San Diego State University

Summer Research and Internship Experience

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Introduction

San Diego State University is the nation's leading small research university. The importance of research and development is to advance all areas of science and engineering. Coupled with the academic program, MESA, the opportunity to experience working in a research environment with prominent professors in our desired field of study was provided to us.

During the extent of the internship, Ismael worked in the Advanced Material Processing Lab, under the direction of Dr. Khaled Morsi. In the lab, Ismael used the CATS (Current Activated Tip-based Sintering) process to establish new crack-healing techniques. Kristine, however, worked under the guidance of Dr. Joseph Lewis in the SEAS (Science of Evolving Adaptive Systems) Lab to investigate, study, and test sections of code in the adaptive computational framework, *Starcat*.

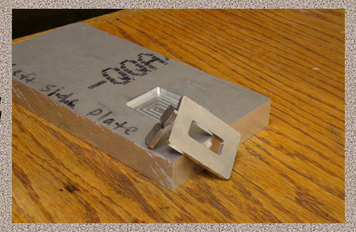
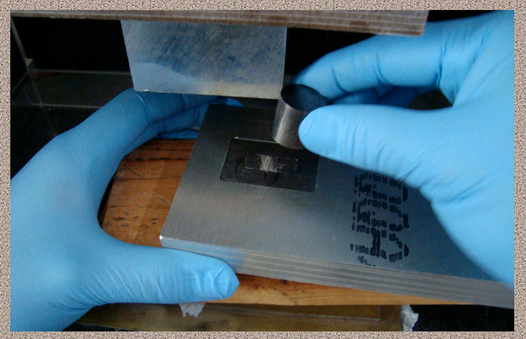


Image of aluminium die with stainless steel inserts and notch specimen (right).

Ismael working in the laboratory — measuring and preparing a sample by filling the specimen with 316 stainless steel powder (left).



Placing the specimen in the Instron machine before running a current test (above).

Methods

Ismael Reveles

- Acquired pieces of high strength steel metal and generated V notches with a diamond blade tool on the materials surface, which allowed use of the same specimen design to be carried out in reproducible tests.

- Conducted literature reviews of articles with related processes to Spark Plasma Sintering.
- Engineered a procedure to explore new implementations for crack-healing in steels, by adopting similar techniques to those of Spark Plasma Sintering.
- Designed and manufactured a test die with a solid modeling program. This allowed the cutting path to be programmed on a CNC (Computed Numerically Controlled) machine. Produced a computer file to extract the commands needed to operate the machine for production.
- Filled and compacted notches with the same composition of powder as the steel parent metal.
- Applied different levels of direct current to the powdered-filled notched specimen to find the desired amount of current to sinter the 316 powder to the parent metal.

Projected Results

Ismael Reveles

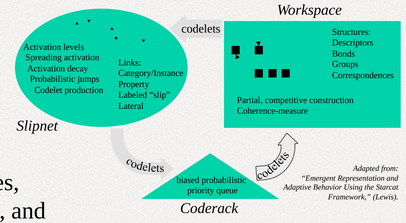
- Analysis of the property changes in the material, as the CATS process is applied on specimen.
- Ability to sinter powder to specimen above 300 amps, while ensuring that the results produce equal hardness measurements throughout the specimen.

Ultimately, we hope to find that by filling in the cracks of material using this process of CATS (Current Activated Tip-based Sintering) we will be able to restore the fracture toughness and strength of the 316 metal to its original state.

Methods

Kristine Schroeder

- Read and studied research materials to attain a general understanding of complex adaptive systems and emergent behavior.
- Utilized an online interface of a predecessor to Starcat, the adaptive computational model of interest *(http://www.itee.uq.edu.au/~scottb/_Copycat/)*. This allowed a means of visual representation to the interworking and relationship of the three main components of the framework: the workspace, slipnet, and coderack.
- Analyzed the code of the Starcat framework. Documented inconsistencies, obsolete code, and areas of question so ultimately changes could be made to clean up the code.



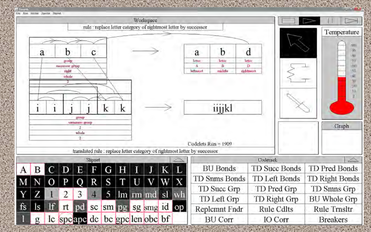
- Assisted Dr. Joseph Lewis in the completion of an article that described the use of Starcat in real-world applications where it is demonstrated that emergent representation can significantly contribute to the behavior of a system.

Projected Results

Kristine Schroeder

- Refinement of the Starcat framework, so it can be utilized in additional research and development of real-world applications.
- Completion of a journal article that is of publishable standards — giving a great opportunity to further skills in scientific writing.

Optimistically, we look to plan additional projects for new areas of research in the SEAS (Science of Evolving Adaptive Systems) Lab.



To better understand the Starcat framework, preliminary hours were spent working with a Copycat applet — a predecessor to the Starcat framework (left).

Kristine — working through the documentation and code for the Starcat framework (right).

Conclusion

This experience was challenging at times since we had to transition from a purely academic environment, where we were able to collaborate with peers more readily, to a more isolated and self-driven atmosphere.

However, this internship allowed both of us to grow in character and apply skills that we had already acquired through previous courses. Additionally, we were provided with knowledge that would not normally be received in the classroom setting.

Finally, we appreciate being exposed to engineering and scientific research at this early stage of our academic career. By doing so, it has better prepared us for our future academic endeavors, so we can continue to strive for the new technologies of tomorrow.

Acknowledgements

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