Dallas Chapter of IEEE Signal Processing Society &
Electrical Engineering Seminar Series Present

Real-Time Fault Signature Monitoring Tools for Motor Drive Embedded Fault Diagnosis Systems

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The industry's dependence on ac machines in critical applications often results in very costly shutdowns due to motor failures. Therefore, fault diagnosis and condition monitoring have been studied in the recent decade to prevent costly interruptions due to motor faults. As a widely applied method, phase current analysis has received much attention in search of providing a practical solution to continuous monitoring and incipient fault detection. In this presentation, the effects of inverter harmonics on motor current fault signatures are explained in detail. The introduced fault signatures due to harmonics provide additional information about the motor faults and enhance the reliability of fault decisions. It is theoretically and experimentally shown that the extended fault signatures caused by the inverter harmonics are similar and comparable to those generated by the fundamental harmonic on the line current. Next, the reference frame theory is proposed as a powerful toolbox to find the exact magnitude and phase quantities of specific fault signatures in real time. The faulty motors are experimentally tested both offline, using data acquisition system, and online, employing the TMS320F2812 microprocessor to prove the effectiveness of the proposed tool. In addition to reference frame theory, a phase-sensitive motor fault signature detection method is presented. This method has a powerful line current noise suppression capability while detecting the fault signatures. It is experimentally shown that the proposed method can determine the normalized magnitude and phase information of the fault signatures even in the presence of significant noise. Finally, a fault diagnosis scheme for on-board diagnosis of rotor asymmetry at start-up and idle mode is presented. It is quite challenging to obtain these regular test conditions for long enough time during daily vehicle operations. In addition, automobile vibrations cause a non-uniform air-gap motor operation which directly affects the inductances of electric motor and results quite noisy current spectrum. The proposed method overcomes the challenges like aforementioned ones simply by testing the rotor asymmetry at zero speed.

Bilal Akin received B.S. and M.S. degrees in electrical engineering from Middle East Technical University, Ankara, Turkey, in 2000 and 2003, respectively, and the Ph.D. degree in electrical engineering from Texas A&M University in 2007. From 2005 to 2007, he was an R&D Engineer with Toshiba Industrial Division, Houston, TX. From 2008 to 2012, he worked as an Application Engineer at Texas Instruments Inc, Houston, TX. Bilal's research interests are advanced control methods in motor drives, real-time fault diagnosis of industrial systems, digital power management, and power electronics applications.

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