Purposeful Failure Methodology for Machinery (2021-023)

Machine Learning Enabled Purposeful Failure Methodology Enabling Enhanced Predictive Maintenance for Retrofitted Legacy Equipment and Modern Industry 4.0 Equipment Integration

Market Overview

This failure methodology utilizes purposeful generation of labeled failure mode datasets enabling machine learning powered production management, performance analysis, and predictive maintenance which reduces unnecessary downtime and unexpected failure. This technology revolutionizes the manufacturing operations management (MOM) system market which was estimated to be $9.75B in 2019 and is projected to reach $22.64B by 2027 with a CAGR of 11.4%. There is a gap in availability of diagnostic and predictive failure data for manufacturing equipment as current methodologies are time consuming and costly or typically do not represent the damage experienced by the equipment. Failing equipment can lead to safety hazards, reduced product quality, and avoidable reduction in output capacity. Improving metrics, real-time analysis, and incorporating artificial intelligence methodologies can alleviate these negative occurrences and bring manufacturers into the Industry 4.0 future with significantly improved overall equipment effectiveness (OEE). Clemson University researchers have developed a Purposeful Failure Methodology which generates labeled relevant datasets and utilizes machine learning to not only improve prescriptive equipment maintenance but also pinpoint equipment failure modes through real-time data collection from in-line equipment.

Technical Summary

The Purposeful Failure Methodology standardizes failure data generation enabling machine learning backed diagnosis and prognosis of equipment failure modes. The methodology utilizes intentional component and system damage growth from identified points of failure tracked by standard and commonplace sensors. The generated data is tracked and labeled prior to input into machine learning algorithms which are then utilized to inform diagnostic and prognostic systems. The methodology recapitulates operational component environments during the generation of failure data via physical twin models leading to direct in-line equipment monitoring and failure prediction translatability. The nature of the methodology is conducive for rapid labeled failure dataset generation, equipment monitoring, and informed predictive maintenance scheduling providing potential cost and downtime savings, increased production, and improved employee safety.
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<th>App Type</th>
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### About the Inventors

**Ethan Wescoat**  
Ph.D. Graduate Research Assistant at Clemson University

Ethan Wescoat is a Ph.D. Graduate Research Assistant at Clemson University’s International Campus for Automotive Research. He earned his Bachelor’s Degree in Mechanical Engineering from the Georgia Institute of Technology and Master’s Degree in Mechanical Engineering from Clemson University. His previous industry experience includes working with Moog Inc., Gulfstream Aerospace, and BMW Manufacturing Co. His current research focuses on controls and manufacturing for vehicles.

**Dr. Laine Mears**  
BMW SmartState Endowed Chair of Automotive Manufacturing

Dr. Laine Mears is the BMW SmartState Endowed Chair of Automotive Manufacturing, Professor and founding faculty member in the Automotive Engineering department at Clemson University. He earned Ph.D. in Mechanical Engineering from the Georgia Institute of Technology. Prior to joining Clemson, he worked 10 years in industry with Tier-1 and Tier-2 automotive and bearing manufacturers in Engineer, Manager, and Product Launch Coordinator roles. Applicable work in industry includes power optimization of hard machining processes, multi-spindle turning analysis and startup of a bulk deformation rolling process for bearing rings, and successful launch of 7 new products to automotive OEMs. Some of her accomplishments include being a member of the American Society of Mechanical Engineers and a Senior Member of both the Society of Manufacturing Engineers and the American Society for Quality. He is an SME Certified Manufacturing Engineer (CMfgE), an ASQ Certified Quality Engineer (CQE), and a licensed Professional Engineer.

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