Unsteady adjoint optimization

with grid adaptation

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ABOUTflow

Background and Current Position

Background

- Born in Khulna, Bangladesh
- B.Sc. in Mechanical Engineering from Bangladesh University of Engineering &Technology
- M.Sc. in Computational Mechanics from University of Duisburg-Essen,Germany

Current Position

- Joined WUT as ESR 14 on October, 2013
- Supervised by Prof. Jacek Szumbarski


Objectives

Primary Goal

- Adjoint solver for unsteady Navier-Stokes (including check pointing)
- Shape optimization using unsteady adjoint solver with option for optimal control
- Optimize the performance with grid adaptation and optionally multi-grid


Work Plan

Preliminary Work

- Unsteady adjoint for a simple problem with check pointing
- Optimal control

Prerequisites

- Unsteady explicit Euler solver(Residual Distribution Scheme)

Primary Task till December 2014

- Implementation of unsteady adjoint in the Euler solver
- Gradient-based shape optimization for single objective (expected)


Work Plan - continued

Testing and evaluation

- Testing of the Euler/NS code on non-stationary cases
- Testing of the obtained gradients against finite difference
- Testing of a complete optimization

Performance improvements

- Hessian-of-solution based mesh refinement
- Goal-oriented based mesh refinement

Progress

Training

- Literature review
- In house training on adjoint-based mesh adaptation and optimization
- Training workshop on AD tools organized by AboutFlow project
- Training workshop on MPI organized by HLRS, Germany
- HPC workshop on MPI, CUDA and OpenACC organized by AboutFlow project

Current Status

- Development of Adjoint implementation on Euler solver is underway.


Secondment

RWTH on Feb-March 2015

- Familiarization in parallelization of adjoint solvers
- Use of operator overloading based AD to develop Adjoint solver
- Participation in courses on AD and scientific computing

Rolls Royce on October 2015

- Training on industrial approach to optimization
- Investigation of turbo-machinery problem using the developed adjoint solver
- Application of grid adaptation tool chain available in WUT for turbo-machinery test cases

Expected Outcome of the Project

- Robust adjoint solver with shape optimization and grid adaptation capability
- Benchmark of mesh adaptation toolchain
- Performance comparison of mesh refinement and regeneration in the context of developed solver
- Experience in cfd solver development and application to industrial flow problems
- Collaboration with academia and industry


Future Plans

Impact from AboutFlow Project

- Experience on numerical optimization
- AD tools
- Programming skill on sophisticated application

Research

- Expected to employ adjoint technique for higher order RDS scheme
- GPU implementation of the developed adjoint solver

Career

- Phd thesis submission in the last quarter of 2016
- Continue to engage in research on Adjoint optimization in academia or industry


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This work has been conducted within the **About Flow** project on "Adjoint-based optimization of industrial and unsteady flows".

`http://aboutflow.sems.qmul.ac.uk`

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