Model Predictive Speed Control with Dynamic Reference for Electric Drive of Permanent Magnet Synchronous Machine

Authors: Luocheng Wang ; Tao Han ; Tiefu Zhao

Abstract: This paper presents an improved finite control set model predictive control (FCS-MPC) for the electric drive system. In the conventional FCS-MPC, the speed regulation is achieved by PI-based outer loop and MPC-based inner loop. This structure weakens the features of fast dynamic response from the model predictive control. In the proposed FCS-MPC, a dynamic reference is introduced to formulate a holistic FCS-MPC in place of the PI-based outer loop. This new structure provides the system with the features of the shorter settling time and zero overshoot. Moreover, these performances are adjusted by a novel design variable called reference prediction horizon defined in the dynamic reference. The performance of the proposed FCS-MPC with dynamic reference is analyzed and verified in both simulations and experiments. A 2-kW electric drive prototype for a permanent magnet synchronous machine has been fully developed and the experimental results demonstrated the feasibility of the proposed method.