

# Large Eddy Simulation for a Deep Surge Cycle in a High-Speed Centrifugal Compressor With Vaned Diffuser

This paper presents a computational study for a high-speed centrifugal compressor stage with a design pressure ratio equal to 4, the stage consisting of a splittered unshrouded impeller and a wedged vaned diffuser. The aim of this paper is to investigate numerically the modifications of the flow structure during a surge cycle. The investigations are based on the results of unsteady three-dimensional, compressible flow simulations, using large eddy simulation (LES) model. Instantaneous and mean flow field analyses are presented in the impeller inducer and in the vaned diffuser region through one surge cycle time intervals. The computational data compare favorably with the measured data, from the literature, for the same compressor and operational point. The surge event phases are well detected inside the impeller and diffuser. The time-averaged loading on the impeller main blade is maximum near the trailing edge and near the tip. The amplitude of the unsteady pressure fluctuation is maximum for the flow reversal condition and reaches values up to 70% of the dynamic pressure. The diffuser vane exhibits high-pressure fluctuation from the vane leading edge to 50% of the chord length. High-pressure fluctuation is detected during the forward flow recovery condition as a result of the shock wave that moves toward the diffuser outlet.