Demodulating of the 3-D tip clearance of turbine blades using BP neural network optimized by genetic algorithm

Hongcheng Liu[1], Xiaodong Zhang[1,2],Yiwei Xiong[1], Siying Xie[1],

[1]School of Mechanical Engineering - Xi'an Jiaotong University
[2]Key Laboratory of Education Ministry for Modern Design and Rotor-Bearing System – Xi'an Jiaotong University
No.28 Xianning West Road, 710049, Xi'an, Shaanxi, P.R. China
{liuhongcheng}@stu.xjtu.edu.cn
{xdzhang}@mail.xjtu.edu.cn

The traditional tip clearance of aero-engine is a one-dimensional variable signal, which contains poor fault information of turbine blades. In contrast, the three-dimensional (3-D) tip clearance of the aero-engine contains more abundant fault information, which can reflect the fault features of turbine blades more intuitively and comprehensively. The typical faults of turbine blades such as thermal fatigue and crack can be diagnosed based on three-dimensional tip clearance. Therefore, an optical fiber probe with three two–circle coaxial bundles based on intensity modulation is used to obtain three-dimensional tip clearance. The voltage signal collected by a single unit of the optical fiber probe is modulated simultaneously by the distance and the inclination angle between the probe end face and the measured surface, therefore it is difficult to demodulate three-dimensional tip clearance from output signal of the optical fiber probe. In this paper, an approach for demodulating of three-dimensional tip clearance of turbine blades is presented using BP neural network optimized by genetic algorithm. Three voltage ratios and three-dimensional tip clearance are used as input and output of BP neural network, respectively. Optimizing the weights and thresholds of BP neural network by genetic algorithm makes the prediction output of BP neural network more accurate.The high dimensional and nonlinearity problem between the optical probe output voltage signal and three-dimensional tip clearance can be solved by this approach. The training and test data is obtained through static calibration bench such as Fig.1 and the data is preprocessed to ensure its reliability and accuracy. Experiment results show that this demodulating approach has good precision, which can fulfil the requirements of three-dimensional tip clearance detection and provides a powerful guarantee for the fault diagnosis of turbine blades.

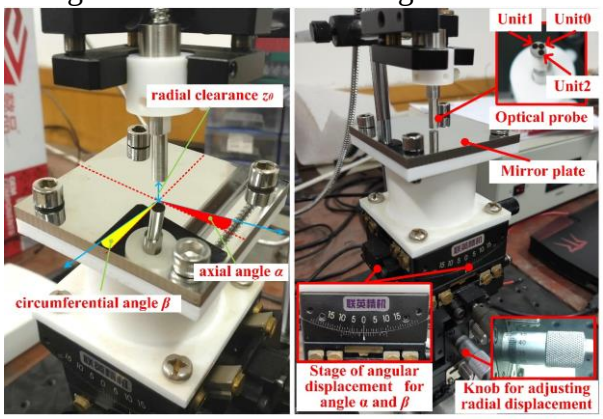

Figure 1: Static Calibration Bench

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