Reliability Assessment of a Balanced Performance-Sharing System Incorporating Local and Global Common Buses

Vandana Bhatt
Department of Mathematics, Statistics, and Computer Science, G. B. Pant University of Agriculture and Technology, Pantnagar, India

S. B. Singh
Department of Mathematics, Statistics, and Computer Science, G. B. Pant University of Agriculture and Technology, Pantnagar, India

Abstract

A reliability model for a balanced performance-sharing system is developed in this study. The proposed system is composed of N subsystems interconnected through a global common bus, where each subsystem contains M components linked via a local common bus. The local buses facilitate performance redistribution among components within the same subsystem, while the global common bus supports performance transfer across different subsystems. The system maintains its balanced state only when both the local and global balance requirements are fulfilled. To provide flexibility in the balancing conditions, local and global balance thresholds are incorporated into the model. System failure occurs whenever the available performance becomes insufficient to satisfy the required performance demand of the system or when the balance conditions are violated. To recover the balanced state, performance redistribution is performed both within subsystems through local buses and among subsystems through the global bus. The amount of transferable performance is limited by the transmission capacities of these buses. A Markov process is utilized to model the performance variation of each component, whereas the system reliability is evaluated through the Universal Generating Function approach. A lithium-ion battery system is presented as a case study to demonstrate the effectiveness of the proposed method.