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Modelling Discrete Time Integrator in MPPT for Photovoltaic System in Simulink Environment

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Properly designed Maximum Power Point system brings the operation of the Photovoltaic System to the maximum efficiency. For implementing the Maximum Power Point Tracking (MPPT), there is a need to include the DC-DC converter into the system. The dc-dc converter can be either buck or boost converter. A boost converter is chosen where its duty cycle is controlled by.

PWM signal from controller implementing a tracking algorithm such as P&O and an integral regulator algorithm through the use of a Discrete Time Integrator that holds the last optimum MPP in the event if the whole system went down due to any malfunction. Further, whatever the weather (irradiation and temperature) and the load conditions, the control system of the converter will ensure the operating point is optimized for maximum power transfer.

The operating point of the PV on the I-V curve is dynamically modified by the controller so that the MPPT obtained the maximum power point at any sunlight conditions and maintain PV power in the neighbourhoods of this point to produce power with the higher efficiency.

The use of Discrete-Time Integrator block is to create a purely discrete model. With the Discrete-Time Integrator block, we can:

– Define initial conditions on the block dialog box or as input to the block,
– Define an input gain (K) value,
– Output the block state,
– Define upper and lower limits on the integral,
– Reset the state with an additional reset input.

With the first time step, block state $n = 0$, with either initial output $y(0) = IC$ or initial state $x(0) = IC$, depending on the Initial condition setting parameter value. For a given step $n > 0$ with simulation time $t(n)$, Simulink updates output $y(n)$ as follows through the use of the below method:

The block sample time determines when the output is computed and the values clip according to upper or lower limits and eventually the values are stored in a memory location where for instance if we are using an MPPT system the Discrete Time integrator can be implemented in the PV system to act on recording the last MPP value, save it in a special memory block and make that value available to use if a system crash occurred and during the recovery from an unexpected malfunction the last MPP can be restored and be available to restart with instead of initiating a new setpoint from an initial state.