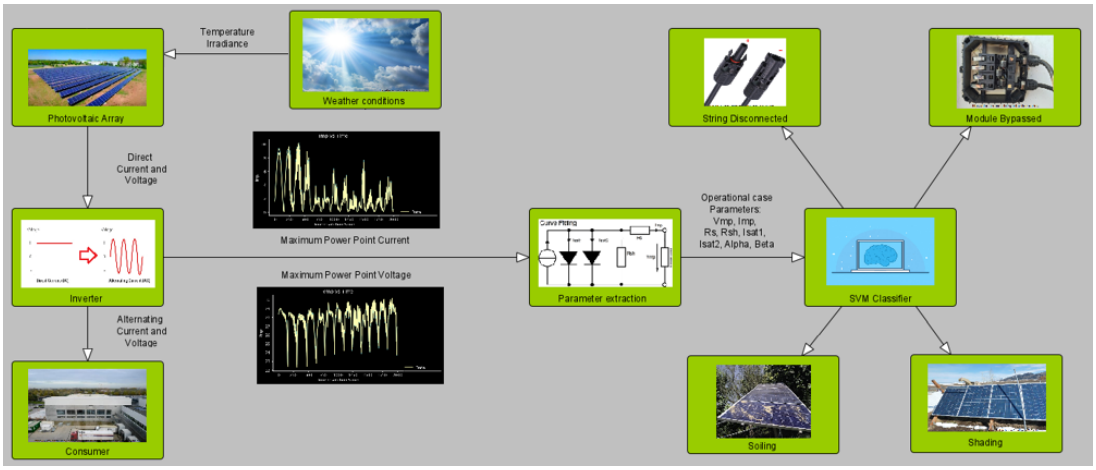
Machine Learning for Photovoltaics

Cost-effectiveness is a decisive factor in the transition from fossil to renewable energy sources. Failures and fixing of these has to be fast. To this end, machine learning algorithms (MLA) are used in this project to evaluate and diagnose various failures in photo-voltaic systems.



Basic diagram of a MLA for fault diagnosis of a photovoltaic system

Challenge

Two major challenges accompany this project. The data to train a Machine Learning Algorithm is scarce or not available. Further to make a diagnostic of a photo-voltaic system it is only allowed to use the input data (temperature and irradiance from a cloud-based service) and output data (voltage and current from the inverter) values. Making the diagnostic cost-effective.

Solution

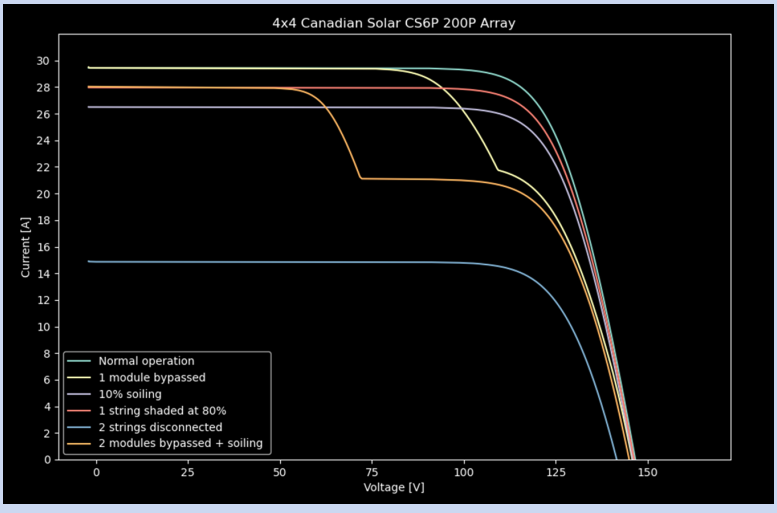
Being data in this field scarce, various failures were modeled in python using two photo-voltaic specialized libraries. The data generated was labeled, stored, and used to train several machine learning algorithms. The different MLAs were evaluated, bests results were achieved using support vector machines (SVM).

Results

The results are an accurate prediction on simulated data of up to 94% using 5 different models of solar panels. It is possible to differentiate between grades of the operational conditions e.g. 5% soiling can be differentiated from 10% soiling. Not only grades but also an accurate prediction (also up to 94%), of two combined operational cases, was achieved.

IV-Curves of Different Operational Cases

Every operational case produces a characteristic current- voltage-curve, the parameters of these, are used to train a machine-learning algorithm. After training, the parameters will serve as a fingerprint for each operational case.



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