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A prediction method for the real-time remaining

useful life of wind turbine bearings based on the

Wiener process

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Abstract — A performance degradation model and a real-time remaining useful life (RUL) prediction method are proposed

on the basis of temperature characteristic parameters to determine the RUL of wind turbine bearings. First, using the moving

average method, the relative temperature data of wind turbine bearings are smoothed, and the temperature trend data are

obtained on the basis of the uncertainty of wind speed and wind direction that causes the temperature of wind turbine

bearings to vary widely. Second, given that the degradation speed of bearings changes with operational time and uncertain

external factors, the performance degradation model is established with the Wiener process. The parameters of this model are

obtained through the maximum likelihood estimation method. Third, according to the failure principle of the first

temperature monitoring value beyond the first warning threshold, the RUL prediction model for wind turbine bearings is

At present, the premature failure rates, restoration times, and operation and maintenance (O&M) costs of wind power are

higher than desirable[1]. The operational unavailability of wind turbines reaches 3% of wind turbine lifetime. The O&M

costs can account for 10%-20% of the total energy cost for a wind turbine project, and this percentage can reach 35% for a

wind turbine at the end of its lifetime [2]. Wind turbines are unmanned remote power plants. Unlike conventional power

stations, wind turbines are exposed to highly variable and harsh weather conditions, including calm to severe winds, tropical

heat, lightning, arctic cold, hail, and snow. Wind turbines undergo constantly changing loads because of these external

**Keywords:** Wind turbine bearings, performance degradation, Wiener process, RUL prediction

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1 Introduction

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### 19 established on the basis of an inverse Gaussian distribution. Finally, the performance degradation process and real-time RUL

# prediction are demonstrated by predicting the RUL of a practical rear bearing of a wind turbine generator. The comparison of

# the predicted RUL and actual RUL shows that the proposed model and prediction method are correct and effective.

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