My 2023 UTSR Summer Experience at Siemens Energy

Parker O’Neal

About me

PRINCETON UNIVERSITY

My name is Parker O'Neal, and I am a senior studying Mechanical and Aerospace Engineering at Princeton University.

I am interested in the advancement of turbomachinery technologies with the goal of decreasing emissions and increasing efficiency.

My specific research interests lie in supercritical carbon dioxide gas turbines and heat transfer.

Background

- Gas turbine blade investment casting is a very lengthy and complicated process with many opportunities for manufacturing defects that can require the rejection of finished parts which do not meet design tolerances.
- Mistakes in the manufacturing process are costly, both in terms of time and money.
- My mentor, Salam Azad, gave me the freedom to approach this problem in whatever direction that I found suitable.
- Since there already existed documents which include statistical analysis of the deviations of the part measurements, I decided to develop a Python tool to help visualize the measurement deviation data in a novel way.

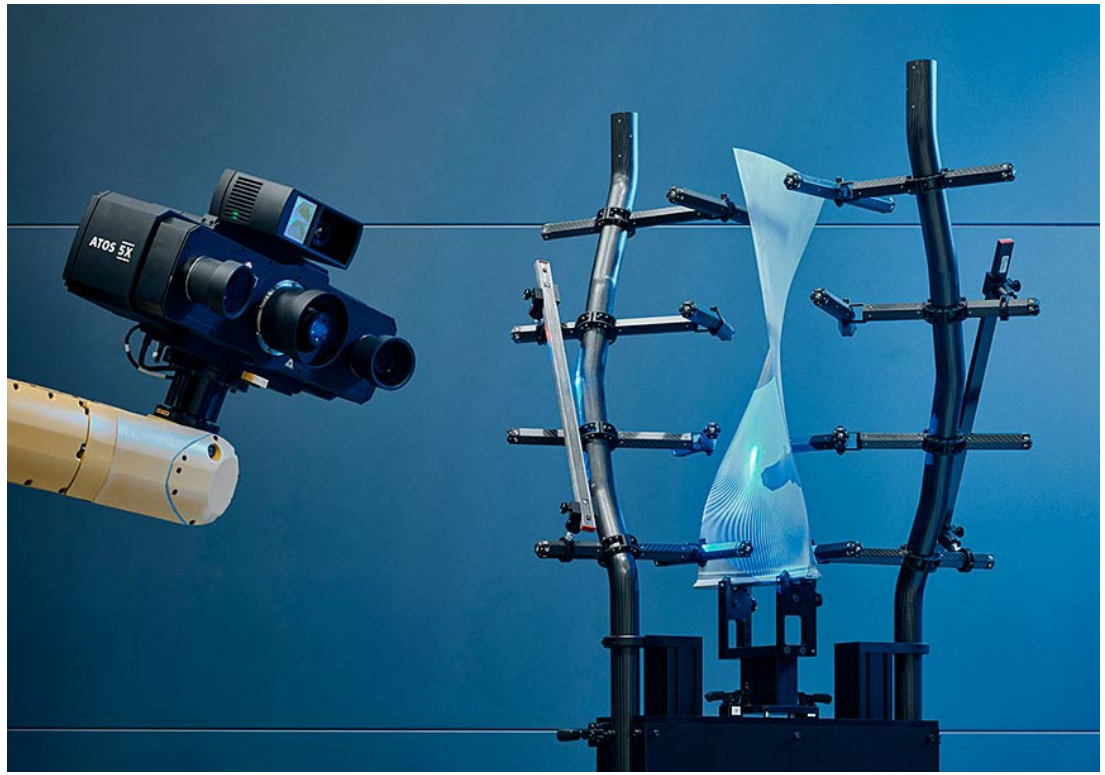
Ceramic core

Wax mold

Ceramic mold

Finished blade (after drilling of cooling holes)

Data Visualization



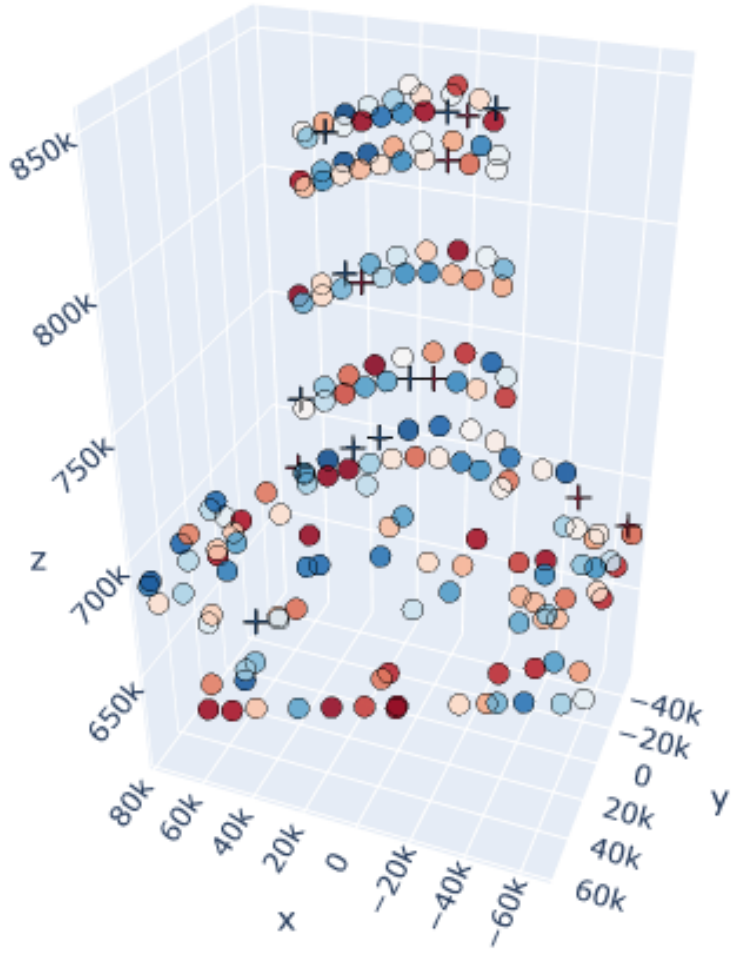
The Python tool I developed reads position data that comes from a blue light scanner as well as wall thickness data that is obtained by ultrasonic testing.

It can display the data of any desired number of parts and works for many different blade types.

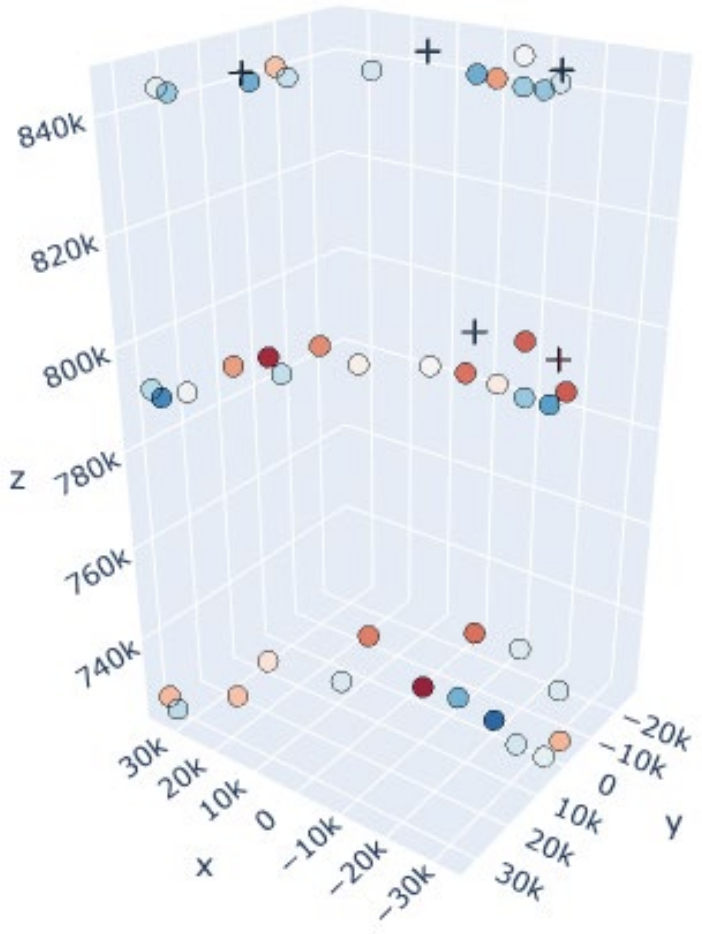
Using this tool, engineers can see patterns in the deviation data such as a shifted ceramic core, improperly formed wax or ceramic mold, and shifting of the constraints during cooling.

This will lead to increased yield of finished blades once engineers recognize and correct patterns in the failure of finished parts.

Bluelight Data: Position



Ultrasonic Data: Wall Thickness



* Dimensions scaled, measurements randomized

TurboExpo 2023

Midway through my summer internship, Siemens Energy honored my request for a week off to attend TurboExpo 2023 in Boston.

I coauthored a paper which was presented at the conference, titled “A Numerical Heat Transfer Investigation Of Lattice Structures As An Alternative AM-Enabled Design For Cooled sCO2 Airfoils.”

I met academics and engineers from all facets of the turbomachinery industry and from all over the world.

Advanced Airfoil Components
a Siemens & Chromalloy Company

Advanced Airfoil Components is a gas turbine blade manufacturing facility owned by Siemens Energy.

I toured the facility and saw just how much work goes into each blade, and it helped me realize how much manpower and space was required to manufacture turbine blades alone.

At the plant, I met with design and quality control engineers to improve my code and discuss new features that would be desirable from a data visualization tool.

Takeaways

- ✓ I learned so much about how Python handles data, and I became a much better coder.
- ✓ I gained experience working with a team of engineers to develop a better, more robust product.
- ✓ I managed my own deadlines and delivered on my promises.
- ✓ I worked in a large company and learned that there is a lot more authorization and paperwork required to get access to software and get projects moving along than there is in academia.
- ✓ I attended my first research conference and learned just how much technology goes into the design and maintenance of gas turbines.

Acknowledgements

- I first want to thank the University Gas Turbine Research Program for the funding that made this summer possible

- Salam Azad was my mentor at Siemens Energy this summer, and I am very thankful for the freedom he gave me in deciding which direction to take my project. He drove me to and from the blade manufacturing facility in Tampa Bay just to give me the opportunity to see how gas turbine blades are made and to meet the engineers who would use my Python tool. I enjoyed our conversations about industry and life, and he made the summer unforgettable.

- Lastly, I enjoyed the time I shared with my fellow interns at Siemens Energy. It was great being around other college students who I could discuss turbomachinery and research with over meals.

References

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