Wind Engineering

Volume 45, Issue 4, 2020, Pages 1040-1054

Maximum power extraction framework using robust fractional-order feedback linearization control and GM-CPSO for PMSG-based WECS

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Abstract: The most important issue in the use of wind energy conversion systems is to ensure maximum power extraction in terms of efficiency. Therefore, maximum power point tracking algorithms are as important as the maximum power point tracking controller. In this study, maximum power extraction frameworks operating the state-of-the-art optimization methods are presented for permanent magnet synchronous generator–based wind energy conversion system. These frameworks consist of a Gauss map–based chaotic particle swarm optimization and a hybrid maximum power point tracking approach that combines feedback linearization technique with fractional-order calculus. The feedback linearization control strategy can fully decouple and linearize the original state variables of the nonlinear system and thus provide an optimal controller crossing wide-range operating conditions. The objective is to maintain the tip speed ratio at its optimal value, which implies the use of a rotational speed loop. The method is based on the feedback linearization technique and the fractional control theory. Gauss map–based chaotic particle swarm optimization, which is a remarkable and recent optimization technique, is utilized to achieve optimum coefficients to efficiently ensure the maximum power point tracking operation in here. A simulation study is carried out on a 3-kW wind energy conversion system to show the effectiveness of the proposed control scheme.

Keywords : Permanent Magnet Synchronous generator, Maximum Power Point Tracking, Feedback linearization control, fractional-order theory, Gauss map–based chaotic particle swarm optimization