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Uncertainty and Reliability Analysis for Engineering Systems

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Reliability is a fundamental performance indicator of products, critically influencing service life, operational safety, and market competitiveness. For complex engineering systems, such as aerospace equipment, intelligent manufacturing systems, and energy infrastructures, uncertainties in geometric dimensions, material properties, and external loads are significantly more pronounced than in conventional products. Manufacturing deviations, material degradation, and fluctuating operating conditions can substantially impair system reliability and may even result in catastrophic failures. Meeting the stringent reliability requirements of modern engineering systems therefore necessitates a comprehensive consideration of uncertainties throughout the entire lifecycle, including design optimization, precision manufacturing, and performance evaluation. Nevertheless, due to the complex interactions among multiple uncertainty sources and the high computational cost of reliability models, major challenges remain. These include efficient quantification of multi-source uncertainties, accurate reliability prediction for complex systems, and robust design methodologies under uncertainty. This Reprint highlights recent research advancements in reliability theory, methods, and engineering applications. By bringing together high-quality contributions, we aim to provide a platform for sharing insights, advancing research on key reliability challenges, and promoting the practical implementation of reliability-oriented solutions in engineering systems.



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