

Research for Aerodynamic Noise Reduction of a Centrifugal Compressor

Project Representative

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Abstract

Industrial centrifugal compressor is widely used in oil & gas field such as petroleum refining plants, gas pipeline, etc. Recently, lower noise level as well as high reliability and high performance are demanded. In this project, investigation of elucidation and prediction of resonance phenomena due to fluid interaction between impeller and vaned diffuser in a centrifugal compressor is targeted by using CFD technology. To obtain knowledge of such aeroacoustic phenomena occurring inside of a compressor, analysis of enormous large scale as well as unsteady compressive flow with high speed rotation in transonic region should be enabled, we perform numerical simulation of Large Eddy Simulation (LES) methodology using Earth Simulator. This work will lead the world in large-scale compressible turbulent simulations. Coarse and fine mesh models are created for a single-stage compressor composed of a shrouded impeller, a vaned diffuser, and a return channel. It is found that a fine mesh is needed to capture the turbulent structures with high accuracy. Pressure fluctuation on the wall was experimentally measured at several points in the diffuser passage and the measured data are used to validate accuracy of the pressure fluctuations predicted by LES. The spatial distribution of peak values of pressure fluctuation at blade passing frequency has a characteristic pattern in the experiment. Our LES qualitatively display the same result.

Keywords : Noise, Resonance, Centrifugal Compressor, Pressure Fluctuation, Large Eddy Simulation