

# Reliability Analysis of a Motor Control Unit Used in Electric Vehicles

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## Abstract

The safety issue of an electric vehicle and components has attracted intensive attention and discussions worldwide. To assure the safety of electrical/electronic systems and components of an electric vehicle, the International Organization for Standardization has developed ISO 26262 in recent years, in which risk assessment and reliability assurance are emphasized. To let manufacturers of electrical/electronic components understand more about ISO 26262, a motor control unit (MCU) to be used in an electric vehicle was taken as an example and related research was carried out. Based on the study of fault tolerance of the system, failure modes of components which result in failure of the system were found. Sensitivity study was performed to investigate how component failures would affect the system reliability. Numerical analysis was carried out based on the result of performance simulation as well as components failure rates documented in the US military reliability handbook. The final result indicates the mean time to failure (MTTF) of the studied MCU is long enough and the speed sensor is the most critical component of the system. It also shows that by reducing both speed sensor's and current sensor's failure rates, the MCU can reach the functional safety level required by ISO 26262.

## Keywords

ISO 26262, motor control unit, performance simulation, functional safety, reliability

## Biography

**Ting-Hao Kan** is currently a graduate student at the Institute of Industrial Engineering, National Taiwan University. He received B.S. in Electronic Engineering from National Yunlin University of Science and Technology, Yunlin, Taiwan.

**Wen-Fang Wu** received the B.S. degree in Engineering from National Taiwan University in 1977, the M.S. and Ph.D. degrees in Aeronautical and Astronautical Engineering from University of Illinois at Urbana-Champaign, IL, USA in 1983 and 1985, respectively. He had worked at Florida Atlantic University, Boca Raton, FL and Columbia

University, New York, NY, USA before joining National Taiwan University as an associate professor in 1988. He is now a professor at the Department of Mechanical Engineering with a joint appointment with the Graduate Institute of Industrial Engineering. He had served as the chairman of the Department of Mechanical Engineering from 2001 to 2004. His research interests include vibration, reliability engineering and probabilistic risk assessment. Owing to the need of local industry, he has recently participated in research projects related to the development of electric vehicles, in which he is asked to contribute his knowledge in reliability engineering.

**Hsin-Wei Huang** just graduated from Department of Mechanical Engineering, National Taiwan University with a M.S. degree. He received the B.S. degree in Mechanical Engineering from National Central University before joining National Taiwan University.