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2nd AIAA CFD High Lift Prediction Workshop

Pranav Gujar
Puneet Gupta
Deepanshu Rajvanshi
Dr. Anutosh Moitra, Head Aerospace Technology

Aerospace Technology - Aerodynamics Division

CONTENTS

SCOPE OF STUDY

- **Case 1: Grid Convergence Study**

  This study was carried out on DLR provided mixed unstructured grids. We have also carried out computations on our own grids. The details are as follows:

Case1: Grid Convergence Study	
Grid	**Angles of Attack simulated**
DLR Coarse	7,16,18.5,20,21,22.4
DLR Medium	7,16,18.5,20,21,22.4
DLR Fine	16
TATA 104M Grid	7,16,18.5,20,21,22.4
TATA 115M Grid	16

- **Case 2: Reynolds Number study**

  This study was carried out on Pointwise supplied mixed unstructured grid. The details are as follows:

Case2: Reynolds Number Study	
Case	**Angles of Attack simulated**
Low Re	16,18.5,19,20,21
High Re	16,18.5,21,22.4

DATA SUBMITTED

Following data has been submitted to AIAA Committee.

Case1: Grid Convergence Study						
Grid	AOA	Force and Moments	Cp Distribution	Velocity Profiles	Iterative Convergence	Grid Convergence
DLR Coarse	7	Y	Y	N	N	Y
	16	Y	Y	N	N	Y
	18.5	Y	N	N	N	Y
	20	Y	N	N	N	Y
	21	Y	N	N	N	Y
	22.4	Y	N	N	N	Y
DLR Medium	7	Y	Y	Y	Y	Y
	16	Y	Y	N	Y	Y
	18.5	Y	N	Y	Y	Y
	20	Y	N	N	Y	Y
	21	Y	N	Y	Y	Y
	22.4	Y	N	N	Y	Y
DLR Fine	7	N	N	N	N	N
	16	Y	Y	N	Y	Y
	18.5	N	Y	N	N	N
	20	N	Y	N	N	N
	21	N	Y	N	N	N
	22.4	N	Y	N	N	N
TATA 104M Grid	7	Y	Y	Y	N	Y
	16	Y	Y	N	N	Y
	18.5	N	N	N	N	N
	20	N	N	N	N	N
	21	Y	N	Y	N	Y
	22.4	N	N	N	N	N

ANALYSIS APPROACH

- **Grid Generation**
  - **Grid Names** : TATA 104M, TATA 115M
  - **Type** : Unstructured Mixed Grid (Prism + Tetrahedral)
  - **Grid generator** : ICEM CFD
  - **Tet Generation Algorithm** : Delaunay

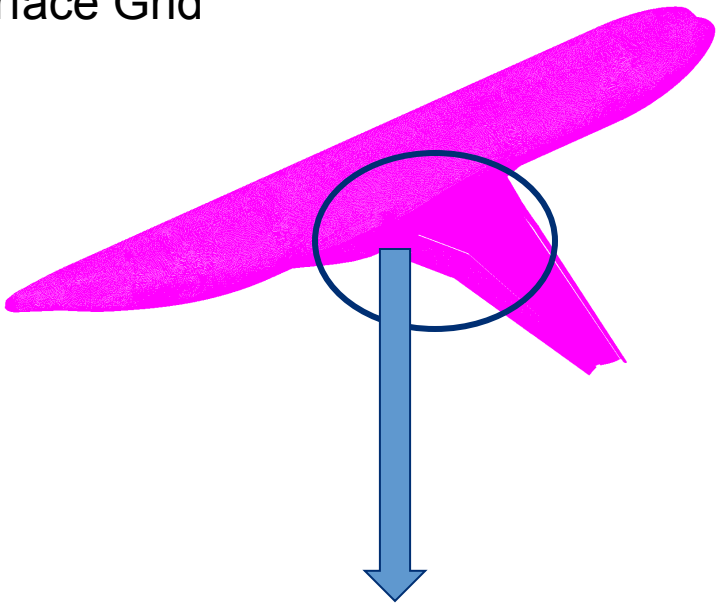
- **CFD Computations**
  - **Solver Name** : CFD++ (by Metacomp Technologies)
  - **Method** : RANS Finite Volume Cell Centered Approach
  - **Discretization** : Second Order Upwind
  - **Limiter** : Minmod
  - **Turbulence Model** : Spalart Allamaras with Rotational Correction (SARC)

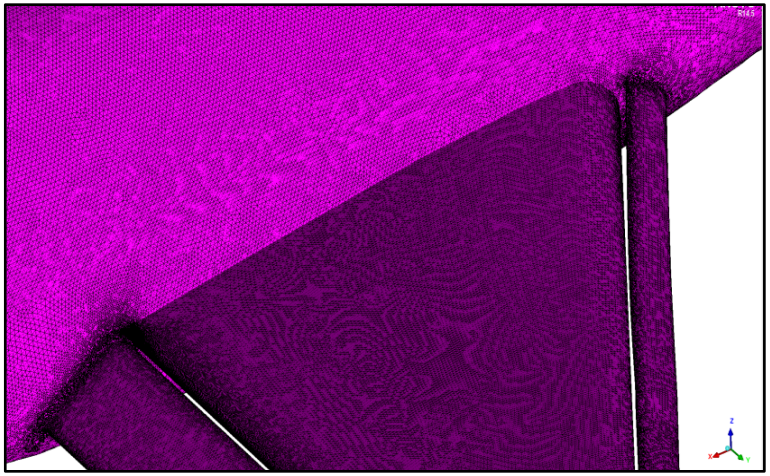
GRID DETAILS

Grid Details				
	Grid	**Type**	**Size**	**Comments**
Config 2	DLR Coarse	Mixed Unstructured	21M	No Negative Volumes encountered.
	DLR Medium	Mixed Unstructured	59M	Few Negative Volumes were encountered and fixed.
	DLR Fine	Mixed Unstructured	165M	Few Negative Volumes were encountered and fixed.
	TATA 104M Grid	Mixed Unstructured	104M	No Negative Volumes encountered.
	TATA 115M Grid	Mixed Unstructured	115M	No Negative Volumes encountered.
Config4	DLR Medium Low Re	Mixed Unstructured	77M	Several Negative Volumes were encountered and fixed. However, problem with convergence still persisted.
	DLR Medium High Re	Mixed Unstructured	74M	Several Negative Volumes were encountered and fixed. However, problem with convergence still persisted.
	Pointwise	Mixed Unstructured	150M	No Negative Volumes encountered.

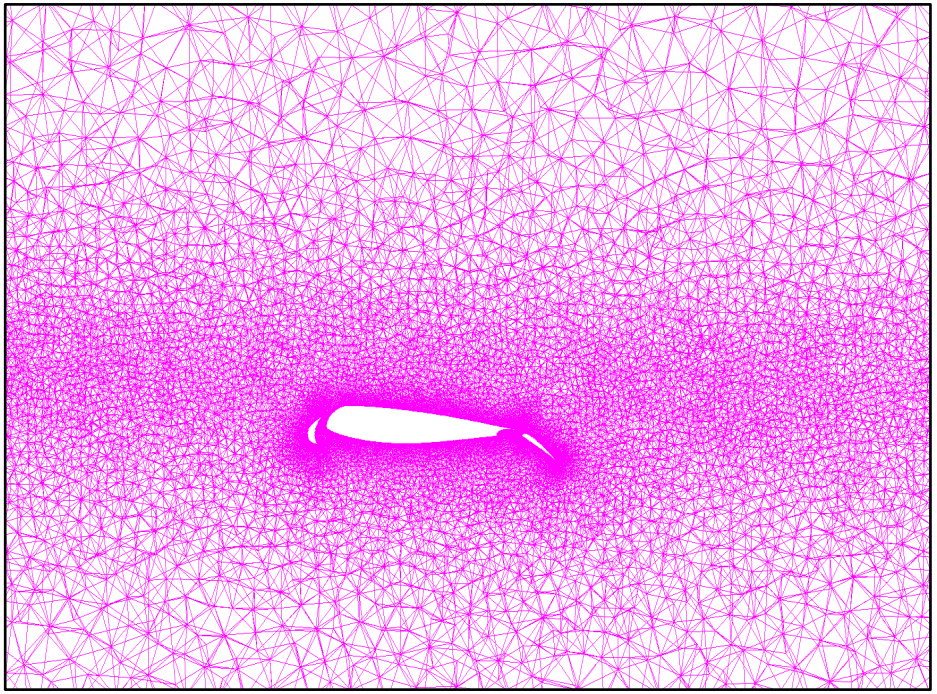
TATA 104M SURFACE & VOLUME GRID

Surface Grid



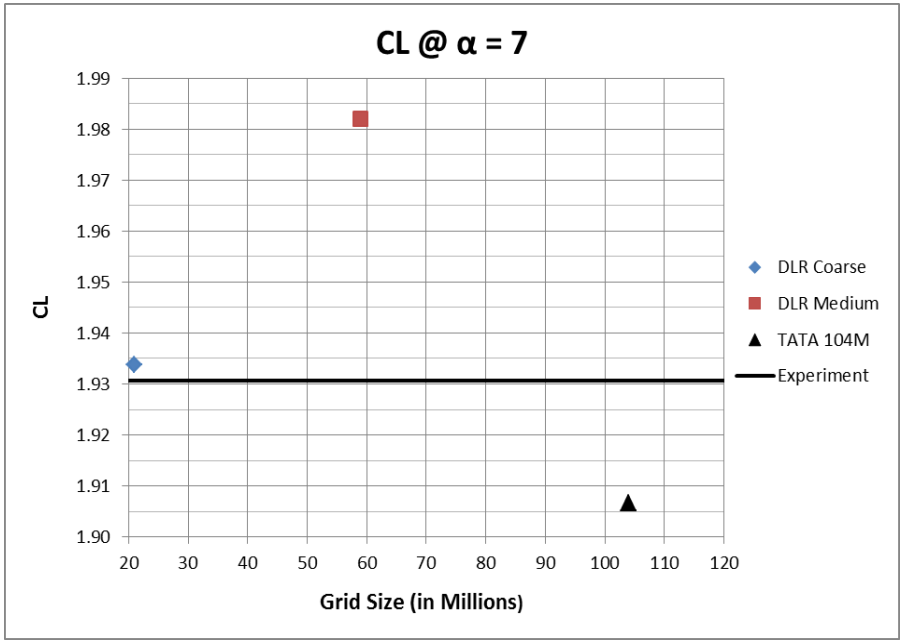


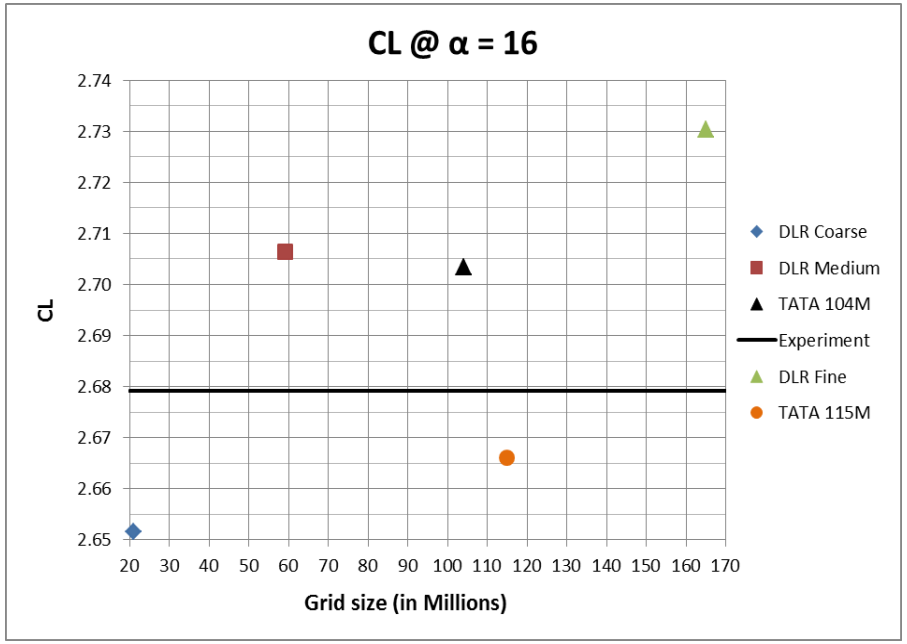
Volume Grid



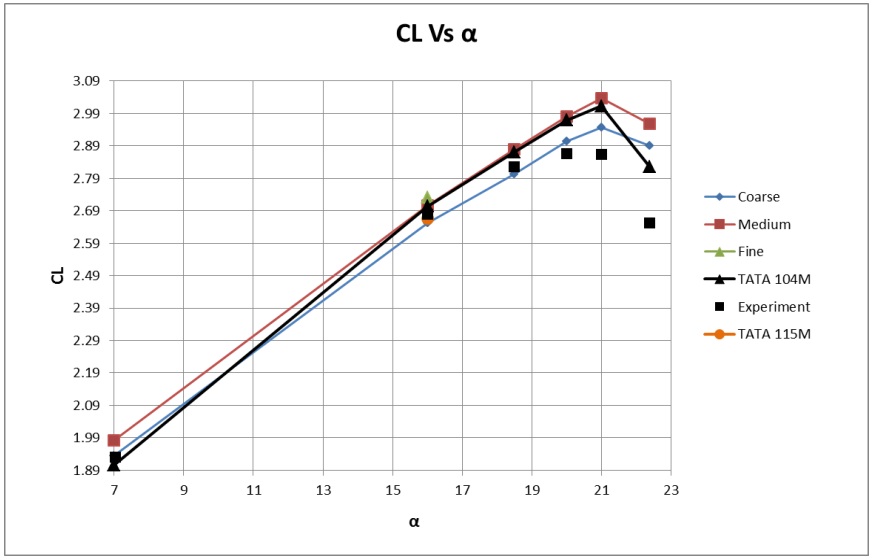
- **Grid Parameters**
  - **Max Surface Spacing (ΔS):** 1% MAC
  - **First Cell Height** : 0.00055mm
  - **Y+ Captured** : 0.086

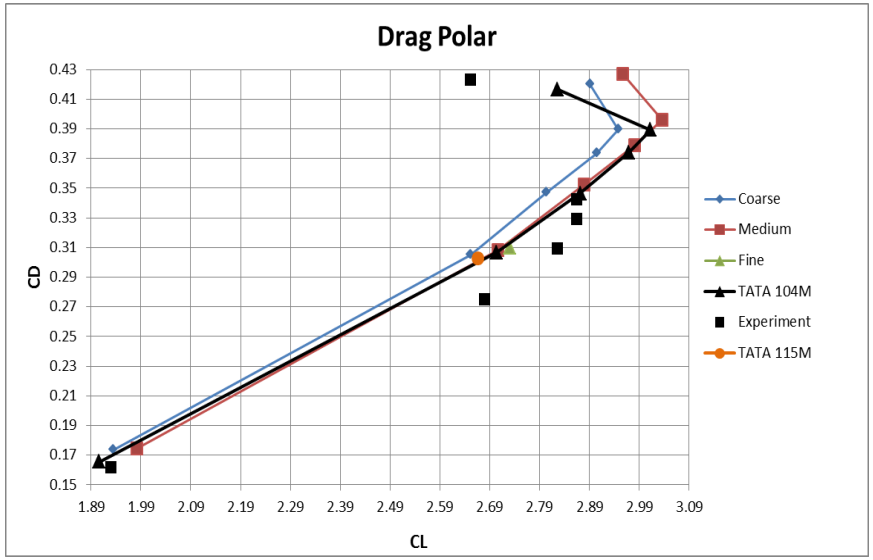
CASE 1 RESULTS

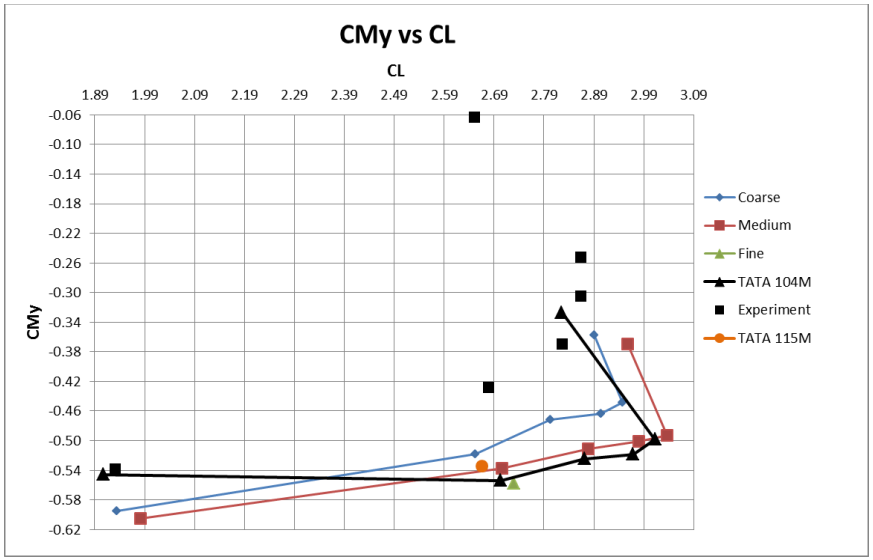




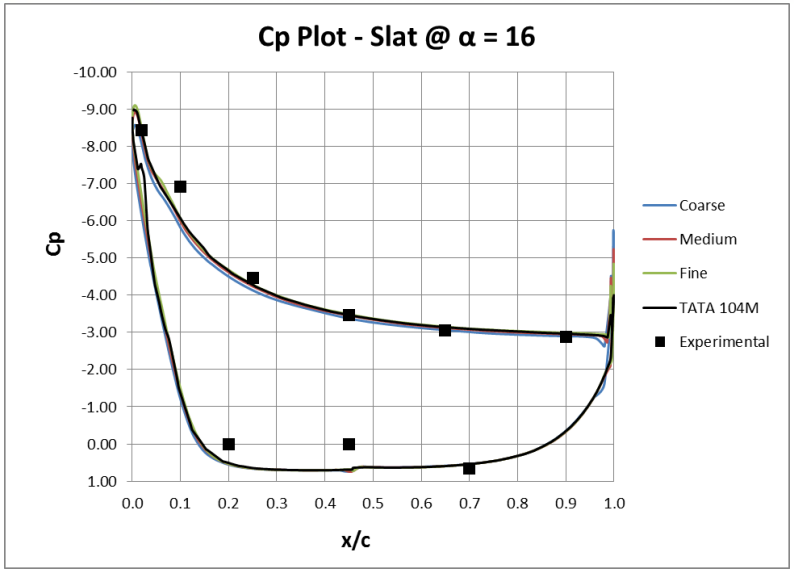
CASE 1 RESULTS (Continued)

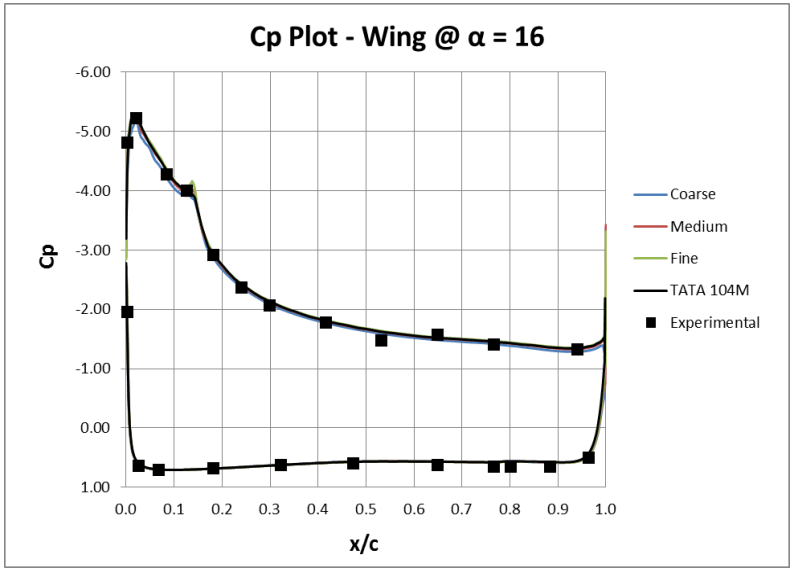


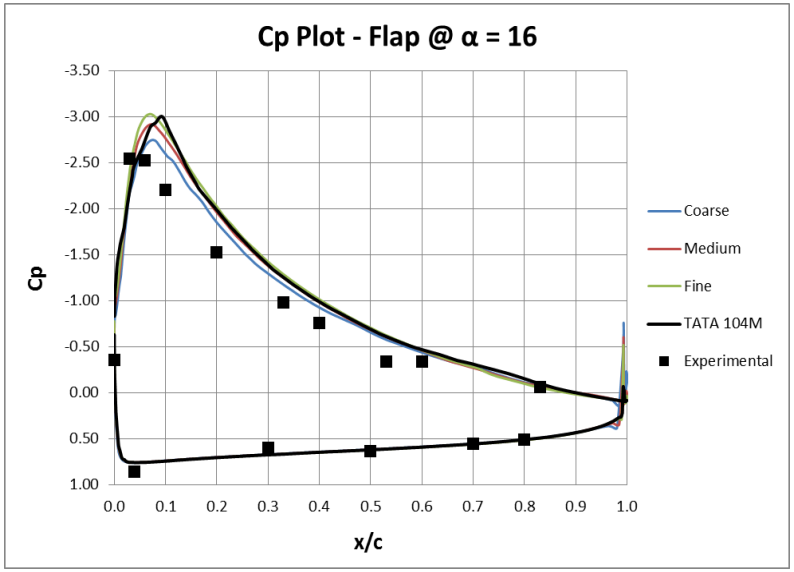




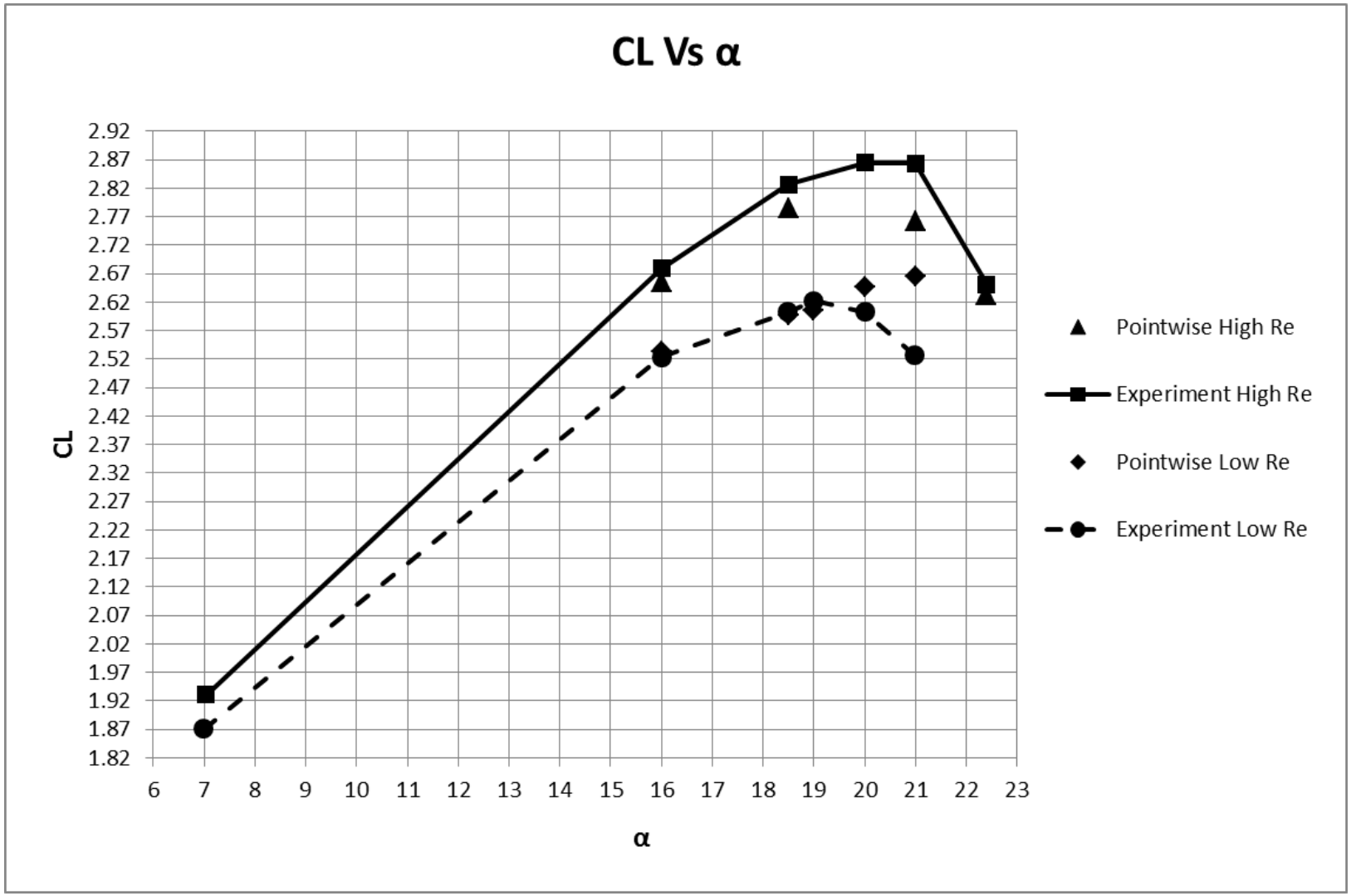
CASE 1 RESULTS (Continued)



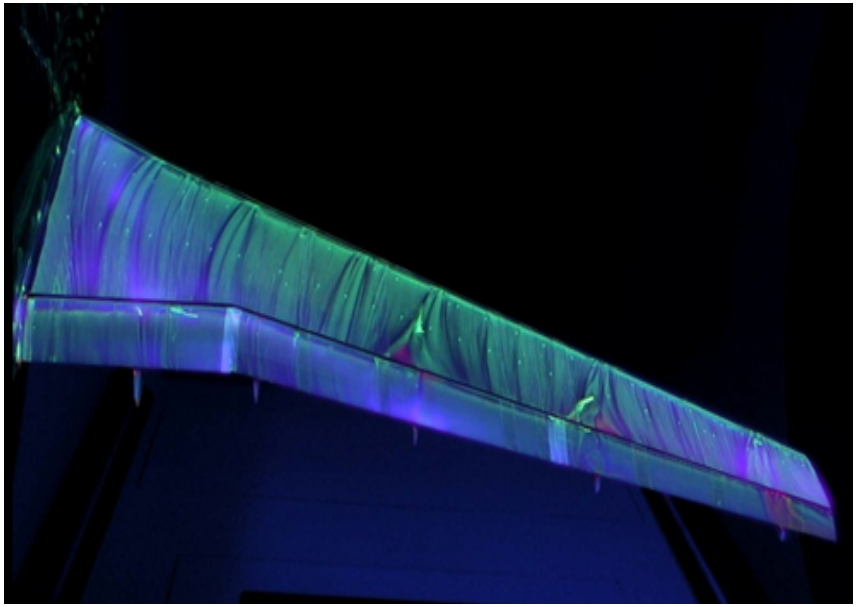




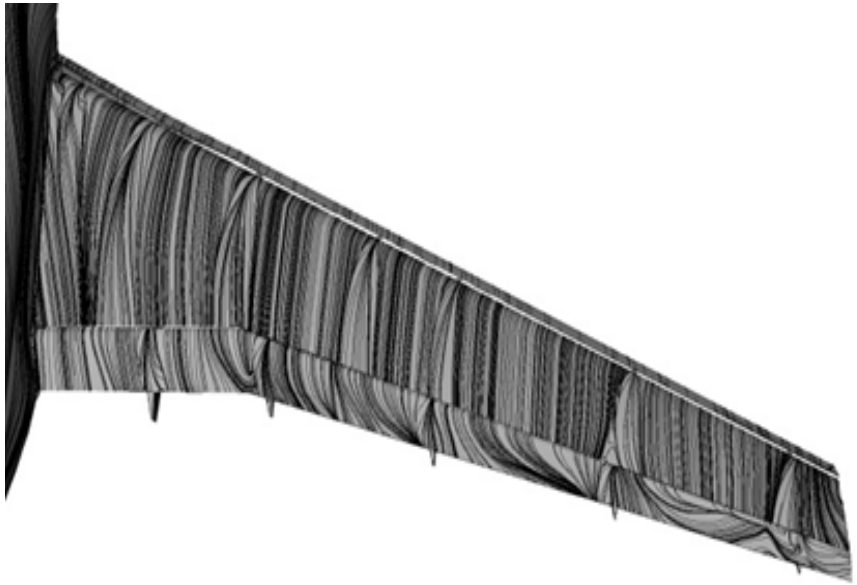
CASE 2 RESULTS



SURFACE FLOW



Experiment



Pointwise Mixed Unstructured
Config4 Low Re

FUTURE WORK

- **Future studies will focus on:**
  - **Full configuration analysis on workshop provided grids and TATA grids**
  - **Turbulence / transition studies**
  - **AIAA conference paper – 2014**
  - **High-lift performance increment studies (subject to data availability)**

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Thank You