Integrated Modeling and Optimization of Manufacturing Variability and Product Reliability for Advanced and Evolving Technologies

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Motivation

- For advanced and evolving technologies to be transitioned from low volume production, new and innovative research focusing on quality and reliability (Q&R) is required.
- This research develops integrated quality and reliability models to facilitate the continued advancement of novel and evolving technologies, such as MEMS and bio-devices.

Research Challenges

- Traditional application of quality & reliability tools is inadequate or inappropriate because decisions that impact quality also influence reliability.
- Failures cannot be predicted based on traditional distribution assumptions (not homogeneous).

Objectives & Significance

The long term goal is to develop new models and analysis tools to assist manufacturing and maintenance of evolving devices, and to offer new insights on quality and reliability analyses for unique technologies.
- Develop integrated Q&R models for manufacturing and maintenance
- Investigate multiple failure processes, especially multiple dependent competing failure processes (MDCFP)
- Establish reliability models for complex multi-component systems
- Explore and implement modern concepts of multi-objective optimization (e.g., quality, reliability and cost)

Impact of Work

- Development of a new integrated quality and reliability philosophy can help achieve greater reliability performance early in the design and development schedule and facilitate timely and successful commercialization.
- This research work generates tremendous intellectual impact on quality and reliability research and education for new design and manufacturing problems, as well as broader economic impact on advanced manufacturing industries.

International Collaborators

- Dr. Hao Peng, Eindhoven University of Technology (The Netherlands)
- Dr. Yisha Xiang, Sun Yat-sen University (China)
- Dr. Naruemon Watanapongsakorn, King Mongkut’s University of Technology Thonburi (Thailand)

Research Approaches and Accomplishments

- Mixture Hazard Rate Based Reliability
- Mixture PDF of Time to Failure
- Mixture pdf of Time to Failure

Burn-in and Preventive Maintenance for n-Subpopulations experiencing Stochastic Degradation


Reliability and Maintenance for Stents subject to MDCFP


MDCFP with Shifting Failure Thresholds