Connection Topology Optimization in Photovoltaic Arrays using Machine Learning Methods

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MOTIVATION

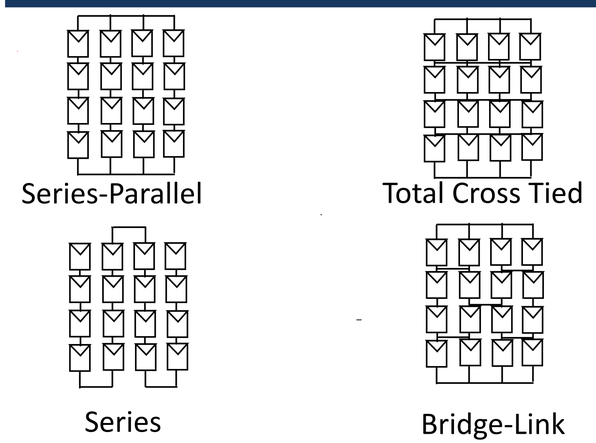
Optimization issues in PV Array Topology ;

- **Partial shading and electrical faults result in significant reduction of power produced;**
- **Reduction of DC/DC Converter and Inverter transients;**
- **Industry requires overall efficiency improvement.**

PROJECT AIM

- **Develop a machine learning model trained with examples of shaded modules with labels of voltage, current, max. power produced;**
- **Obtain analytics including voltage, current and power from the PV modules;**
- **Reconfigure dynamically to a new connection.**

POPULAR ARRAY CONFIGURATIONS



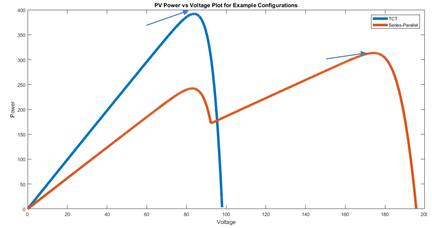
METHOD

- **Simulate the partial shading and fault conditions using the single diode PV modules (4x4) available in Simulink/PLECS;**
- **Train the system for different configurations i)Series-Parallel ii)Total Cross Tied iii)Bridge Link iv) Series only;**
- **Generate the best configuration as a label for each partial shading condition;**
- **Using test data, obtain the best configuration.**

SenSIP -13x8 Solar Facility @ ASU Research Park.

PRELIMINARY SIMULATIONS

- **Preliminary simulations clearly indicate an increase in PV power when the array is reconfigured from one configuration to another under partial shading conditions. The constraint considered here is to improve the power and current produced.**



Example of a partial shading condition where the TCT configuration produces a higher output power than Series only configuration.

ONGOING & PLANNED WORK

- **Use supervised and unsupervised clustering algorithms and neural network machine learning techniques for configuration selection;**
- **Monitor PV module irradiance, voltage and power values using an automated process from the SenSIP solar facility at ASU Research Park;**
- **Determine the effects of DC/DC Converters and Inverters in topology optimization;**
- **Prevention of the MPP from being locked in a local minima using the algorithm presented in [3].**

REFERENCES

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