From Power System Design to Power IC Design

Original Field-Oriented Vector Control

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Abstract—When rotating-field machines are employed as drive motors, the question on of torque generation and control requires special consideration. It is, for instance, possible to use the vector of the stator voltage or the vector of the stator current as the manipulated variable for the torque, depending on whether the static converter supplying the motor provides a variable voltage or a variable current. This paper for describes the principle of field orientation a new closed-loop control method for rotating-field machines [1-4] by way of reference to an induction motor. It is shown how these manipulated variables must be influenced to provide instantaneous and well-damped adjustment of the torque independently of the inherent characteristics of an induction motor.

Abstract—Synchronous machines are being employed on an ever increasing scale in industrial drive systems fed by static converters. The reasons for this lie in their straightforward, robust construction, the simple manner in which they can be magnetized [1] and their excellent characteristics when used in conjunction with static converters [2]. Since these drives are expected to offer the same high-grade dynamic characteristics as variable-speed dc drives, provision must be made to control the torque instantaneously to a linear curve relationship. The same applies to control of the magnetization. Both control operations must be decoupled, i.e. one must only influence the torque and active power, and the other only the magnetization and reactive power. TRANSVECTOR® control, which operates on the principle of field orientation, is eminently suitable for control functions of this type.

AC Drives – A Historic Review

When Secondary Issues Become Primary Concerns

Russel J. Kerkman, “Twenty years of PWM AC drives: when secondary issues become primary concerns”, IEEE Industrial Electronics Conference (IECON), Taipei, Taiwan, August 5-9, 1996.
When Secondary Issues Become Primary Concerns

- Transmitted Noise: Electro Magnetic Interference (EMI) and Drive Integrity
- Motor Winding and Bearing Failures: The Unintended Consequences of Modern Inverters

EMI Noise: Leakage current without common mode choke


Motor Winding Failures: Evidence of shaft voltage and bearing current

Russel J. Kerkman, “Twenty years of PWM AC drives: when secondary issues become primary concerns”, IEEE Industrial Electronics Conference (IECON), Taipei, Taiwan, August 5-9, 1996.
Electromagnetic Interference (EMI) noise is defined as an unwanted electrical signal that produces undesirable effects in a control system, such as communication errors, degraded equipment performance and malfunction or non-operation. References on the general principles of EMI are available [1]-[3], as well as methodologies on calculating radiated emissions [4]. IEEE Standard 518 applied these principles to slow switching Silicon Controlled Rectifier (SCR) dc drives in 1982 [5]. All ac Pulse Width Modulation (PWM) drives have the potential to cause EMI with adjacent sensitive equipment, when large quantities of drives are assembled in a concentrated area [6]-[11]. However, faster switching speeds of new converter/inverter topologies require an updated study of new system EMI issues created.

Field-Oriented Vector Control


Werner Leonhard, 30 years space vectors, 20 years field orientation, 10 years digital signal processing with controlled ac-drives - a review, EPE Journal, 1991.
Vector Control: Recommended Books

Control of Electrical Drives,
Werner Leonhard,
Springer Verlag, 3rd edition (January 15, 2001)

Vector Control and Dynamics of AC Drives
D. W. Novotny and T. A. Lipo
Clarendon Pr, USA., September 1996.
Vector Control of AC Machines

Pioneer Paper

“The principle of field orientation as applied to the new TRANSVECTOR closed loop control system for rotating field machines,”

30 years space vectors, 20 years field orientation, 10 years digital signal processing with controlled ac-drives - a review, part 1 & 2,

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Jaroslav Lepka and Petr Stekl,
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N. P. Quang and J.-A. Dittrich,

The Field Orientation Principle in Control of Induction Motors,
Andrezej M. Trynadlowski,

Vector Control and Dynamics of AC Drives,
D. W. Novotny and T. A. Lipo, Clarendon Pr, USA, September 1996.