Abstract

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Asymptotic Output Tracked Artificial Immunity Controller for Eco-Maximum Power Point Tracking of Wind Turbine Driven by Doubly Fed Induction Generator

This paper aims to design a controller for a Doubly Fed Induction Generator (DFIG) targeting the Eco-Maximum Power Point Tracking (EMPPT) for environmental aspects. The proposed controller consists of two clusters, which are the novel Artificial Immunity sensorless Eco-Maximum Power Point Tracking (AI EMPPT) and the asymptotic non-linear control techniques. The main target of the AI EMPPT is to reduce the carbon dioxide emission by generating the maximum possible power from the renewable electrical energy resource, which is wind electrical power generation to replace the fossil-fuel conventional generation. To build the AI EMPPT, an Artificial Immunity System Estimator (AISE) based on artificial immunity technique and a Model Reference Adaptive System (MRAS) are used to estimate the DFIG rotor speed. Then, the AI EMPPT is applied to provide the reference electromagnetic torque signal. Subsequently, the reference electromagnetic torque interacts with the estimated generator speed, determined by the wind mechanical power, to supply the wind electrical power. The second cluster is the asymptotic non-linear control technique which proposes the reference signal tracking of the rotor direct and quadratic current, respectively. Thus, assigning specific zeros through feedback ensures the reproduction of an output that converges asymptotically to a required reference rotor current. For online operation, the Artificial Immunity Technique (AIT) is utilized to deal with the generated control reference signal. A proposal hardware implementation on Field Programmed Gate Array (FPGA) is also presented. The introduced approach was applied to a wind turbine generator driving a 3.7 kW load. MATLAB program was used to simulate and test the performance of the proposed control methods. The results to show the effectiveness of the proposed technique. The reduction in CO2 emission was calculated.