



Hawai'i Natural Energy Institute Research Highlights

Grid Integration

Automated Distribution Circuit PV Hosting Capacity Estimation

OBJECTIVE AND SIGNIFICANCE: This project aims to develop improved algorithms that significantly advance accuracy while reducing computation time for estimating the maximum capacity of distributed photovoltaic (PV) systems that can be effectively interconnected to utility secondary distribution services. The goal is to ensure that these systems can be integrated without compromising the safety, reliability and quality of service for all customers, within the constraints of existing infrastructure and controls.

BACKGROUND: HNEI GridSTART, as a sub-awardee to the University of Central Florida, participated in a U.S. Department of Energy (DOE) project titled "Sustainable Grid Platform with Enhanced System Layer and Fully Scalable Integration." Under this sub-award, the team developed a stochastic analysis-based method for estimating PV hosting capacity of distribution feeders (Figure 1).

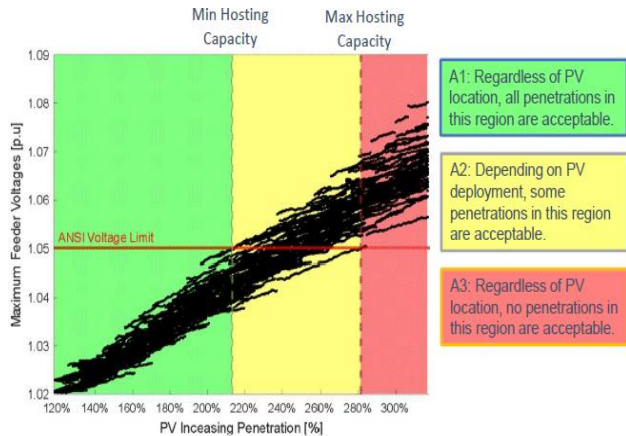


Figure 1. Schematic diagram of PV hosting capacity results.

Building on this foundation, HNEI GridSTART has continued to enhance the PV hosting capacity estimation approach through APRISES funding. The research centers on developing a more efficient algorithm that maintains high accuracy while reducing computational demands for determining maximum distributed PV hosting capacity of secondary distribution services.

PROJECT STATUS/RESULTS: HNEI GridSTART successfully developed a novel two-phase PV hosting capacity analysis algorithm to improve efficiency and reduce computation time. The algorithm underwent rigorous testing across various distribution and low-voltage networks, considering multiple grid

operational constraints including admissible voltage limits, unbalanced voltage limits, thermal overload of distribution components, substation overloads, and power losses. This thorough and systematic evaluation ensured the algorithm's effectiveness across different network scenarios and operational conditions.

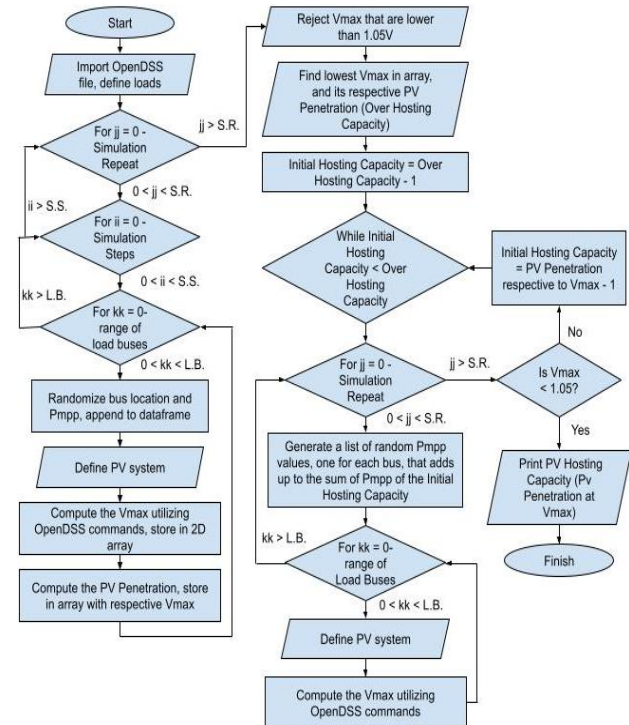


Figure 2. Flow chart of the new two-phase PV hosting capacity analysis algorithm.

The project provided valuable educational opportunities for an engineering undergraduate student to gain practical experience in distribution grid fundamentals, operational standards, OpenDSS software utilization, and Python programming for OpenDSS integration. The research concluded with a paper presented at the 2024 IEEE International Conference on Environment and Electrical Engineering and the 2024 Industrial and Commercial Power Systems Europe (June 17-20, 2024), and was subsequently published in the IEEE Xplore digital library. With the presentation and publication of the conference paper, the project has now been completed.

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