Developing a Simulink Model to Study Mismatch in Crystalline Silicon Photovoltaic Modules

Arpan Goroda and Subinoy Roy\*

Department of Physics, C.V. Raman Global University, Bhubaneswar,752054, India

Author email: arpangoroda@gmail.com, subinoy.roy91@gmail.com\*

\*Corresponding Author

**Abstract**. Mismatch losses in photovoltaic (PV) modules and arrays are a serious problem, which occurs when interconnected solar cells or modules have different properties or experience different conditions from one another [1]. In such cases, the output of the entire module or array under worst case conditions is determined by the solar cell with the lowest output [2]. It is very difficult to study mismatch effect in modules by experimental means, rather, a simulated study is more convenient [3]. Common simulation tools such as PSpice, PVsyst are useful and commonly used, however, are expensive and requires higher node operations [4]. Simulink has been an inexpensive simulation tool that can efficiently simulate solar cells and modules [5]. This paper presents a novel Simulink model of crystalline silicon photovoltaic modules. The model has been utilized in studying the mismatch losses in the modules by altering the electrical parameters of solar cells and simulating different conditions like partial shading, irradiance, and temperature variation. The current-voltage and power-voltage characteristics have been produced and the results are compared to the real-life module characteristics.

References:

1. Niazi, K. A. K., Yang, Y., & Sera, D. (2019). Review of mismatch mitigation techniques for PV modules. IET Renewable Power Generation, 13(12), 2035-2050.
2. Manganiello, P., Balato, M., & Vitelli, M. (2015). A survey on mismatching and aging of PV modules: The closed loop. IEEE Transactions on Industrial Electronics, 62(11), 7276-7286.
3. Alonso-Garcia, M. C., Ruiz, J. M., & Chenlo, F. (2006). Experimental study of mismatch and shading effects in the I–V characteristic of a photovoltaic module. Solar Energy Materials and Solar Cells, 90(3), 329-340.
4. Roy, S., & Gupta, R. (2019). Quantitative estimation of shunt resistance in crystalline silicon photovoltaic modules by electroluminescence imaging. IEEE Journal of Photovoltaics, 9(6), 1741-1747.
5. Kumar, R., & Singh, S. K. (2018). Solar photovoltaic modeling and simulation: As a renewable energy solution. Energy Reports, 4, 701-712.