

## 1 Problem formulation

A distributed network can be understood as a collection of nodes. Each node performs its task to collectively achieve a specific goal, such as environment monitoring, target localization and sensor networks. If cooperation exists among the nodes (meaning the individual nodes are able to interact with each other), it can be exploited to improve the 'estimation' or 'sensing' process of each node. A distributed adaptive algorithm addresses the problem of estimation in a distributed network.

Consider a network that comprises of  $M$  such interconnected nodes, each observing some temporal data arising from various spatial sources. Our objective here is to enable the nodes to estimate a vector of parameters from the observed data. In a centralized approach, each node would convey its estimate (or the raw data) to the central processor for processing. If a node needs access to the final processed result, the central processor will have to relay it back. This not only waste valuable resources (bandwidth, time) but also makes the system prone to failure due to the presence of a critical central processing node, without which the network would fail. An alternate approach would be to enable each node to function as an adaptive filter with the aim to estimate the parameters of interest from local observations. The local estimates could be fused with the estimates of the neighboring nodes so that each local estimate is influenced by data sensed by not only at that node but also by the data sensed by other nodes in its vicinity. Several cooperation strategies with their respective pros and cons have been put forward by various researchers.

This project will attempt to study one such cooperation strategy given in [1]. The project will study a peer-to-peer adaptive diffusion technique in which each node is allowed to communicate with its neighbors at each iteration. At each node, the estimates received from the surrounding nodes are fused with the local observations and fed to the adaptive filter.

## 2 Objective

The objective of this project is to study the mean and mean square behavior of diffusion LMS over an adaptive network and reproduce the results of reference number 1.

## References

- [1] Cassio G. Lopes and Ali H. Sayed, "Diffusion Least-Mean Squares Over Adaptive Networks: Formulation and Performance Analysis", *IEEE Transaction on Signal Processing*, vol. 56, no. 7, July 2008.
- [2] Cassio G. Lopes and Ali H. Sayed, "Diffusion Least-Mean Squares Over Adaptive Networks", ICASSP 2007. pp. 917-920.