Regression analysis to compute held-back values from the ShockSat dataset

Client Description	Industry	Technologies:
NASA through freelancer.com	Aerospace	- Machine Learning

Challenge:

"Engineers at NASA are working to make revolutionary improvements to aviation, expand understanding of Earth's atmosphere, and develop technology for space exploration. Different components on the spacecraft and its payload, such as the onboard electronics, are impacted by these events and may be damaged by different frequencies of the shock spectrum. For example, electronics are more susceptible to high frequencies and structural components may be more susceptible to lower frequencies. Because of the potential damage due to the shock propagating through the spacecraft, it is important to model the propagation as closely as possible to reduce the risk of a component failure. Unfortunately, this is a difficult problem given the variety of materials onboard a spacecraft and the complicated propagation paths. NASA created standards in the early days of spaceflight based on extensive testing across structures. While these old models are better than nothing, mathematical methods and high-performance computing tools are well-suited to provide better models for shock propagation. The Aftershock Challenge provides you the opportunity to show NASA what you've got by showing how well you can model shock propagation through a satellite structure."1

The specific challenge overview:

The challenge organizers created a structure of multiple types of metals and attached 37 shock sensors across the whole structure. A controlled shock was applied to the structure, and data were collected from all 37 sensors. The organizers then hid the values from 11 sensors. The participants were asked to predict the values of the 11 sensors.

Our solution:

To compute the missing values, regression analysis was applied. First, the distance of each location/sensor to the impact location was measured. The programming language R was used to build polynomial models. The independent values were the distance, and the dependent values were the channel sensors' values. Our prediction ranked among the top 3 in a worldwide competition.

Benefits:

As mentioned in the specific challenge overview, our analysis predicted the missing sensor values. This approach could provide substantial savings by providing a software solution that reduces the number of sensors. A potential 30% cost reduction can be expected.

[1] https://www.nasa.gov/feature/aftershock-nasa-shock-propagation-prediction-challenge