Integrating Feature Engineering with Deep Learning to Conduct Equipment Health Management for Semiconductor Manufacturing

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Abstract

Fault detection and diagnosis (FDD) and predictive maintenance (PdM) are two critical issues in equipment health management (EHM). The former aims at identifying equipment conditions (healthy vs. poor) while the latter focuses on the prediction of the remaining useful life (RUL) for key components. In reality, imbalanced datasets containing limited defective samples make precise FDD very challenging. In addition, the prediction of the RUL is difficult because of limited availability of true data. In this research, FDD and PdM are transformed into the prediction of probe's core states and tip length. In particular, this research aims at accomplishing the following goals: (1) ensemble learning is used to identify key performance indicators (KPIs) that significantly affect probe's core states (classification) or tip length (regression). (2) A two-stage stacking architecture is applied to improve the predictive performances. (3) Oversampling schemes are adopted to handle imbalanced datasets and improve predictive performances in core states. Research findings demonstrate that vendor type, chip size, chip leads, cleaning depth, and cleaning touchdown are common KPIs in probe's core state and tip length. Further, stacking architecture and oversampling can significantly improve the *F* measure by at least 10%.

Keywords:

fault diagnosis, remaining useful life, probe length, equipment health.