Necessary Condition to Utilize Adaptive Control in Wind Turbine Systems to Improve Power System Stability

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Abstract : The global capacity of wind power has dramatically increased in recent years. Therefore, improving the technology of wind turbines to take different advantages of this enormous potential in the power grid, could be interesting subject for scientists. The doubly-fed induction generator (DFIG) wind turbine is a popular system due to its many advantages such as the improved power quality, high energy efficiency and controllability, etc. With an increase in wind power penetration in the network and with regard to the flexible control of wind turbines, the use of wind turbine systems to improve the dynamic stability of power systems has been of significance importance for researchers. Subsynchronous oscillations are one of the important issues in the stability of power systems. Damping subsynchronous oscillations by using wind turbines has been studied in various research efforts, mainly by adding an auxiliary control loop to the control structure of the wind turbine. In most of the studies, this control loop is composed of linear blocks. In this paper, simple adaptive control is used for this purpose. In order to use an adaptive controller, the convergence of the controller should be verified. Since adaptive control parameters tend to optimum values in order to obtain optimum control performance, using this controller will help the wind turbines to have positive contribution in damping the network subsynchronous oscillations at different wind speeds and system operating points. In this paper, the application of simple adaptive control in DFIG wind turbine systems to improve the dynamic stability of power systems is studied and the essential condition for using this controller is considered. It is also shown that this controller has an insignificant effect on the dynamic stability of the wind turbine, itself.

Keywords : almost strictly positive real (ASPR), doubly-fed induction generator (DIFG), simple adaptive control (SAC), subsynchronous oscillations, wind turbine