Harmonic Prime Mover Development for Thermo-acoustic Agglomeration

Power plants that burn coal can produce large amounts of pollution. The government tries to keep the levels of pollution down by requiring that only certain levels of pollution are allowed. Some of the power plants use hydrostatic scrubbers to clean the emission of coal particles. In this process the coal exhaust particles are clustered together using water, followed by the application of an electric field. This causes the clustered coal particles to be directed to the sides of the stack, where they can then be swept away. This process is effective for particles larger than a certain size.

The Harmonic Prime Mover Development for Thermo-acoustic Agglomeration research was intended to be used as an additional cleaning technology for smoke stacks at coal plants. The principles of a Kuntz tube were applied in a circular geometry to agglomerate the coal particles so that the hydrostatic scrubbers could be more efficient. Since the temperature of a coal heat stack is beyond the melting point of conventional speakers that could be used, a thermo-acoustic prime mover system was developed using the existing heat of the smoke stack as the heat source and the surrounding water as the cooling device for the prime mover.

My part of the research was to design and build a harmonic thermo-acoustic prime mover to act as a speaker for the system. This was an extensive task that required me to learn how to use DeltaE, a DOS based software program for the development of thermo-acoustics devices compiled at Los Alamos National Lab. The software comes with a functional example of a principle frequency prime mover which can be modified to fit the user specifications. No one had made a harmonic prime mover at that point in time so finding a way to produce a prime mover to work in a harmonic was difficult, and it took a good deal of time to modify the existing model to specification.

The next step in the project was to gather a list of parts that would be required to build the model. This as well took some time since I had to learn where to look for the parts that would be required, from metal piping to heat sensors. The parts had to be machined to fit the other parts of the system, and then assembled.

The data acquisition software that we intended to use was developed in a previous version of LabView © and could no longer meet our acquisition needs. This required that I program a new driver for the temperature sensor system that we had at our disposal. Front end user software then had to be developed so that data from various temperature sensors and microphones could be gathered for data analysis. This data showed that I had been able to make a thermo-acoustic harmonic prime mover which could later be modified to the specifications of the individual smoke stacks.

The results of this project were presented at Argonne National Lab's Annual Undergraduate Symposium, and then later at the Posters-At-The-Capital event held in Frankfort, KY. To be able to present this research in those avenues, my research mentor taught me how to make an effective PowerPoint presentation, and also to design a professional looking poster.