Optimal BPV Topology Design under Partial Shading Conditions

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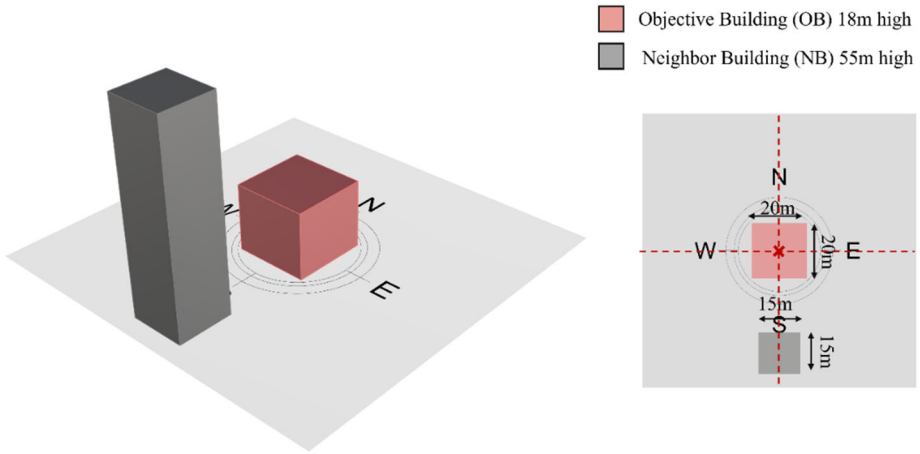
Partial Shading Condition (PSC) is responsible for the power loss of the PV system in the urban area[1]. PV reconfiguring methods are proposed to mitigate the Partial Shading Effect (PSE). PV reconfiguring methods include Traditional PV configuration and PV Reconfiguration techniques. Typical traditional PV configurations contain Series-Parallel (SP) and Total-Cross-Tied (TCT) [2]. PV Reconfiguration techniques include Physical PV array reconfiguration and Electrical PV array reconfiguration[3].

This work aims to find an optimal building-installed PV topology design under partial shading conditions (PSC). Based on the PV reconfiguring methods, different BPV system installation strategies will be studied to adapt to different PSCs. Two neighbour-building cases produce the PSCs considered in this work: 1) Tall but thin neighbour buildings and 2) Wide but small neighbour buildings. The building geometries are presented in Fig.1; two buildings are settled in a territory of 100 meters long and 100 meters wide. The objective building (OB) is located in the centre of the square, and the neighbouring building (NB) is right to the south of the objective building. The PV system is installed on the south façade of the building. The footprint of the OB is 20 meters long and 20 meters wide for each. The height of the OB is 18 meters. Besides, 1) NB is tall and thin, 55 meters high, 15m×15m large; 2) NB is small but wide, 30 meters high, 20m×40m large. The distance between NB and OB is set to 20 meters in both cases. The shadow cast by NB is sufficient to cover the OB's southern wall.

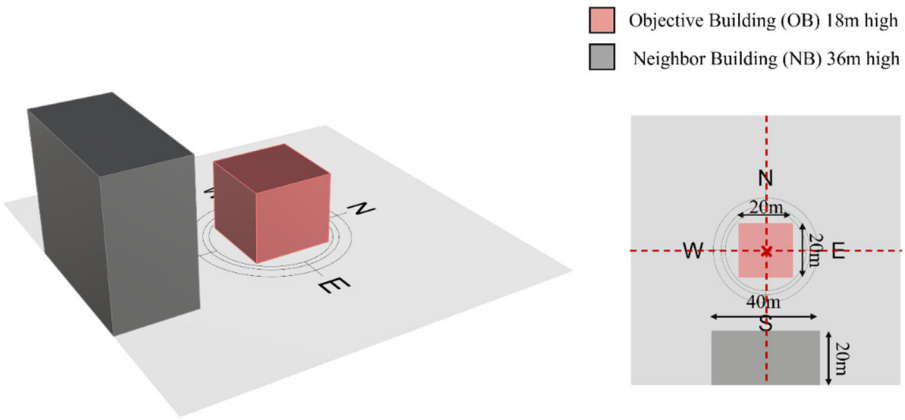
Two different installation strategies are 1) Normal installed system and 2) Transposed installed system. The simulation is based on Rhino/Ladybug and Matlab/Simulink. The simulation results show that:

1) For a tall but thin neighbor-building case, the Transposed system is recommended.
2) For a small but wide neighbor-building case, the Normal system performs

better.



(a) Tall but thin NB case



(b) Short but Wide NB case

Fig1. Building Geometry with different NB shapes

References

[1] K. Brecl, M. Bokalič, and M. Topič, "Annual energy losses due to partial shading in PV modules with cut wafer-based Si solar cells," *Renewable Energy*, vol. 168, pp. 195–203, May 2021, doi: 10.1016/j.renene.2020.12.059.

[2] F. Belhachat and C. Larbes, "PV array reconfiguration techniques for maximum power optimization under partial shading conditions: A review," *Solar Energy*, vol. 230, pp. 558–582, Dec. 2021, doi: 10.1016/j.solener.2021.09.089.

[3] S. Anjum and V. Mukherjee, "Static and Dynamic Reconfiguration Strategies for Reducing Partial Shading Effects in Photovoltaic Array: A Comprehensive Review," *Energy Technology*, vol. 10, no. 7, p. 2200098, 2022, doi: 10.1002/ente.202200098.