Predicting temporal variation of local solar PV generation from all sky images based on Stereo and CNN approaches

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Solar photovoltaic (PV) power generation is one of important renewable energy, and both mega-solar and small scale solar PV systems have been rapidly increasing these days. While the solar PV is a common renewable energy source, it is difficult to predict temporal variation of power generation accurately due to its strong dependence on weather conditions. Especially it has been reported that passing of patchy clouds makes the prediction more difficult (Itagaki et al., 2011, 2012). The difficulty is from restriction of spatial resolutions of both weather forecast and observations, that is the grid interval of current weather forecasting is the order of 1 km, and the typical spatial resolution of geostationary satellites, such as Himawari-8, is 500m - 1km size, both are not enough to resolve the small-scale cloud structures (less than 1 km).
To have better spatial resolution for observing clouds, we have developed a cloud monitoring system constructed with multi (more than two) wide field of view (FOV) cameras, the interval of each camera is a few hundred meters. The interval allows us to monitor cloud locations and cloud-base altitude with a stereo estimation method. The wide FOV cameras used in this study can resolve cloud position with a smaller resolution than 100m. In addition, we have corrected solar PV generation data whose time interval is 6 seconds. Training a convolutional neural network about the relationship between sequential cloud images and temporal variation of PV generation, we successfully determined amount of solar PV generation under specified weather conditions. In this presentation, we will introduce our approach for measuring three-dimensional cloud positions and its results, and we will discuss predicting temporal variation of solar PV power generation with the cloud positions and the cloud motions.

Keywords: Solar PV generation, Renewable energy, CNN, Stereo observations

