



## A Functional Time Warping Approach to Modeling and Monitoring Truncated Degradation Signals

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Degradation signals are sensor-based signals that are correlated with degradation processes of engineering components. In this paper, we present a flexible modeling framework for characterizing degradation signals that can only be observed up to a prespecified failure threshold. The underlying assumption of this framework is that the engineering components degrade according to a similar trend, referred to as the common shape function, but at different degradation rates. Under this assumption, the degradation signals of different components are synchronized using a random time warping process, which transforms the common trend function into degradation processes that progress at varying rates. Our primary objective is to obtain real-time predictions for the residual lifetime of components deployed in the field. We test the performance of our methodology using vibration-based degradation signals from a rotating machinery experiment and simulated degradation signals.

**Keywords:** Functional data analysis; Degradation Modeling; Residual life prediction