EE 123 Project Proposal

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We have two potential project proposals, both of which we find interesting.

1. Sparse Reconstruction of Sound Fields

Not unexpectedly, methods for reconstructing sound fields to create the perception of "spatialized" audio simplify to solving a least squares problem. Our sound spatialization system (we call it N-Dimensional Audio) currently uses Higher Order Ambisonics (HOA), which expresses a sound field as a sum of simple functions in spherical coordinates known as spherical harmonics. A discrete array of speakers can only produce an approximation to this sound field, which it will optimize according to some loss function. We propose to consider and implement an algorithm for sound field reconstruction based on the notion that the sound field is sparse, and leverage the work in compressed sensing to do so. We could use some of these papers as our guide: 1, 2, 3.

We feel there is a good chance that you do not approve this project because it is not focused on the type of DSP we covered in this class and also, if we fail theoretically in some regard, we may end up with a project which has almost no physical deliverables, which may not be acceptable for a class like EE123. Regardless, if you all willing to allow us to pursue this (and maybe give us some small help along the way), we think we can be successful with this project.

2. Decomposition of Stereo into Independent Components for Spatialized Reconstruction

We had a great idea (partially inspired by Miki) and Googled it and found this very helpful PhD Thesis that had effectively done *exactly* what we were thinking about. The problem of source separation from two channels of music ultimately also comes down to an undetermined system (at least in the formulation presented in this thesis, other models differ, most notably Independent Component Analysis (ICA)), but we are of the belief that there is far more information that can be extracted from the spectrogram (and variants) than has been done so far. We believe there is more than enough information in two channels of stereo to uniquely reconstruct the original stems which make up the song (given some assumptions on the signal which will likely hold for any type of music that sounds even remotely reasonable to the human ear i.e. not like Gaussian noise). We have no intention to theoretically analyze any of these properties, but rather leverage this intuition to do very good source separation and reproduce music in a cool new way.