Editorial

Although multi-phase motor drives have been around for thirty-five years, it is only recently that they have attracted a considerable amount of interest in the research community and industry worldwide. The last five years have seen a huge increase in the quantity of published work in this area. The first conference ever to host a special session on multi-phase and multi-motor drives was Electrimacs, held in Montreal in 2002. This was followed by a lecture session during EPE 2003 in Toulouse, and, more recently, during IEEE Power Electronics Specialists Conference, held in Aachen in June 2004. One can thus assume that this pattern will continue in the future and this special issue, the idea of which was conceived during EPE 2003, is a step in that direction. I would like to take this opportunity to express the gratitude to the Editor of the EPE Journal, Ms. Brigitte Sneyers, for taking the idea on board and giving me the opportunity to act as the Guest Editor of the special issue. The issue consists of six papers. Four of these are revised versions of the papers presented at EPE 2003. The original version of the second paper was presented at IEEE Industry Applications Society Annual Meeting in 2001, while the last paper is an original contribution, which has not been published before.

The advantages of multi-phase motor drives over their three-phase counterparts are numerous and are detailed in the papers of this special issue. The main driving force behind the recent accelerated development in this area is a set of very specific industrial applications, illustrated on the front cover of the issue – electric ship propulsion, more-electric aircraft, locomotive traction and electric vehicles. These are simultaneously examples of applications requiring multi-motor drive systems. Independent control within a multi-motor system comprising three-phase machines is only possible if each machine is supplied from its own inverter. However, in traction applications, two (or more) motors may run at ideally the same speed under ideally the same loading conditions, in which case it becomes possible to parallel the three-phase machines to the same three-phase inverter. This concept has been investigated in considerable depth in recent times, since it enables a saving in the number of semiconductor switches and other components and thus potentially yields a better reliability.

On the first sight, multi-phase motor drives and multi-motor drives do not have much in common, except for the word multi in the name and a range of applications. One may therefore wander why the two are lumped together here. The issue is for this reason subdivided into three sections, where the first two contain papers related to multi-phase motor drives and three-phase multi-motor drives, respectively. The third section contains two papers, which discuss multi-motor drives based on utilisation of multi-phase machines, thus unifying the two topics of the first two sections.

The first paper of the issue investigates the operation of multi-phase sinusoidal permanent magnet synchronous machines with concentrated windings under faulted conditions. It thus covers one of the main advantages of multi-phase machines over three-phase machines, a better fault tolerance, which is of ultimate importance in safety-critical applications. The second paper is a case study, which details design, modelling and control of a five-phase trapezoidal brushless DC machine, aimed at electric vehicle applications. The third paper, which concludes the first section of the issue, discusses space vector modulation techniques for multi-phase inverters, with the emphasis placed on the five-phase inverter. The second section contains a single paper, which looks at the possibility of using two three-phase permanent magnet synchronous motors paralleled on the same inverter for locomotive traction, instead of the customary approach based on induction motors. The last section contains two papers, which both deal with two-motor drives that have a single inverter as the supply. Stator windings are connected in series in an appropriate manner, which enables independent control of the two machines. The first of these two papers investigates utilisation of two five-phase induction motors, while the second analyses two-motor drive with series-connected asymmetrical six-phase induction motors.

The first four papers of the issue, all dealing with rapidly maturing technologies, are believed to be of immediate relevance to the industry, thus continuing the well-established tradition of the EPE Journal to publish results of the directly applicable research. The last two papers are both part of a rather novel and wider concept, which is still very much in the research stage. Whether or not multi-drive systems of this type will ever become accepted by industry remains to be seen.

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