A Data-Driven Diagnosis and Prognosis Method for Machinery Tools Based on EMD and Dual-Task Deep Neural Networks

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Rolling bearings transmit a rotary motion between two bodies. Faulty components generate more friction which translates into dissipation of additional energy and heat which in turn increases the carbon footprint of the machine by an immense amount. By predicting if and when a component will start to malfunction, I aim to cut down the energy consumption and hence the running cost and the carbon footprint of the machine by a significant amount.   Health state recognition and remaining useful life prediction are two major challenging tasks in the area of diagnosis and prognosis of rotating machinery tools. The performance of data-driven-based methods mainly depends on the quantity and quality of input features. Therefore, to improve the performance, I propose a new framework based on Empirical Mode Decomposition and dual-task deep convolutional neural networks. The EMD method has been used to extract energy based discriminative input features. A dual task 1-D deep convolutional neural network has been designed to predict the remaining useful life and health state of machinery tools. Moreover, the proposed approach has the ability to deal with non-stationary signals.   A case study through the PRONOSTIA degradation dataset has been performed to validate the proposed methodology. The obtained best root mean square error and mean absolute error are 0.02 and 0.012, respectively, for the measure of remaining useful life prediction performance. The health state recognition accuracy is as high as 96.5 percent. The experimental results and comparative study show the effectiveness of the proposed framework.

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