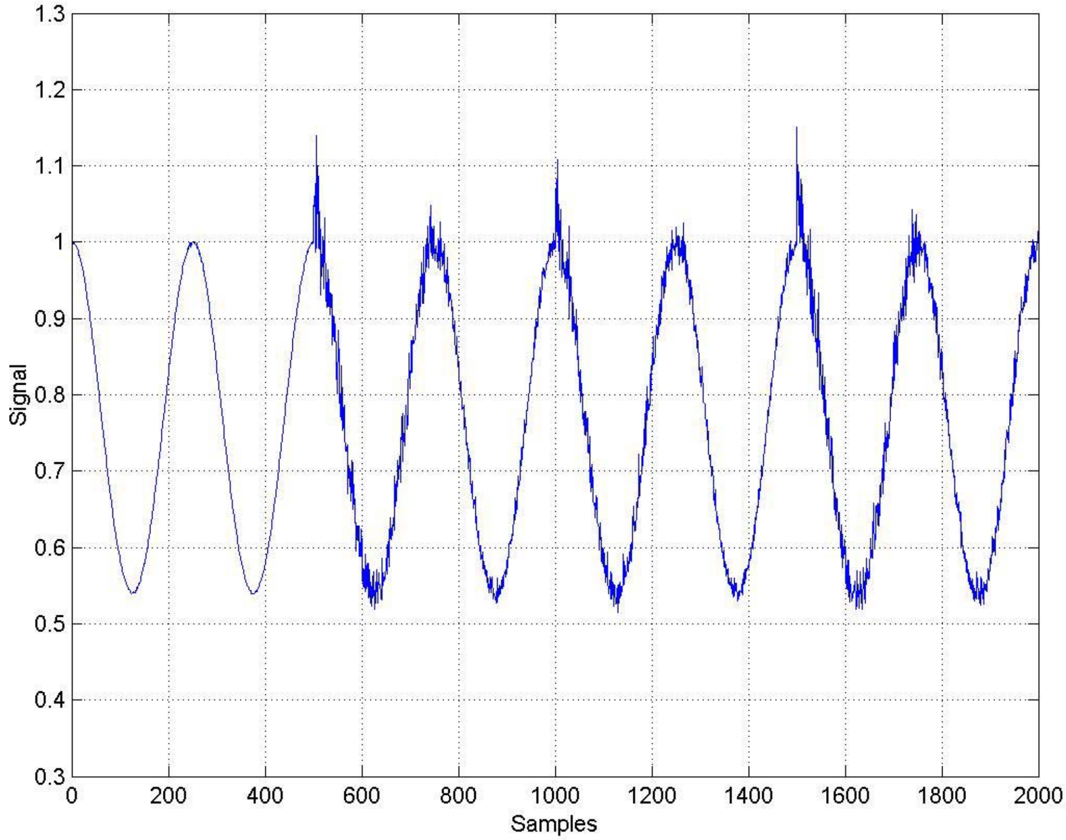

Figure 9.2 Weighted output signal response obtained using SMI/LMS algorithm

The convergence of the weights for both the algorithms are shown in figure 9.3 and 9.4. It is seen that SMI/LMS starts the adaptation with the optimum weights and has to do very little to converge when the interfering angles change. On the other hand LMS algorithm has to converge from the arbitrary initial weight values (in this case, zero) to the optimum weight values. However before it converges to its optimum values the interfering angles would change their directions, which results in the large errors as shown earlier in the weighted response for the LMS algorithm.

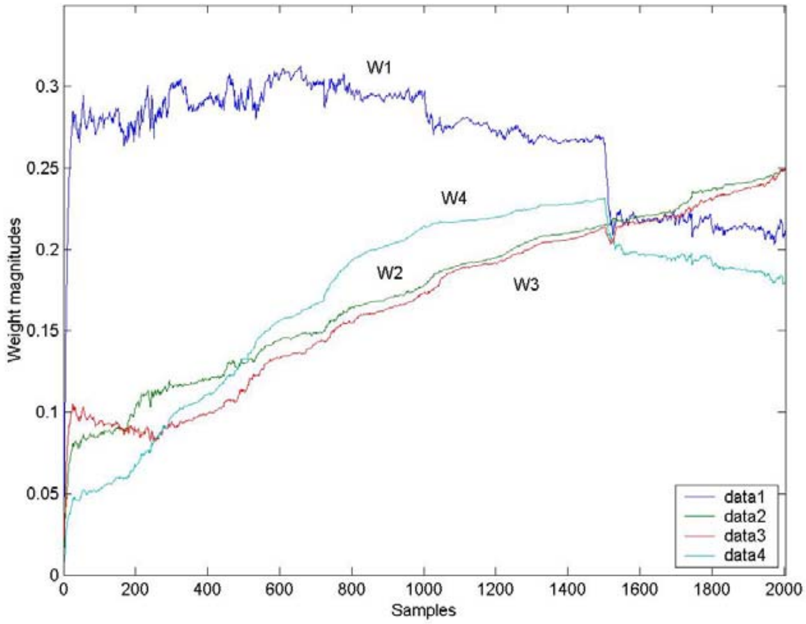

Figure 9.3 Weight convergence plot for LMS algorithm

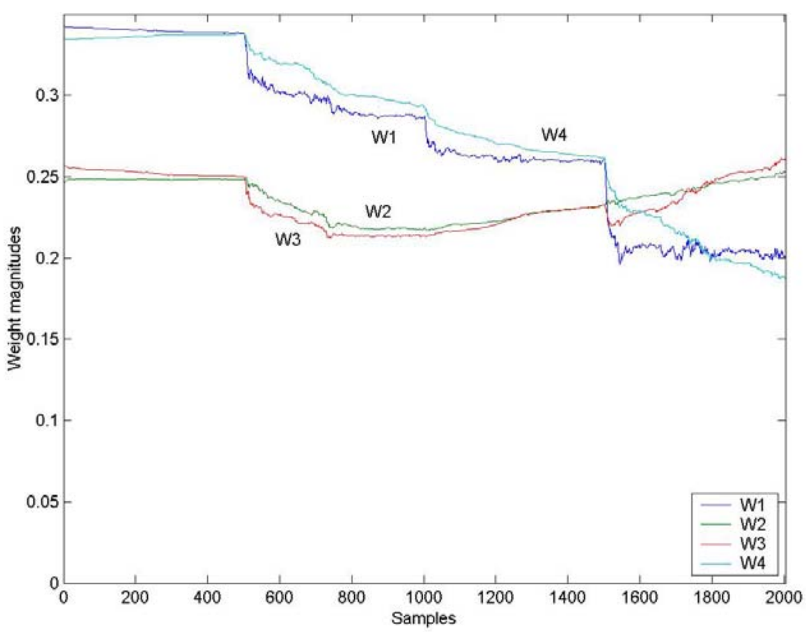

Figure 9.4 Weight convergence plot for SMI/LMS algorithm

Future work

Future work of this study could involve an extension of the simulations performed, to different modulation techniques. Also, the algorithm can be tested in different signal propagation environments. A further enhancement in the algorithm performance may be achieved by incorporating a variable convergence rate rather than a constant convergence rate. Also, when used in an environment that doesn't require continuous transmission improved convergence rate can be achieved by re-initializing the weights (using SMI) between the bursts.