Opracowanie i zastosowanie modelu matematycznego silnika bezszczotkowego prądu stałego dla ustalonych stanów pracy

Elaboration and application of mathematic model for stead-state analysis of brushless DC motors driven from quasi-square wave inverters

Abstract

The work involves elaboration and application of a new field-circuit model for steady-state analysis of permanent-magnet surface-mounted brushless DC motors driven from quasi-square wave inverters. A consistent and computationally efficient model that combines the magnetostatic finite-element and the steady-state time-periodic circuit models with time averaging is proposed. A weak field-circuit coupling between the models is established through the effective constant current and lumped parameters determined at various loading conditions. The model takes account for nonlinearity, stack-skew and armature reaction flux, although it neglects the magnetic flux harmonic effects involving.

The performance characteristics, determined via the proposed model for two different motors, are comparable with those obtained from the comprehensive time-stepping finite-element model, with the execution time being approximately a hundred times shorter for the former. The model is also validated against measurements carried out for the two motors showing inaccuracy of predictions within 12 per cent in the whole range of rotational speed. The applicability of the model in designing process is demonstrated by the test carried out which involves re-designing one of the tested motors toward rise of mechanical power.