Time and Frequency Domain Identification and Analysis of a Permanent Magnet Synchronous Servo Motor

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Abstract

This study employed the approach of non-linear autoregressive moving average model with exogenous inputs (NARMAX) to analyze the dynamics of a Permanent Magnet Synchronous Motor (PMSM). The non-linearity in PMSM including cogging force, reluctance force and force ripple is difficult to estimate. By using the NARMAX approach, thrust-speed relationship and thrust-position relationship could be analyzed by identifying both time and frequency domain models of the system. The frequency domain analysis is studied by mapping the discrete-time NARMAX models into generalized frequency response functions (GFRFs) to reveal the non-linear coupling between the various input spectral components and the energy transfer mechanisms in the system. From the results, the interpretation of the higher-order GFRFs has been comprehensively studied and non-linear effects have been related to the physical models of the systems.