# 1 PROPOSAL: Distributed Source Localization Using Numerical Methods

For my project, I intend to build a distributed network of PZT sensors whose cards can localize an impact in a composite board based on a method called Sparse Reconstruction. In ref. [1] they introduce a method called the MLSR-FD algorithm, where each sensor node receives observations from its neighbors and based on that each sensor estimates where the position of the impact should be. Figure 1 describes the physical setup of the PZT sensors. If I get enough time, I can compare this algorithm to a fully expectation-maximization (EM) approach to the source localization problem.
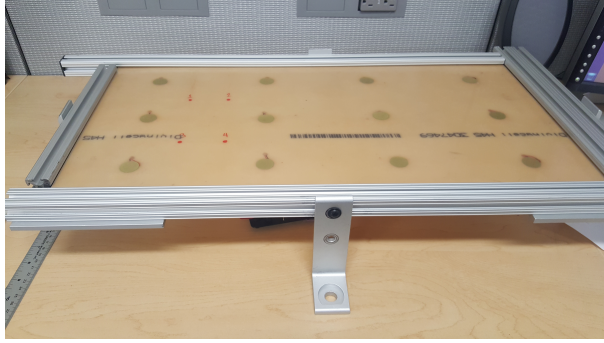


Figure 1: Physical setup of the sensors. It is a composite board with a grid of PZT sensors where each one is connected to a Particle Photon.

It is important to mention that the piezo-sensors can only measure the shear waves that occur during the impact/touch because the voltage comes from having the piezos get "squished." Another consideration to take into account is that time is a very important variable since we would like to obtain near-real-time results. Finally, the source position estimates given in [1] $\hat{\mathbf{r}}^{(j)}(0) = [\hat{x}_{sk}, \hat{y}_{sk}, \hat{z}_{sk}]^T$ are determined by performing the algorithm described in [2]. Ref. [1] summarizes the process in which the source is localized.

- Each sensor $i$ transmits an energy observation to all other $j$ sensors

- Given the observations, the sensors calculate a local estimate

- Given the local estimates of each sensor, now each sensor determines a global consensus

- The global estimates are transmitted to the "sink node" sensor that estimates the final position based on an average

After I obtain the solutions to these equations, I will proceed to make work-precision diagrams and evaluate the method based on order of accuracy since the sample impact locations in this board will remain unchanged. In Figure 1, the dots drawn with sharpies indicates the positions that I will be testing.

# References

[1] Q. Huang, Y. Feng, and Q. Zhang. Fully distributed source localization via sparse reconstruction in wireless sensor network. In *2014 12th International Conference on Signal Processing (ICSP)*, pages 2221–2225, Oct 2014.

[2] Lei Liu, Jin-Song Chong, Xiao-Qing Wang, and Wen Hong. Adaptive source location estimation based on compressed sensing in wireless sensor networks. *International Journal of Distributed Sensor Networks*, 8(1):592471, 2012.