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Centralised multimode power oscillation damping controller for photovoltaic plants with communication delay compensation

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Abstract-

Low-frequency oscillations are an inherent phenomena in transmission networks and renewable energy plants should be configured to damp them. Commonly, a centralised controller is used in PV plants to coordinate PV generators via communication channels. However, the communication systems of PV plants introduce delays of a stochastic nature that degrade the performance of centralised control algorithms. Therefore, controllers for oscillation damping may not operate correctly unless the communication channel characteristics are not considered and compensated. In this paper, a centralised controller is proposed for the oscillation damping that uses a PV plant with all the realistic effects of communication channels taken into consideration. The communication channels are modelled based on measurements taken in a laboratory environment, considering its stochastic nature. The controller is designed to damp several modes of oscillation by using the open-loop phase shift compensation. Theoretical developments were validated in a laboratory using four converters acting as two PV inverters, a battery and a STATCOM. A centralised controller was implemented on a real-time processing platform with communication infrastructure. Experimental results show the communication channels impose severe restrictions on the performance of centralised POD controllers, highlighting the importance of their accurate modelling and consideration during the controller design stage.

Index Terms- power oscillation damping, communication delay, low-frequency oscillations

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