GENERAL DESCRIPTION OF OVER-PHASE CONTROL METHOD

Brazhnikov A.V.

Siberian Federal University, Krasnoyarsk, Russia
e-mail: multypha@mail.ru

The increase of the phase number m more than four allows not only to improve a number of technical-and-economic characteristics of the inverter-fed linear and non-linear induction motors, but also to open the way for the design of the electrical drives having radically new properties and possibilities. It is conditioned by the possibility for the use of some non-traditional motor control methods in the induction drive system which appears when m≥5. These non-traditional control methods cannot in principle be used when the inverter-fed linear motor phase number is equal to three or four.

The greater control potentials of the multiphase inverter-fed induction drives are explained by the following. If m is equal to three or four, the drive system has two variables of operating influence on the electromagnetic processes occurring in the system – the phase voltage magnitude, and its frequency. In the case, when m>4, one more variable of operating influence may be added to the above mentioned ones – the magnitude of the phase shift (i.e. electrical angle) between the nearest (in time) phase voltages of a multiphase inverter. The change of this shift can be obtained by mere corresponding application of the corresponding software, namely, by the corresponding change in the inverter transistors control algorithm (i.e. by the change of the moment in which the corresponding transistors are switched on and switched off) without application of any additional electronic or mechanical switchers, or some complicated motor winding sets.

The possibility of above mentioned phase shift change results in the extension of the set of the motor control methods by adding to this set a number of non-traditional ones which may be used in the multiphase drive systems.

In particular, the over-phase control method (OPM) is one of the above-mentioned non-traditional ones. It was developed by the authors of this paper for the use in the field of both linear and non-linear inverter-fed multiphase (i.e. having the phase number m≥5) induction motor drives.

The essence of the control according to OPM is that in this case the electrical angles A between the voltages (or currents) of the nearest (in time) phases of inverter are increased by a factor of H (in comparison with any traditional control method) without any change of the inverter voltage (or current) amplitude and frequency, i.e. in this case Ah=H*At, where H is some whole number, At is the value A when some traditional control method is used (At=360/m, electrical degree), and Ah is the value A when OPM is used.

The change of this phase shift can be obtained by mere application of the corresponding software, namely, by the corresponding change in the inverter transistors control algorithm (i.e. by the change of the moment in which the corresponding transistors are switched on and switched off) without application of any additional electronic or mechanical switchers, or some tailor-made complicated motor winding sets.

Two ways of realization of OPM are possible:

Way 1. By the corresponding change in the switching algorithm of the inverter transistors without any changes in the traditional scheme of the inverter (i.e. without application of any electronic or mechanical switchers of the motor stator phase windings or their sections). The first way can be used both for low- and high-power multiphase drive systems.

Way 2. By the use of an electronic or mechanical phase commutator placed between a frequency converter and an induction motor. In this case the change in the OPM parameter H is reached not by any change in the electrical angles between the voltages (or currents) of the nearest phases of inverter, but by the change in the version of connection output terminals of inverter to the terminals of the motor stator phase windings.

In this case the multiphase inverter has traditional scheme and operates at the sole value of the parameter H: H=1. The change in the value of the parameter H is achieved by the above mentioned phase commutator placed between an inverter and a motor.

The second way is more expedient for the multi-motor drive systems, in which different motors fed by one frequency converter may operate at different values of the parameter H at the same moment (for example, for distribution of traction forces between the motorized wheels of a wheeled vehicle).