**3D design and performance simulation of PV plants using the SolarPV software tool**

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ABSTRACT

This paper presents a 3D design and performance simulation tool for PV stations with SolarPV，which embodies BIM technology through Sketchup. The goals of SolarPV is to achieve the following functions: (1)Rapid 3D virtual reality modeling of PV stations, parametric design of PV stations; (2)Automatic arrangement of PV stations; (3)Hourly shading analysis of PV stations; (4)Meteorological data interface based on Meteonorm and NASA; (5)Cloud-enabled project, user, database and algorithm; (6)Massive database of PV modules and inverters; (7)Export standard CAD files; (8)Support PV stations with curved surface or mountain terrain; (9)Support PV station layout with multiple surfaces; (10)Support PV station layout with trackers; (11)Annual total solar radiation distribution map of the selected surfaces; (12)Optimal design of PV station; (13)Calculate the hourly solar radiation on the inclined surface of the photovoltaic array from the hourly solar radiation; (14)Obtain the I-V performance curve and maximum power point of PV under different solar radiation and different temperatures; (15)Obtain operating efficiency of inverters under different input parameters (current, voltage and power); (16)Analysis of various losses in PV stations, including IAM loss, irradiance loss, temperature loss, mismatch loss, inverter efficiency loss, wiring loss and so on; (17)Obtain monthly and annual cumulative power generation and performance ratio of PV stations.

SolarPV has followed key technologies: (1)Plugin development based on Sketchup Ruby API; (2)Scan-line method to fill PV modules on irregular planar surfaces; (3)Parallel-line method to fill the surface with obstacles; (4)Ray method for shading report; (5)Seamlessly integrate with SolarPV simulation engine; (6)In-depth analysis and layout optimization combined with radiation; (7)Several radiation models to get solar radiation of the inclined surface; (8)A heuristic iterative algorithm to get five parameters of PV; (9)The inverter model to obtain the power generation efficiency of the inverter under different working conditions; (10)Various loss models of PV stations; (11)Modeling of energy transfer and conversion in PV stations.

To summarize, SolarPV can combine BIM technology and PV simulation technology, and it is an efficient tool for the 3D design and performance simulation of PV power plants.

Keyword: PV Plants; SolarPV software tool; Design and performance simulation; Sketchup.

## Personal information



Prof. Jianbo Bai got Ph.D. degree from Southeast University in 2006. Then, he was a research associate at the Hong Kong Polytechnic University from 2007-2008. He acted as a visiting scholar at the Lawrence Berkeley National Laboratory from 2013-2014. Now he has served as vice dean of the College of Mechanical and Electrical Engineering at Hohai University since 2016. His current research interests include comprehensive and highly efficient use of solar energy, simulation and optimizing of PV power stations, etc. He has hosted a project supported by National Natural Science Foundation of China and two projects supported by National Natural Science Foundation of Jiangsu Province in China. Prof. Bai has published a book named “Modeling, Simulation and Optimizing of Solar PV Systems” in Chinese in 2014. His research team has developed a software for design and simulation of grid-connected PV systems named “Hohai Anneng SolarPV”, which has been adopted by some universities and PV companies in China.

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