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NUMERICAL MODELS FOR PV CELL BEHAVIOUR FORECAST ACCORDING TO PARAMETERS ESTIMATION UNDER MONOCHROMATIC OR SUN ILLUMINATION.

Abstract

The photovoltaic technology is object of several discussions in the recent years. Despite the low efficiency of the standard use due to the captured wavelengths of the light, the new applications are demonstrated to increase the performance of the photovoltaic cells: space applications can generate more power because of the longer lasting intensity of the Sun and the recent applications with monochromatic illuminations can achieve efficiencies higher than the common ones. However, all these achievements are bounded to increased costs, selection of suitable materials, forecast of operating conditions to avoid fast degradation, installation issues and so on. All these problems could be handled with simulations and numerical estimation of the cell parameters in order to reconstruct the working environment and have a better understanding of the photovoltaic generation behaviour. However, a complete numerical model is hard to find. Usually, the photovoltaic cells are studied through simplistic approaches that are not suitable for specific environment like space. Therefore, this paper proposes adaptable numerical models that can fully describe the cells behaviour using a numerical environment for simulation. The main goal is to study the specific case of a single wave incident signal on a photovoltaic cell in order to build a simulation model capable of working with different wavelengths (or direct Sun light). The addressed topics are: the numerical estimations of all the physical and electrical parameters needed to build a complete cell model from a generic datasheet; the I-V curve reconstruction and working power point identification; the I-V curve modification according to the operating condition and application; a generic efficiency evaluation and comparison with a frequency tuned solar cell. All the numerical results are compared with laboratory tests performed to optimize the efficiency with monochromatic transmission according to the impinging spectrum of a single layer solar cell.