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Title: Final Progress Report: Internship at Los Alamos National Laboratory

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Final Progress Report:
Internship at Los Alamos National Laboratory

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By

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Company Information

Los Alamos National Laboratory (LANL) is located in Los Alamos, New Mexico. It provides support for our country's nuclear weapon stockpile as well as many other scientific research projects. I am an Undergraduate Student Intern in the Systems Design and Analysis group within the Nuclear Nonproliferation division (NEN-5) of the Global Security directorate at LANL.

Project Info

Originally I was tasked fluidized bed modeling, however, I changed projects. While still working with ANSYS Fluent, I performed a study of particle tracks in glove boxes. This is useful from a Health-Physics perspective, dealing respirable particles that can be hazardous to the human body. I iteratively tested different amounts of turbulent particles in a steady-state flow. The goal of this testing was to discover how Fluent handles built-in Rosin-Rammler distributions for particle injections.

Work Environment

I worked on the health physics flow problems and distribution analysis under the direction of two mentors, Bruce Letellier and Dave Decroix. I set up and ran particle injection calculations using Fluent. I tried different combinations of input parameters to produce sets of 500,000, 1 million, and 1.5 million particles to determine what a good test case would be for future experiments.

I worked in a building outside the security fence with many other students from many different projects and places. When one of us had a problem working on our projects and our mentors couldn't be reached at that moment we helped each

other work things out. It was nice to be around students my age and compare experiences and career goals.

Job Responsibilities

My responsibilities at LANL this summer were to perform statistical analysis of particle data using MATLAB, run sample fluid calculations fluent ANSYS Fluent, and run particle tracking analyses using Fluent.

The first step is to take data from a cascade impactor that was set in an environment to collect particles. The cascade impactor collects particles on plates that are later weighed to determine the amount of mass present in each stage. A cascade impactor separates particles based on size using flow tubes that capture particles above a certain size in each stage. Progressively each stage captures smaller particles. After each stage is weighed, a distribution of particles is produced.

From the raw data, MATLAB was used to create useful graphs of the distribution and fit the curve statistically to a Rosin-Rammler distribution. Once the parameters for the distribution and the range of particle sizes determined, the data can be input into Fluent for simulation.

One could blindly accept the results that Fluent outputs with the original parameters, however I endeavored to discover more about how Fluent handled distributions from injections. What I

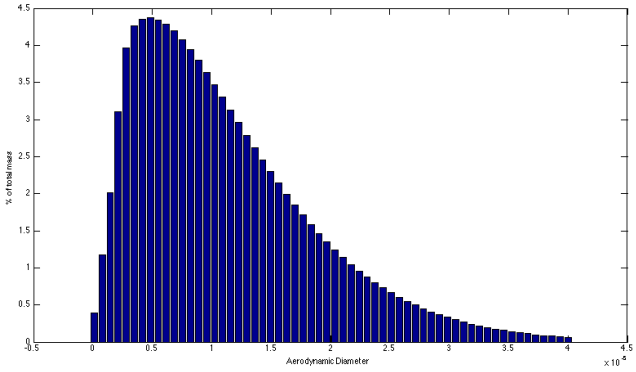

Figure 1, Mass distribution

discovered is that Fluent breaks up a polydisperse distribution into many monodisperse streams to simplify the model. This effectively creates a histogram of particles rather than a smooth function, with 'bins' of different sizes. One other thing I discovered is that Fluent handles mass distributions and cannot use count distributions for calculations. Lastly, Fluent cannot accept User Defined Functions for particle distributions unless the user writes a custom injection file to get the correct distribution.

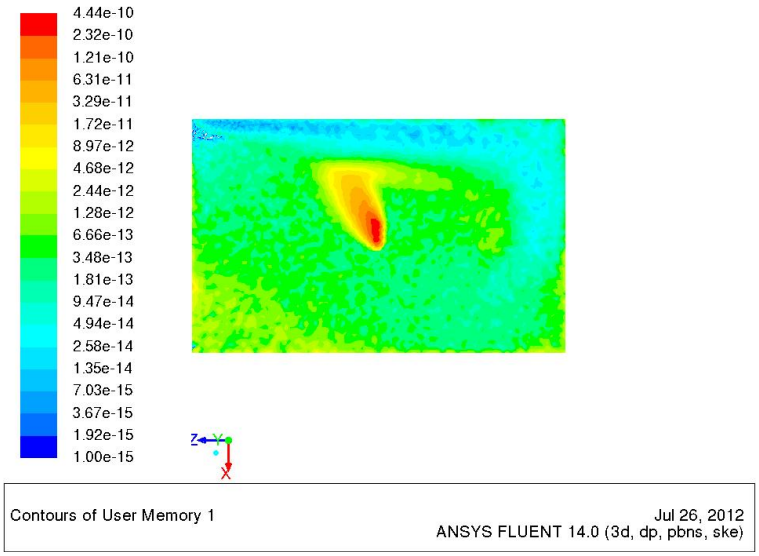

Figure 2, Mass deposited on floor

Learning Objectives

My first learning objective was to model fluid flows with suspended particles. This learning objective was modified, and I found myself working with flowing particles that were much smaller than the fluidized bed of particles that was started originally.

The second learning objective was to preform size distribution analysis of functions using MATLAB, and I used MATLAB to analyze functions for both the original intent, as well as my final assignment.

My Third and final objective was to learn aerosol theory and statistics. I used aerosol theory when analyzing size distributions using MATLAB as well as in flow calculations using Fluent. Aerosol theory was the basis for all of my work at LANL.

Knowledge and Skills Learned

In my time at LANL, I acquired many skills and learned many things that are applicable later in my career as well as in academics. I learned to use MATLAB to a higher proficiency than I had previously. This is a skill I can apply to my engineering courses as well as my career after college. I put my technical report writing skills to work writing progress reports and a final trade study report, which will be included in my submission. Originally I had stated that I would make a poster and present my work at a student symposium at the end of the summer. I wasn't able to present my material, however I wrote a paper to substitute the poster.

I started the summer not knowing anything about ANSYS Fluent, and I come out knowledgeable in setting up and running fluid calculations, as well as creating geometries and meshes in ANSYS Workbench.

Something I did not set out to learn was Aerosol physics, which has applications in almost every industry. It is an application of lift and drag laws in very low Reynolds number flow ($\sim$1).

Beneficial ERAU Courses

Even though I did not use CATIA during my internship, the type of tools in ANSYS Workbench are similar when it comes to creating geometries that can then be meshed to use in fluid calculations, so EGR200 was a great help there. To understand fluid flows and drag laws, Fluid Mechanics (ES206) was what gave me

most of a basis for my understanding of the problems I was solving. Before I let the computer run calculations, I would solve equations analytically before to make sure that the form of the final answer was correct. Differential Equations (MA 345) gave me the skills to preform these calculations.

Conclusion

I performed a variety of tasks in my work as an Undergraduate Student Intern at LANL this summer, and learned how to use a powerful CFD application in addition to expanding my skills in MATLAB. I enjoyed my work at LANL and hope to be able to use the experience here to further my career in the future working in a security-conscious environment. My mentors provided guidance and help with all of my projects and I am grateful for the opportunity to work at Los Alamos National Laboratory.