Abstract:
This paper proposes a simplified finite-control-set model predictive current control (FCS-MPCC) without mechanical sensors for permanent-magnet synchronous generators (PMSGs) in variable-speed wind energy conversion systems. The procedure of selecting the best switching vector is optimized by computing the reference voltage vector (VV) directly from the reference current. Subsequently, the sector where this reference VV is located is determined from its angle. Finally, the cost function is evaluated only for three times to obtain the optimal switching vector. Therefore, the necessity to test all feasible VVs will be avoided, which reduces the calculation burden of the traditional finite-control-set model predictive control method. Moreover, an extended Kalman filter, which is a robust state observer, is proposed to estimate rotor speed, rotor position, and stator inductance of the PMSG. The estimated (filtered) stator currents, instead of the measured currents, are fed back to the prediction model, and therefore, a lower current total harmonic distortion and better noise rejection are realized. Estimation and control performance of the proposed simplified FCS-MPCC method are illustrated by the simulation results for all operation conditions.