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Practical Wide-speed-range Sensorless Control System for Permanent Magnet Reluctance Synchronous Motor Drives via Active Flux Model

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Abstract

This article introduces a control strategy to obtain near-maximum available torque in a wide speed range with sensorless operation via the active flux concept for permanent magnet-reluctance synchronous motor drives. A new torque dq current reference calculator is proposed, with reference torque limited by the torque/speed envelope and by maximum current constraint. This solution approximates the maximum torque per ampere below base speed and also in the flux-weakening region, where voltage limitations impose constraints on the allowable dq currents with less computational effort. Comprehensive digital simulation results (1-6000rpm) and experimental results (50-3000rpm at low inverter available DC voltage of 12V(dc) instead of 48V(dc)) demonstrate the effectiveness of the proposed sensorless control strategy in a wide speed range, with stable and reliable operations up to a speed equal to eight times the machine base speed (constant power speed range = 8).

Keywords

Author Keywords: AC drives; active flux observer; permanent magnet synchronous motor; sensorless control; state estimation; vector control; wide speed range

KeyWords Plus: FIELD-WEAKENING REGION; IPMSM DRIVES; TORQUE; OPERATION; SATURATION; DESIGN

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