Matthew Armijo

CHME 391

Matthew Armijo CHME 391 Final Report

My name is Matthew Armijo and I am originally from Belen, New Mexico, where I attended Belen High School. While in school, I enjoyed taking and excelled in my chemistry and math classes, so I knew that I wanted to enter a field related to those disciplines. During my sophomore year of high school, I was assigned a project in one of my classes that asked us to research and learn more about potential careers that interested us. It was through this project that I first learned about chemical engineering and realized that this sounded like a career that was right for me. In my senior year of high school, as I was struggling to pick which university to attend out of the ones that had accepted me, I took an opportunity to visit NMSU and visit with the head of the chemical engineering department, Dr. Rockstraw.

Prior to this visit to NMSU, I was very hesitant to attend an in-state school, as I felt that this would limit my opportunities and wouldn't provide me with the experience that I would need to succeed both in and out of school. However, after meeting with Dr. Rockstraw and learning more about the support and opportunities the NMSU chemical engineering program has to offer me, my decision was made on what school to attend. I've now been at NMSU within the CHME program for three years and will be entering my senior year now in fall 2020. At this time, the highest level CHME courses I have completed are CHME 307 – Transport Operations III: Staged Operations, and CHME 441 – Chemical Kinetics and Reactor Engineering.

In November of 2019, I accepted an offer for an internship with Sandia National Labs during the summer of 2020. Initially, my internship was planned to be in-person, and I would be doing hands on lab work as part of my assignment. However, the outbreak of the covid-19 pandemic caused this to change and meant that my internship could no longer be in-person. Although it initially looked like my internship may be over before it even began, thanks to the hard work of the Sandia intern program, my manager, and many other Sandia Labs employees, my internship was able to be transitioned to completely remote, so that I could safely work from home with a Sandia computer.

The department I was hired into is responsible for the operation of a silicon and semiconductor microfabrication facility that is capable of production as well as research and development. When constructing silicon-based microsystems, two or more silicon wafers are often bonded together, sometimes with integrated devices that can have a wide variety of applications. To detect voids and other defects that form when these silicon wafers are bonded, piece of an equipment known as a confocal scanning acoustic microscope (CSAM) is used that utilizes acoustic waves to image the interface between the bonded wafers. My main objective throughout the summer was to write an image recognition program in Python that would be used to automatically detect and generate data about voids in the images created by this piece of equipment.

This project at first seemed very daunting for me, as I had zero previous experience with both Python and image recognition software. However, my education and experiences within the NMSU CHME department had prepared me well to be able to approach unfamiliar tasks and learn from them. I began by researching online python basics as well as various image recognition techniques that were available to me. My Matlab experience from CHME 392 and other courses also helped me to learn more about Python, as although I wasn't using Matlab, I was able to carry over many of the concepts and techniques that I'm familiar with. As I began to work on writing the code, I started with sections that were very straightforward and easy to understand. As I completed more sections and expanded my Python knowledge, I created increasingly more complex sections of the program. When I finished with the code, the program was able to generate data about the number of voids, their sizes, distances between one another, location on the wafer, and then display this data in both graphical and tabular forms.

My second project involved writing another Python program that uses the same type of images created by the CSAM, but this time looking at wafers with devices on them, and determining which devices are faulty. Although it is usually very easy to determine if a device is faulty just by looking at the image, some wafers have a very large number of devices on them, and it would be impractical from someone to look through every image at every device to try and find faulty ones. The first thing I did was to integrate the previous code I had written as a function into a larger set of functions used to process images from the CSAM. This allowed that program to be used in tandem with other image processing programs for wafers instead of just by itself. After that, I began by looking at some of the statistical data for individual devices on wafers to determine what could be used to qualify a device as faulty or improperly bonded. Some of the material I had learned in IE 311 was useful to me here, as it allowed me to determine what data sets were statistically significant or insignificant, and then classify devices based off data that indicated it may be faulty. The resulting program can detect faulty devices, good devices, and suspect devices, and then display these results using a color-coded diagram of the wafer.

With regards to safety, being that I was working remotely from home for the duration of the internship, there were no physical safety hazards present. However, I did always have to be conscious of cyber security and the protection of the data I was working on. This involved making sure that controlled information was not released to anybody who was not authorized to have it. For example, when sending an email, I always had to double check that there was not any information contained within that shouldn't be sent to the recipient. Information security was also of the utmost importance when preparing this report, as even more stringent requirements exist when releasing information outside of the Sandia system.

Due to the internship being remote, communication between myself, my manager, and other employees was different than what one would expect in a typical workplace setting. Normally, I prefer to be able to talk to people face to face, but of course this wasn't an option for me. Instead, I had to use the other resources available to me to effectively communicate with other members of the workforce. For the most part, I was able to use email and instant messaging to effectively communicate, but sometimes there were situations in which the intermittent nature of these forms of communication were not enough. If I had many questions, or wanted to get feedback on my work, the best option in this situation was to set up a skype meeting, which barring any technical difficulties was almost as good as being able to meet face to face. When speaking with other employees, one of the most important things for me to do was to always ask questions when I wasn't sure about something, especially with the initially unfamiliar aspects of my assignments. Another important form of communication I employed was within my code itself. Although I might be able to look at it and easily understand what it does and why I designed it a certain way, others might not be able to as easily. Thus, it was important for me to write my code in a way that would be clear to others what it was doing, as well as leaving comments within that help to explain it for others that may work on it further after me.

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-NA0003525. SAND2020-7800 O