Identifying local PV shading in urban areas based on AC power and regional irradiance measurement

Identifying Local PV Shading in Urban Areas based on AC Power and Regional Irradiance Measurement

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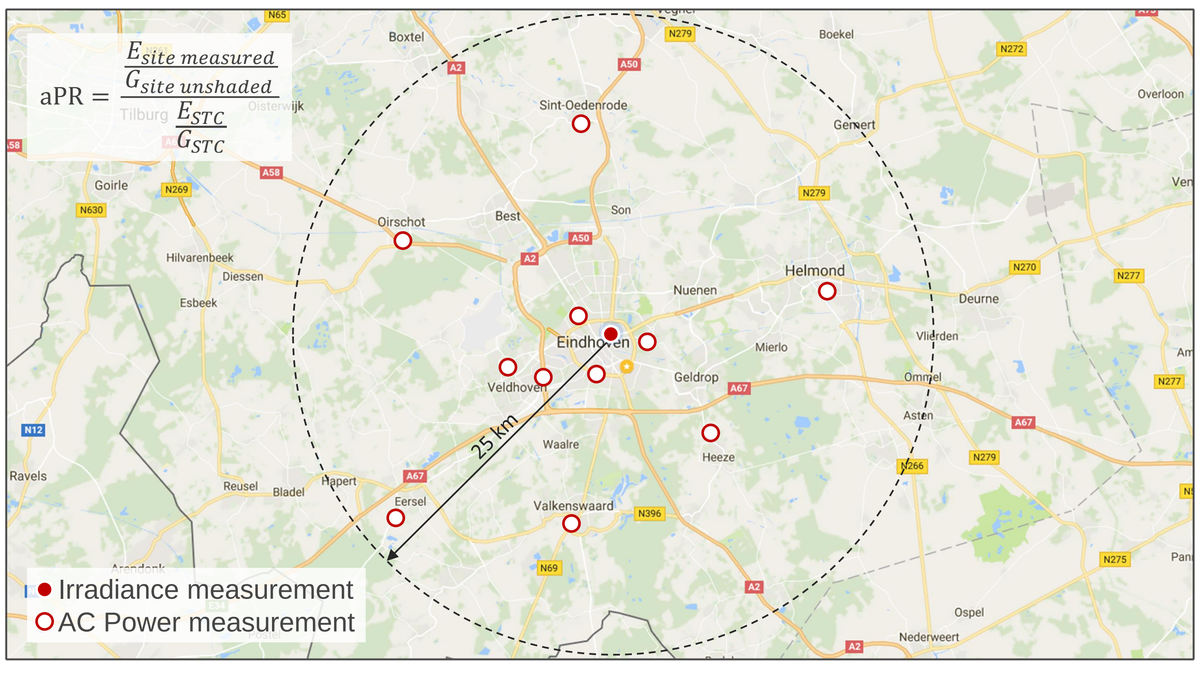
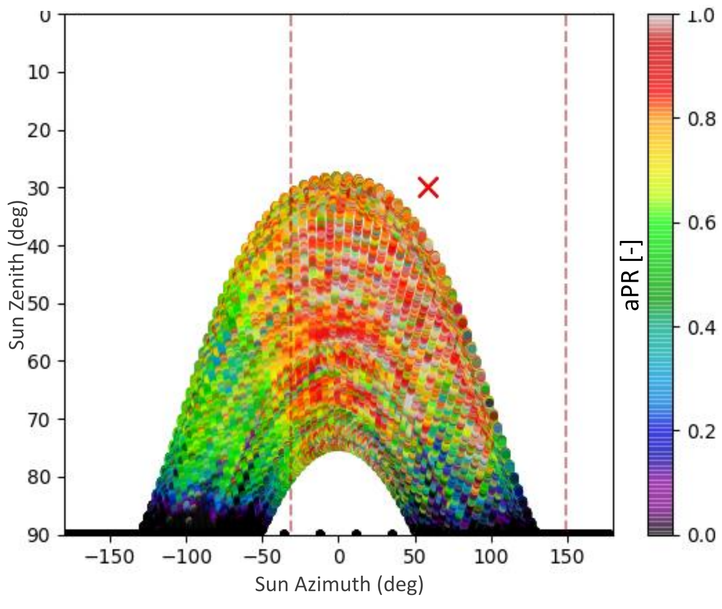
- Photovoltaics in the built environment
- Automated on-site shade detection
- Machine learning – Support Vector Machine
- Fault detection, performance monitoring

In the new era of BIPV applications, it is natural, that PV is installed on a surface that is regularly shaded. Furthermore, dependency of future buildings on on-site electricity generation will increase. This drives the need for accurate performance monitoring, of which shade detection is an essential element.

A method is developed, that relies on locally measured AC power and regional irradiance data. By calculating the apparent Performance Ratio (aPR) and applying machine-learning algorithms on the measured AC power data, locally shaded periods are identified, without local irradiance measurement. The method consists of 5 steps.

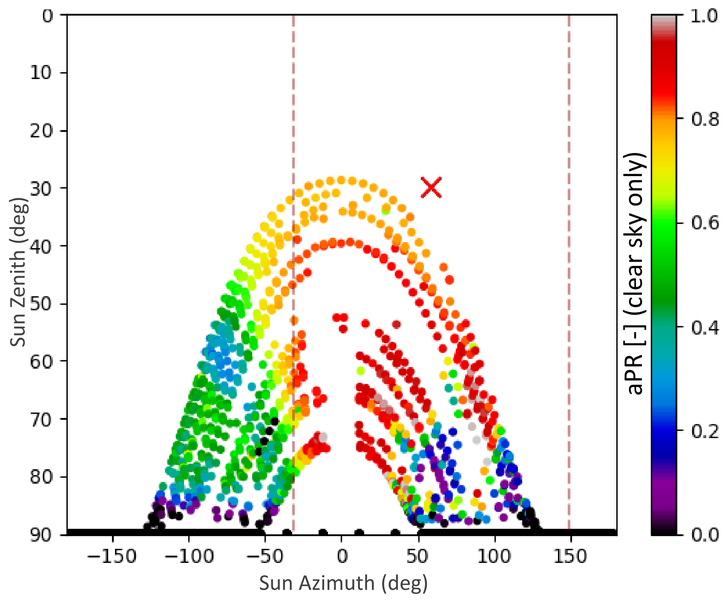


Step 1. Analemma graph



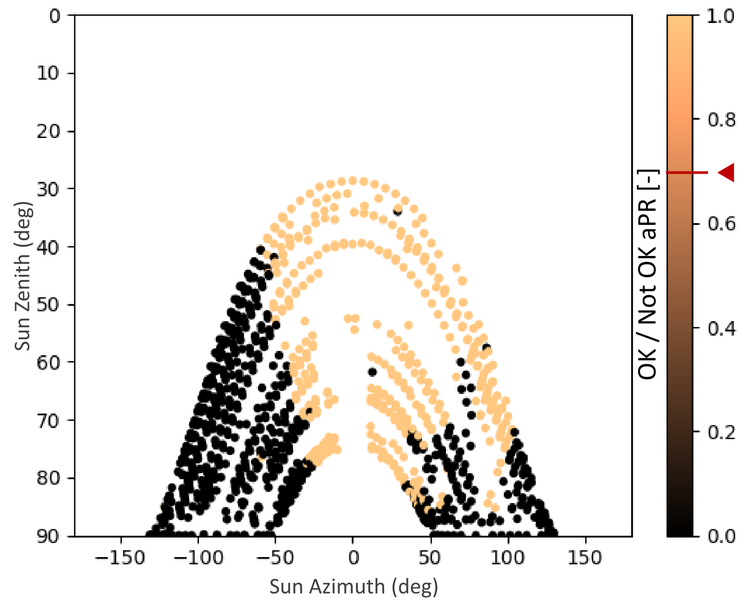
Create an analemma graph of aPR. Each point on the graph represents a solar position. aPR is marked with colors.

Step 2. Filtering for clear sky



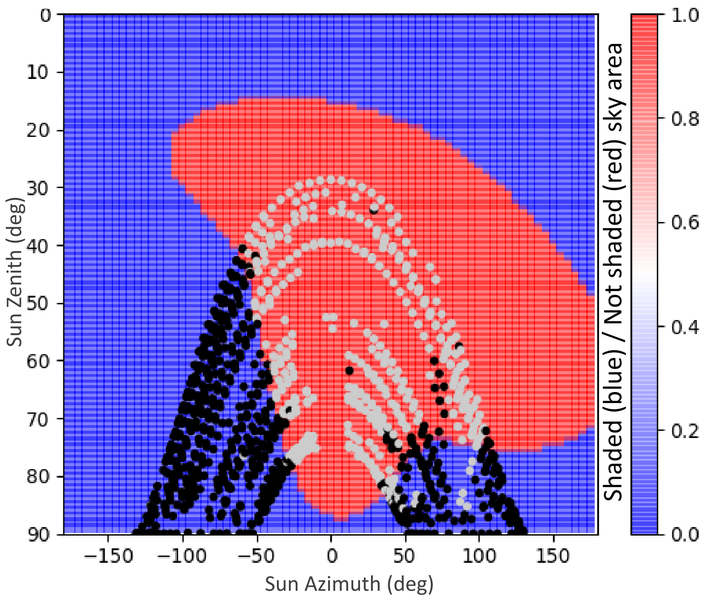
Eliminate data points with possibility of cloud-shading, using clear sky detection by Matthew J. Reno and Clifford W. Hansen.

Step 3. Binarizing



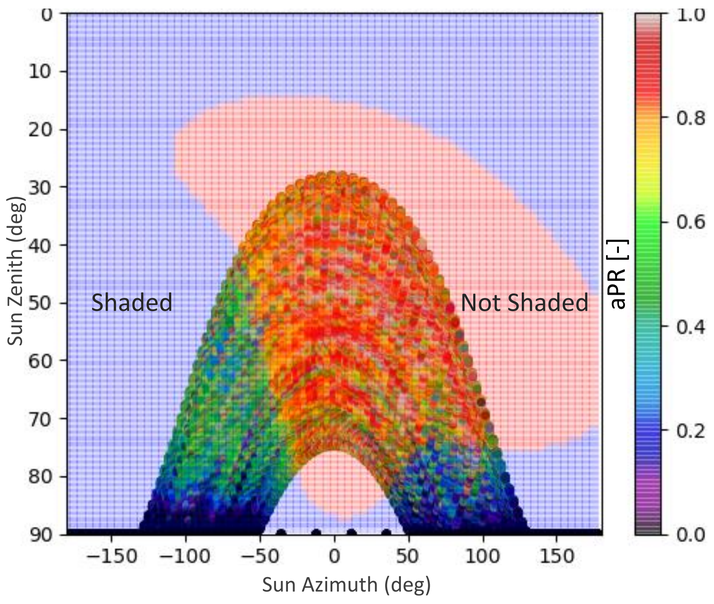
Binarizing the remaining measurement points with an aPR threshold. (<0.7) This set of points will be the training dataset for the SVM classifier.

Step 4. Train SVM



Use the previously binarized dataset to train the Support Vector Machine.

Step 5. Classification



Use trained SVM to perform a soft-margin nonlinear classification of all data points recorded in the first step to identify locally shaded sky areas.

Conclusions – future work

With this scalable method it is possible to distinguish between local and cloud-shading and - in case of a single-plane installation - to plot the shading contour of the nearby objects without local irradiance measurements. It can provide useful input for fault detection and monitoring of BIPV installations in an urban area. The next step is the validation by on-site shading measurements.

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