

Photovoltaic (PV) power converters and maximum power point tracking (MPPT) algorithms are required to ensure maximum energy transfer between the PV panel and the load. The requirements for the MPPT algorithms have increased over the years-the algorithms are required to be increasingly accurate, fast, and versatile, while reducing the intrusiveness on the overall performance of the PV panel and converter. The family of hill-climbing algorithms such as incremental conductance (InCond) and perturb and observe (P&O) has gained popularity given their simplicity and accuracy, but it requires the injection of a perturbation that changes the operating point even in steady state and are prone to errors during changing environmental conditions. In recent literature, the use of the switching ripple has been proposed to replace the perturbation in the hill-climbing algorithms given its inherent presence in the system and speed. The constant work toward smaller and faster ripples presents challenges to the signal detection involved in this kind of algorithm. This paper develops and implements a new InCond MPPT technique based on switching ripple detection using a digital lock-in amplifier (LIA) to extract the amplitude of the oscillation ripple even in the presence of noise. The use of this advanced technique allows to push forward the reduction of the ripple in order to virtually eliminate the oscillation in steady state maximizing the efficiency. The accurate detection allows for adaptive-step features for fast tracking of changing environmental conditions while keeping the efficiency at maximum during the steady state. Detailed mathematical analysis of the proposed technique is provided. Overall, the use of the proposed LIA allows to push the reduction of the ripple even more while keeping accuracy and delivering superior performance. Simulations and experimental results are provided for the proposed technique and the InCond technique in order to validate the proposed approach.