DISTRIBUTED CONTROL OF PERMANENT MAGNET DRIVE SYSTEMS VIA ETHERNET

LILANTHA SAMARANAYAKE[*1], SANATH ALAHAKOON[2]

[1] *Department Of Electrical Engineering, Royal Institute Of Technology (Kth), Stockholm*

[2] *Department Of Electrical And Electronic Engineering, University Of Peradeniya, Peradeniya*

The recent advancements of permanent magnet (PM) materials, solid-state devices and microelectronics have contributed to new energy efficient, high performance electric drives that use modern PM synchronous motors. Not surprisingly, these motors are continuously receiving serious considerations for various applications such as traction, automotive, robotics, aerospace etc. In general, PM synchronous motors can be classified into the brushless d.c. (BLDC) motors and a.c. synchronous motors (PMSMs). These motors can be further grouped based on the rotor configurations as surface mounted, inset and interior permanent magnet type motors. In this study, surface-mounted brushless d.c. motors are used in the distributed control drive system operated via Ethernet.

Distributing the main system modules i.e., mainly the controller in the closed loop, widens the single location applications of PMSM to applications with motors located at different places but are operating towards a common goal. The gild wing position operation of an air craft, driving wheel speed control of electric vehicles with no mechanical links between wheels are some of such applications. Hence it is a common requirement in all distributed motor control applications to maintain the speed locked (synchronized) condition among each other under respective load torque variations. That is, if one or a few motors of such a system encounter torque disturbances, the corresponding changes in speeds have to be reflected to the rest of the motors in the group with a minimum synchronizing error.

Operating many machines in parallel with local controllers always result in a complicated and expensive wiring system. It is also difficult for fault diagnosis and maintenance. This results in increased system down time. Hence the distributed architecture of system control is vital in this kind of synchronization applications. In contrast to the centralized control systems, in a distributed control system, a communication network (Ethernet in this case) is used to connect the sensor to controller and controller to actuator of each control loop. Usually communication through the Ethernet is time constrained and makes the analysis and controller design complicated. The reason for this is the invalidity of the ideal centralized assumptions such as synchronized sensor and/or controller signal availability, non-delayed sensing and actuation.

Hence the challenge of making the system distributed via Ethernet is first to handle the timing problems in the communicating media. The speed synchronization of different drives in the system is another challenge. Both the problems are addressed in this paper with extensive emphasis on different controller strategies.

Complete financial assistance by SAREC / Sida Sweden is greatly acknowledged.