

# Incipient Fault Diagnosis Method via Joint Adaptive Signal Decomposition

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**Abstract:** Identification and diagnosis of the incipient fault in electromechanical systems is a challenging task due to its weakness and concealment of magnitude. The one-step signal decomposition method has more or less the problem of losing fault feature information because of over or under-decomposition issues. In this article, a novel diagnosis method is proposed for incipient fault identification via a new algorithm called joint adaptive signal decomposition (JASD). The joint algorithm benefits from the narrow-band signal decomposition superiority of

variational mode decomposition (VMD) and the nonstationary signal processing ability of adaptive chirp mode decomposition (ACMD), which greatly enhances the capacity to extract the incipient fault components from vibration signal. Meanwhile, a new index called Integration Kurtosis which covers comprehensive feature of the fault is designed to achieve synchronous parameters optimization of the joint algorithm. In the diagnosis scheme, the parameter-optimized VMD is first utilized to reconstruct the original signal by selecting the most relevant modes, and the secondary decomposition of the new signal is conducted by the parameter-optimized ACMD. Then, the feature of the incipient fault can be extracted sufficiently by analyzing the envelope spectrum of the decomposed sub-component modes. Finally, both numerical simulations and real signal experimental results validate the effectiveness and reliability of the proposed JASD fault diagnosis method.

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