Delta Power Control Strategy for Multi-string Grid-Connected PV Inverters

Introduction:
Photovoltaic (PV) systems have been increasingly integrated into the power grid in recent years, mainly driven by the continuous reduction in the price of PV panels as well as the system installation costs. More PV systems are expected to be installed in the future and will share a major part of the power production, especially in residential-scale systems. Accordingly, the importance of PV participation in the grid control becomes clear, and is being introduced in certain grid regulations.

For instance, in Germany, the frequency-dependent active power reduction has been introduced for medium-voltage system. Similar requirements have also been defined in other grid codes, where PV systems are not allowed to be immediately disconnected from the grid in the case of frequency deviations. Instead, the output active power from the PV systems has to be reduced to a certain level, in order to support the grid and also to provide power reserve.

Proposed system:
A DPC strategy for multi string grid-connected PV systems has been proposed such that in contrast to the prior art solutions, the presented strategy offers a cost-effective solution to the DPC without extra components (e.g., energy storage devices, irradiance measurements). This is achieved by co-ordinately controlling some PV strings in the master-operation mode (i.e., MPPT) and some in the
slave-operation mode (i.e., CPG operation according to the delta power constraint).

Particularly, a master PV string operates in the MPPT mode to determine the total available PV power; the other slave PV strings use the estimated available power from the master PV string to calculate their operating point in the P–V characteristic curve of the PV arrays, and regulate the PV power at the left side of the MPP with the CPG operation. This leads to a delta power production for the entire systems, while ensuring a stable operation.

The dynamics of the DPC strategy are also examined with a cloudy day irradiance condition, where the control performance of the DPC strategy is highly challenged by a rapid change in the solar irradiance. In this case, the sampling rate of the DPC algorithm (i.e., MPPT and CPG algorithms) becomes important, as it affects the algorithm tracking performance.

**Advantages:**
- Leads to a delta power production for the entire systems, while ensuring a stable operation.
- The reserved power is accurately controlled.
Applications:
- Grid applications.

Block Diagram: