Project Summary for NSF NCSS I/UCRC – ASU SenSIP Site

ASU-2018-3

Project Name:	**Topology Reconfiguration in Photovoltaic Arrays using Machine Learning**
Principal Investigator:	Andreas Spanias (PI) Student: Vivek Sivaraman Narayanaswamy

Problem Statement:

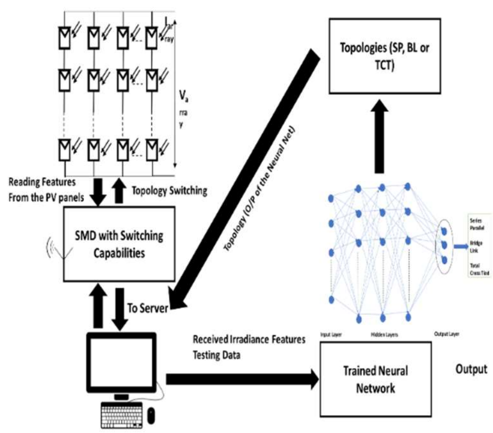
In this project, a cyber-physical system (CPS) approach for optimizing the output power of photovoltaic (PV) energy systems is proposed. In particular, a novel connection topology reconfiguration strategy for PV arrays to maximize power output under a set of partial shading conditions using neural networks is put forth. Depending upon an irradiance/shading profile of the panels, topologies such as series parallel (SP) and total cross tied (TCT) produce different maximum power points (MPP). The connection topology of the PV array that provides the maximum power output is chosen using a multi-layer perceptron model. The method proposed can be implemented in any CPS PV system with switching capabilities and is simple to implement.

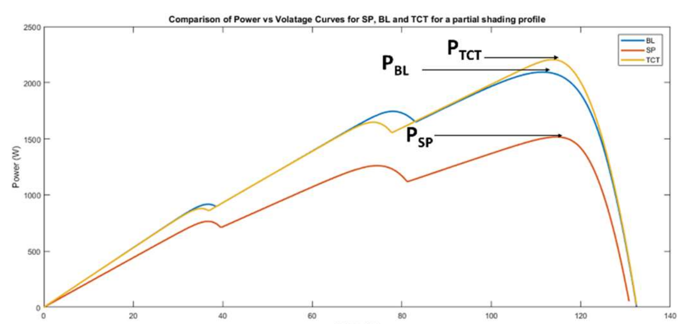
Description:

As the first step, we generate a set of irradiance profiles that correspond to a variety of partial shading profiles representing cloud movement. The irradiance samples are used as inputs to Simulink PV array models corresponding to three configurations namely Series-Parallel(SP), Bridge Link (BL) and Total Cross Tied(TCT). The configuration which produces the maximum power is used as the label for that irradiance profile. The dataset consisting of (irradiance, best topology index) is normalized and equal number of class instances are used. Finally, we use a multi-layer perceptron on the dataset to obtain the classification model.

Latest Accomplishments

- We investigate another configuration namely the Honeycomb configuration in addition to the existing configurations.





Reference:

V. S. Narayanaswamy, R. Ayyanar, A. Spanias, C. Tepedelenlioglu and D. Srinivasan, "Connection Topology Optimization in Photovoltaic Arrays using Neural Networks," 2019 IEEE International Conference on Industrial Cyber Physical Systems (ICPS), Taipei, Taiwan, May 2019, pp. 167-172.

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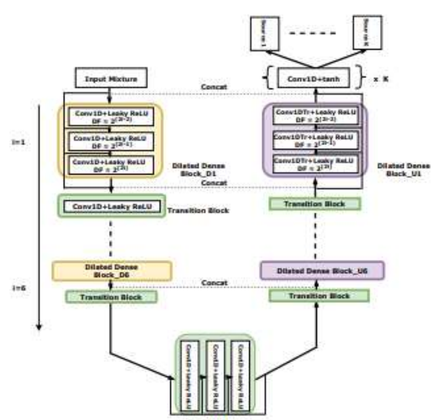
Project Summary for NSF NCSS I/UCRC – ASU SenSIP Site

ASU-2018-3

Project Name:	**DDU-Net : Audio Source Separation via Multiscale Feature Learning**
Principal Investigator:	Andreas Spanias , Jayaraman J. Thiagarajan (LLNL), Huan Song (Bosch Research USA) Students : Vivek Sivaraman Narayanaswamy, Sameeksha Katoch

Problem Statement:

Modern audio source separation techniques exploit temporal context of audio by relying on time-domain feature based deep learning architectures. However, these methods fall short of exploring the specific architectural choices that aid in efficient source separation. This knowledge gap has triggered a need for extensive empirical analysis which provides insights into which architectural choices need to be prioritized. To this end, in this work, we propose the DDU-Net: Dilated-Dense U-Net architecture which incorporates the multi-scale feature extraction capabilities and feature reuse benefit of dilated dense convolutions to obtain state-of-the-art source separation results. In this project, ablation studies including several variants of dilated dense connections are carried out analyze the significance of proposed architectural preferences.



Description:

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In this project, we propose DDU-Net, a fully convolutional approach for audio source separation that leverages a U-Net style architecture, coupled with novel strategies for reliable multi-scale feature extraction. By using a U-Net comprised of an upstream and a downstream block of convolutions at different scales, we jointly infer concise multi-scale representations for mixture signals and the constituent source estimates, where the number of sources and the mixing process are assumed to be known a priori. Although multi-scale feature learning can be carried out using simple downsampling in the downstream path and appropriate upsampling in the upstream path of an U-Net, we show that it is more effective to utilize dilated convolutions, which can model temporal dependencies without any additional parameterization to 1−D convolutions. More importantly, this process avoids the need for specific resampling strategies to combat aliasing artifacts that can arise during upsampling. Furthermore, in order to support sophisticated dependency modeling and to facilitate better gradient flow in deep networks with multi-scale features, we utilize dense connections both within each convolutional block and to support information flow between downstream and upstream paths.

Latest Accomplishments

- We developed a novel approach for audio source separation using dilated dense U-Nets for time-domain audio separation.
- Produce a significant improvement in performance measured by SDR (Signal-Distortion Ratio) over selected baselines.

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