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Predictive Model Control for Photovoltaic Station Maximum Power Point Tracking System

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A maximum power point tracking algorithm is necessary to increase the efficiency of the solar panel. Due to the growing demand on electricity, the limited stock and polluted nature of conventional sources (such as coal and petroleum, etc.), photovoltaic (PhV) energy becomes a promising alternative as it is omnipresent, freely available, environment friendly, and has less operational and maintenance costs. Therefore, the demand of PV generation systems seems to be increased for both standalone and grid-connected modes of PhV systems . An efficient maximum power point tracking (MPPT) technique is necessary that is expected to track the MPP at all environmental conditions and then force the PV system to operate at maximum efficiency.

Model predictive control (MPC) offers several important advantages: (1) the process model captures the dynamic and static interactions between input, output, and disturbance variables, (2) constraints on inputs and outputs are considered in a systematic manner, (3) the control calculations can be coordinated with the calculation of optimum set points, and (4) accurate model predictions can provide early warnings of potential problems. Knowing that the overall objectives of an MPC controller can be summarized: i) To prevent violations of input and output constraints; ii) Drive some output variables to their optimal set points, while maintaining other outputs within specified ranges; iii) Prevent excessive movement of the input variables; iv) Control as many process variables as possible when a sensor or actuator is not available.

MPC, is a model-based on line control approach with the following modules: a prediction horizon, a receding horizon procedure, and a regular update of the model and re-computation of the optimal control input . A MPC system consist of the following devices: - a process model is used to predict the current values of the output variables; -the residuals, the differences between the actual and predicted outputs;- feedback signal block;-a Prediction block. The predictions are used in two types of MPC calculations that are performed at each sampling instant: set-point calculations and control calculations.

The set points for the control calculations, also called *targets*, are calculated from an economic optimization based on a steady-state model of the process, traditionally, a linear model. Typical optimization objectives include maximizing a profit function, minimizing a cost function, or maximizing a production rate.