NSF-Funded 2022 ERAU REU: Ensemble Deep Learning

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PROGRESS REPORT

INTRODUCTION

The Nevada National Security Site (NNSS) is a United States Department of Energy reservation located approximately 65 miles northwest of Las Vegas. NNSS specializes in defense nuclear nonproliferation and the pursuit of science. They cannot conduct full-scale nuclear tests, but instead conduct controlled underground experiments and computer simulations to verify that the arms are safe and usable.

NNSS is interested in using neural networks to analyze radiographic images, which is one method of data collection done during controlled experiments. For our neural network, we will be using a widely-used image dataset. However, we hope that our results can still be applied to the research done at NNSS.

PROJECT SCOPE

After background research is collected, a neural network will be created using Python and other packages like Keras/Tensorflow. The network architecture will be trained many times, with a confidence interval given for each trained architecture. Over time, the architecture will be made more sophisticated and an uncertainty quantification (UQ) approach will be implemented to verify the accuracy of the network. Finally, a probability model will be created with a UQ approach.

DATASET

The dataset used is synthesis, optical imaging, and absorption spectroscopy data for 179072 metal oxides [1]. The data contains 180902 images that are size 64 by 64, with 3 channel (RGB). Some of the images are blank, leading to 179072 total samples. The data is normalized from 0-1 for every channel. The color in the middle of each image represents the color of the printed sample, while the "coffee ring" around each sample is darker due to drying. Figure 1 presents an example of the NSF images contained in the dataset.
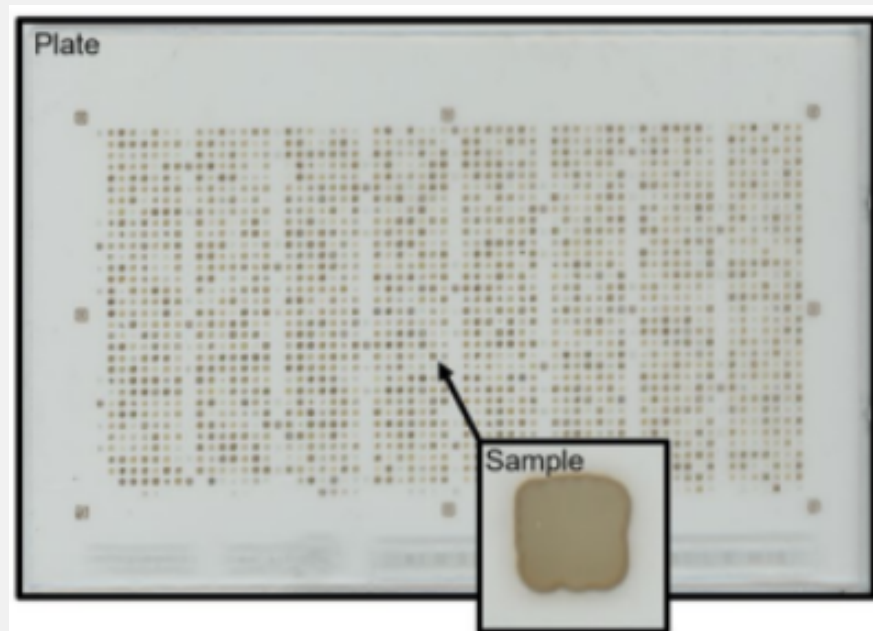
Figure 1: An example set of the images contained in the data set.

REFERENCES

[1]   Stein, H. S., Soedarmadji, E., Newhouse, P. F., Guevarra, D. & Gregoire, J. M. Synthesis, optical imaging, and absorption spectroscopy data for 179072 metal oxides https://doi.org/10.6084/m9.fgshare.7502207 (2019).