

Random Vibration Analysis for Impellers of Centrifugal Compressors Through the Pseudo-Excitation Method

***Y.F. Wang^{1,2}, S. J. Wang^{1,2}, and L.H. Huang³**

¹Department of Engineering Mechanics, Dalian University of Technology, China.

²State Key Laboratory of Industrial Equipment, Dalian, China

³School of Construction and Infrastructures, Dalian University of Technology, China

*Corresponding author: yfwang@dlut.edu.cn

Impellers of large centrifugal compressors are loaded by fluctuate aerodynamic pressure in operations. Excessive vibration of the impeller can be induced by unsteady airflows which may cause fatigue failures. Traditional vibration analyses require multiple-load-step computations with input of pneumatic force in time domain which are usually very time consuming. Hence, it is necessary to develop random vibration models and solve them in frequency domain. In this paper, the finite element model is generated based on the result of unsteady CFD analysis for a shrouded impeller. The pseudo-excitation method is used to obtain the power spectra and spectral moments of the three-dimensional, dynamic displacement and stress of the impeller. Compared with the direct transient vibration analyses in time domain, the pseudo-excitation method provides accurate and fast estimation of dynamic response of the impeller, making it an applicable and efficient method for random vibration computation of impellers.

Keywords: Impeller, Random vibration, Aerodynamic load, Pseudo-excitation method.