Aerodynamic Shape Design and Optimization of Air Intake

Project Introduction

Objectives
To develop an efficient tool to do aerodynamic shape design and optimization for air intake.

Project Investigator / Manager
Dr. Tsai Her Mann
Temasek Laboratories
tslthm@nus.edu.sg

Website
www.temasek-lab.nus.edu.sg

Abstract
Develops an efficient CFD tool that will be used routinely for accurate solutions of the Navier-Stokes equations over complex configurations.

Project Details

Description

The present study is to develop an efficient CFD tool that will be used routinely for accurate solutions of the Navier-Stokes equations over complex configurations. This solver must be efficient enough to satisfy with the requirements of the aerodynamic shape design and optimization. The hybrid multi-block approach provides great flexibility to handle the topological complex configurations. For the overlapping grids, the IHC method is used because of its simplicity in the concept and implementation. The strategy that the code is parallelized by using domain decomposition and MPI to take advantage of parallel computers or clusters of PCs greatly reduces the computational time for large-scale computations. By changing boundary conditions, these general-purpose codes can be used to study a wide range of aerodynamic problems.

Then the developed CFD tool will be applied to the optimization design for the aerodynamic configurations. The adjoint method will be used as an optimizer coupled with the developed flow solver in combination with the overset method. Using techniques of control theory, the gradient of the cost function can be determined in directly by solving an adjoint equation, which has coefficients determined by the solution of the flow equations. The cost for solving the adjoint equations is approximately the same as the cost for solving the flow equations, and it is independent of the number of design variables.

This project provides an efficient tool for CFD and Optimization Design and provides a good platform for the future research work.