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1- Classification of ground targets from radar images (by Amit Mishra)

Abstract; Classification of targets in a combat scenario is a major task. Radar images are more suiitable for this than optical images, because optical cameras can not operate in night time or during cloudy/foggy weather. In this project, you will work on the use of deep learning algorithms to identify ground targets. This is a well researched project and you will find a lot of papers in this domain. Your particular task would be to find the algorithms that can perform well in spite of a reduced training dataset.

Dataset: https://www.kaggle.com/datasets/atreyamajumdar/mstar-dataset-8-classes

3- Defect characterisation of pore-like defects based on simulated ultrasonic testing information (by Mikael; mikael.sahl@hv.se)

Abstract: The purpose of this mini project would be to apply deep learning to classify spheroidal cavities into a limited number of discrete classes based on their morphology.

In ultrasonic testing the echoes of mechanical waves are used to identify, size and to some extent characterise defects inside components. The most commonly format for the data is a time-series of amplitude values known as an A-scan. By merging data from multiple A-scan, top views as well as side vies can be generated which shows heat-maps of high echo intensity locations.

Porosities (pockets of gas) tends to form during the additive manufacturing process due to non-perfect process parameters or gas pores inside the feedstock. Pores which are spherical tend to be less detrimental to structural integrity than more oblate pores, thus we want to be able to characterize the sphericity in a limited number of discrete classes (e.g., percentages ranges).

Dataset: The dataset would be either the time-domain signal or frequency domain (via FFT). To increase the probability of acquiring a detectable signal, the dataset will probably consist of a set or A-scans for each defect, each offset slightly positions wise to give multiple viewpoints of the defect (known as C-scan). The provided data is simulated and variables not of interest for the classification will be varied stochastically to add variation to the data.

Data can be provided in an easily readable structured plain text files.

Expected Outcomes: The expected outcome would be to learn whether it is possible, and in that case what level of accuracy is feasible for classifying the defects with regards to previously mentioned criteria using a deep-learning algorithm.

4- Plastic pollution detection using satellite images (Amit Mishra**)**

Abstract: Plastic pollution in oceans is a major challenge. Detection, classification and tracking of pollutants need continuous monitoring and powerful ML algorithms. In this project, you shall go through an existing work on this. You would be expected to enhance the results. You can also collect more data (its freely available) and even try to design an automated scanning tool that can identify plastic pollutants and raise an alarm.

Data and Existing Work:

https://sentinel.esa.int/web/success-stories/-/copernicus-sentinel-2-benchmark-dataset-for-detection-of-dense-marine-plastic-accumulations

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0262247

Dataset: https://zenodo.org/record/5151941#.Y76GSC8Rryx

https://marine-debris.github.io/

5- Calibration using AI

Abstract: Sensor data is a reflection of the reality. If the true measurand is x, then the sensor measures y = f(x). We want to find out the true x from this through f-inverse (y). This is called calibration. There are quite a few work on the use of ML for calibration. And, as we have discussed, anything that can be expressed as a function can be an ML problem. Use the data from the repository to design a few calibration algorithms. You can look at this paper as a reference.

Data:
https://archive.ics.uci.edu/ml/datasets/Gas+Sensor+Array+Drift+Dataset+at+Different+Concentrations

6- ECG Classification using AI

Abstract: Classification of arrhythmia from ECG/EKG data is a difficult task which takes the doctors years of experience. Can you train a deep learning algorithm to do this?
This is an old challenge. There are papers from as early as 2008 till very recently.

Data: https://www.kaggle.com/datasets/shayanfazeli/heartbeat

7- Identify the bird

Abstract: Classification of bird species from its songs is a challenging task. It is also a very useful task. If we can do this, then we can install cheap mic-based sensors in bird habitats and track the biodiversity over time. We can also look at the pattern of migratory birds. Can you train a deep learning algorithm to do this? Try to improve on the existing approaches.

Data: https://www.kaggle.com/c/birdclef-2022