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A Comparative Study of Deep Learning-Based Predictive Methods for Remaining Useful Life

H.-L. Hsu and Y.-T. CHI

National University of Kaohsiung, Institute of Statistics, Kaohsiung University Rd., Nanzih District, Kaohsiung, Taiwan

Estimating of remaining useful life (RUL) is a crucial predictive activity in industrial applications. Two main research directions for RUL prediction have been identified in the literature ([1]): the first is to use deep learning models to estimate RUL, while the second involves the similarity-based health state matching, which combines deep learning tools with a similarity measure based on health indicator (HI) curve. This study proposes three methods to estimate RUL based on these two research directions. The first method adopts a Convolutional LSTM Network (ConvLSTM) model to estimate RUL. In contrast, the second method modifies the HI curve matching technique by introducing a CNN-based approach to construct the HI information and the cosine similarity method. Finally, the individual prediction results of these two methods are integrated to predict the RUL. The application results on the NASA C-MAPSS aircraft turbofan engine dataset show that the three proposed methods have better predictive performance regarding three evaluation metrics, ACC, SCORE, and RMSE, compared to the original literature method and that the ensemble of our methods produces the best average prediction performance.

[1] R. Khelif, B. Chebel-Morello, S. Malinowski, E. Laajili, F. Fnaiech, and N. Zerhouni, "Direct remaining useful life estimation based on support vector regression," *IEEE Transactions on Industrial Electronics*, vol. 64, no. 3, pp. 2276–2285, 2017.