

---

## APC-I, Aerodynamic Prediction Challenge workshop

---

# AERODYNAMIC PREDICTION OF NASA-CRM using FaSTAR ON THE UPACS GENERATED GRIDS

Thien Xuan DINH, Hiroyuki SUZUKI, Testuya FUJIMOTO

Computational Fluid Dynamics Group  
Department of Engineering I, VINAS Co., Ltd.,



0  
[www.vinas.com](http://www.vinas.com)

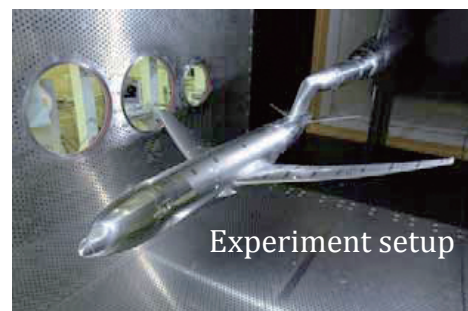
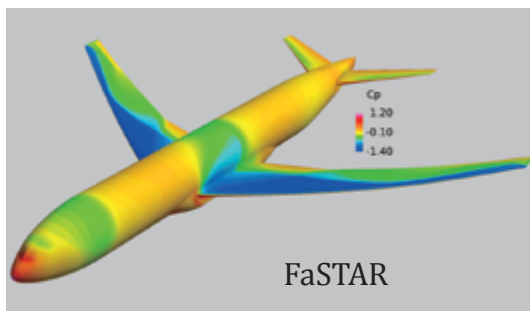
---

## Objective and Conclusion

---

**Objective:** to predict the aerodynamic performance of NASA-CRM using FaSTAR on the mesh grids generated by UPACS package in comparison with the experiment data of JAXA

**Conclusion:** the aerodynamic performance of NASA-CRM was well predicted by FaSTAR



1  
[www.vinas.com](http://www.vinas.com)

## Content

---

1. Prediction case
2. Analysis setting
3. Result
4. Conclusion

## 1. Prediction case

---

### Deformed case 1, UPACS mesh grid

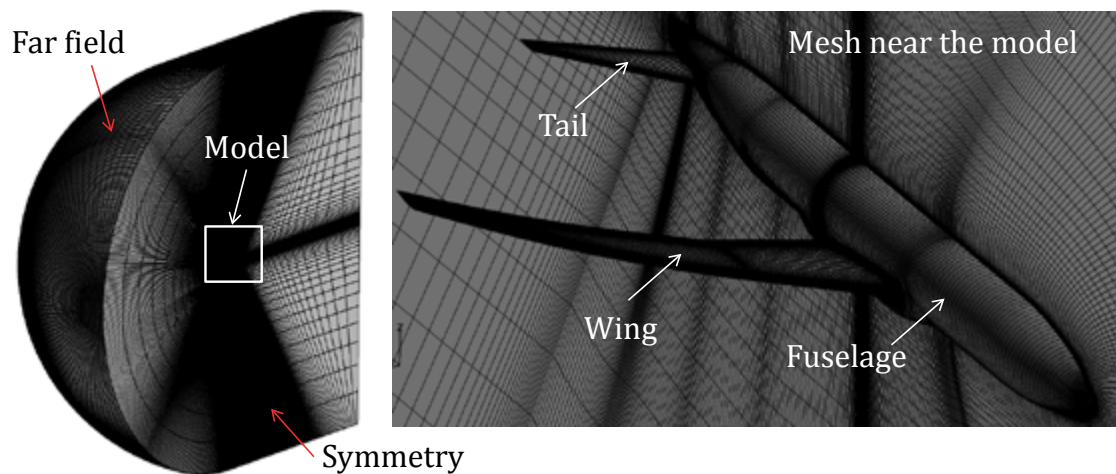
- Model
  - Full fuselage + wing + tail configuration of NASA-CRM
  - No rudder
- Speed
  - $M = 0.847$
- Angle of attack
  - $\alpha = -0.62^\circ, 2.47^\circ, 2.94^\circ,$   
 $3.55^\circ, 4.65^\circ, 5.72^\circ$



## 1. Prediction case

---

- Mesh generated by UPACS
  - A haft of model
  - 2.2 M cells (medium)
  - $y^+ < 1$



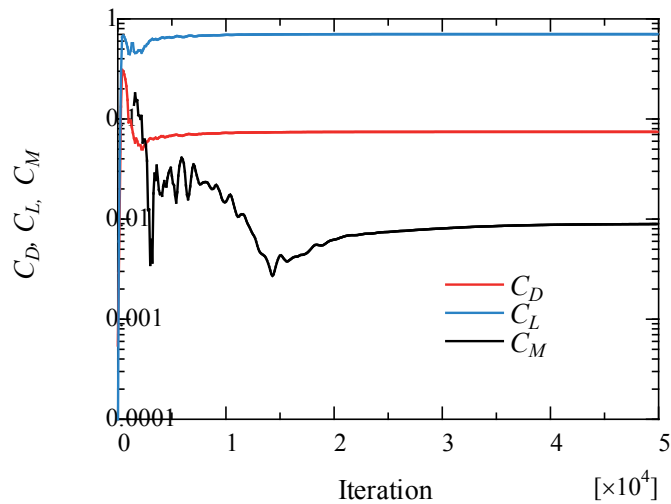
## 2. Analysis setting

---

- Solver: FaSTAR
- Turbulence model: SA
- Convection scheme: HLLEW
- Order of accuracy: U-MUSCL ( $\chi=0.5$ )
- Limiter: Hashida
- Parallel: 12 cores/node×4 nodes
- Computational time: 20h/case

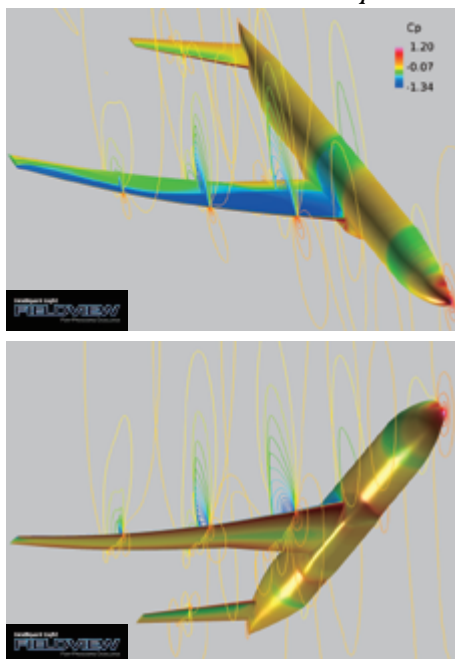
### 3. Result

- History of drag, lift, and moment at  $\alpha = 5.72^\circ$

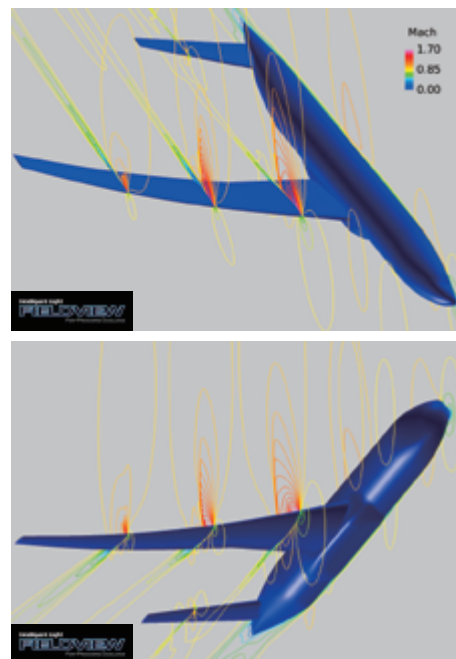


### 3. Result $\alpha = 5.72^\circ$

Pressure coefficient  $C_p$

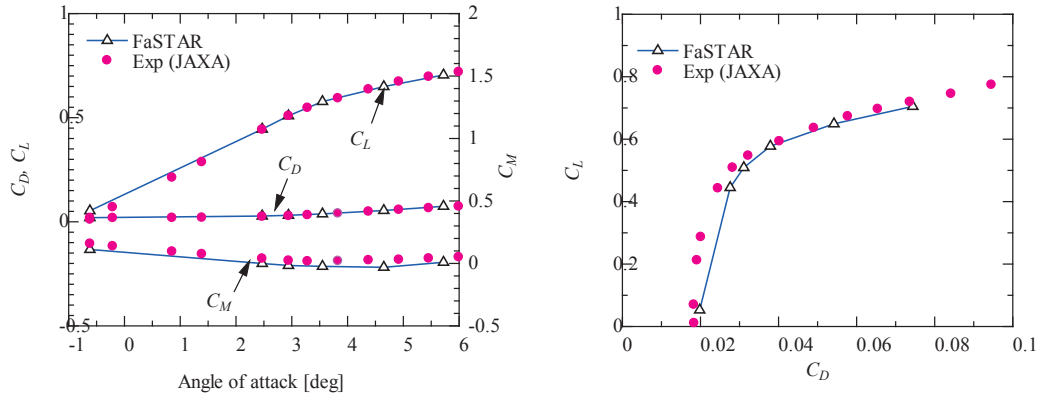


Mach number  $M$



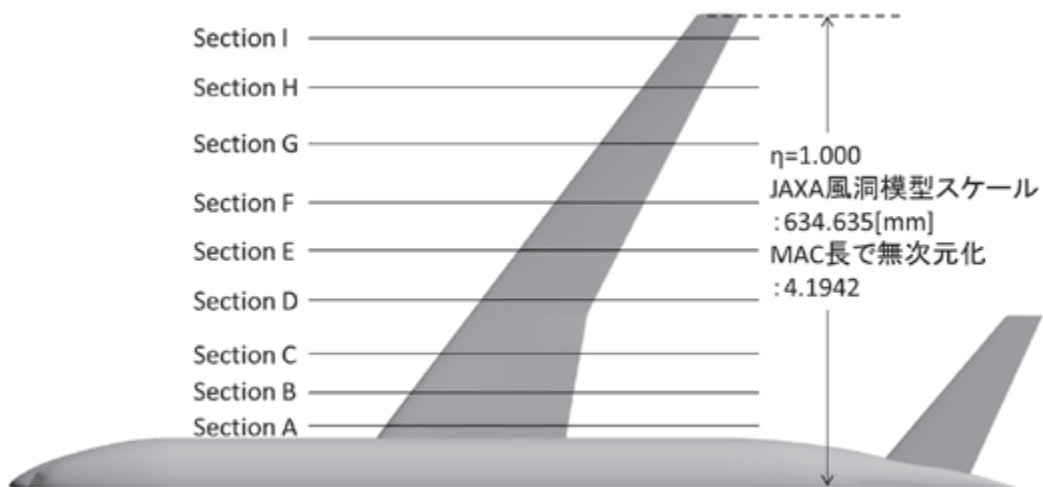
### 3. Result

- Drag, lift, and moment coefficients



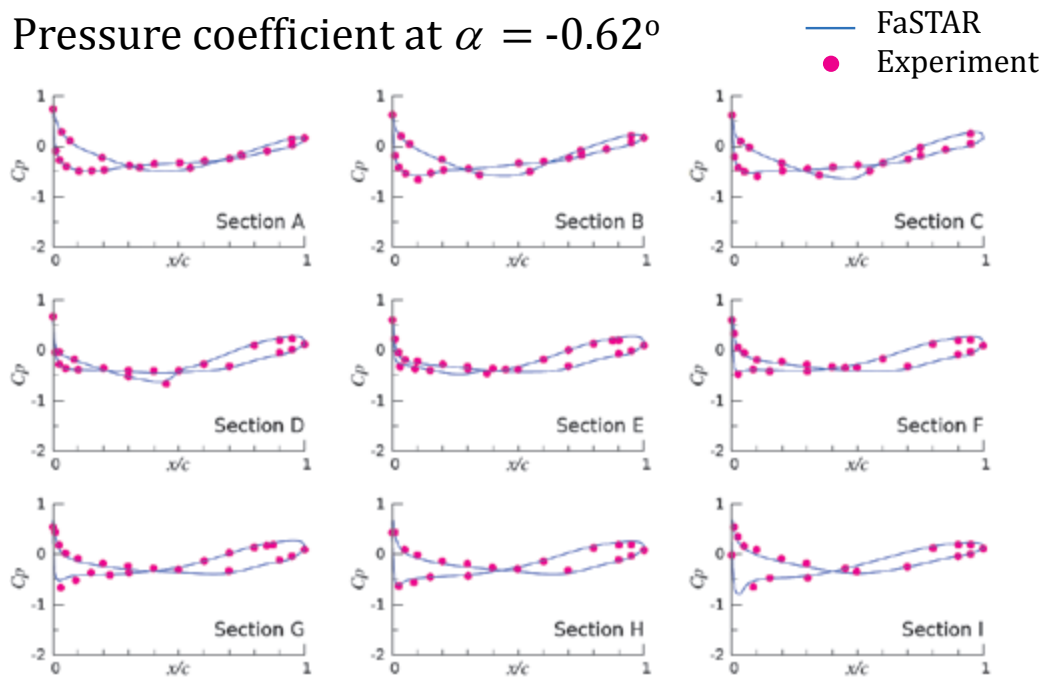
### 3. Result

- Pressure coefficient



### 3. Result

- Pressure coefficient at  $\alpha = -0.62^\circ$

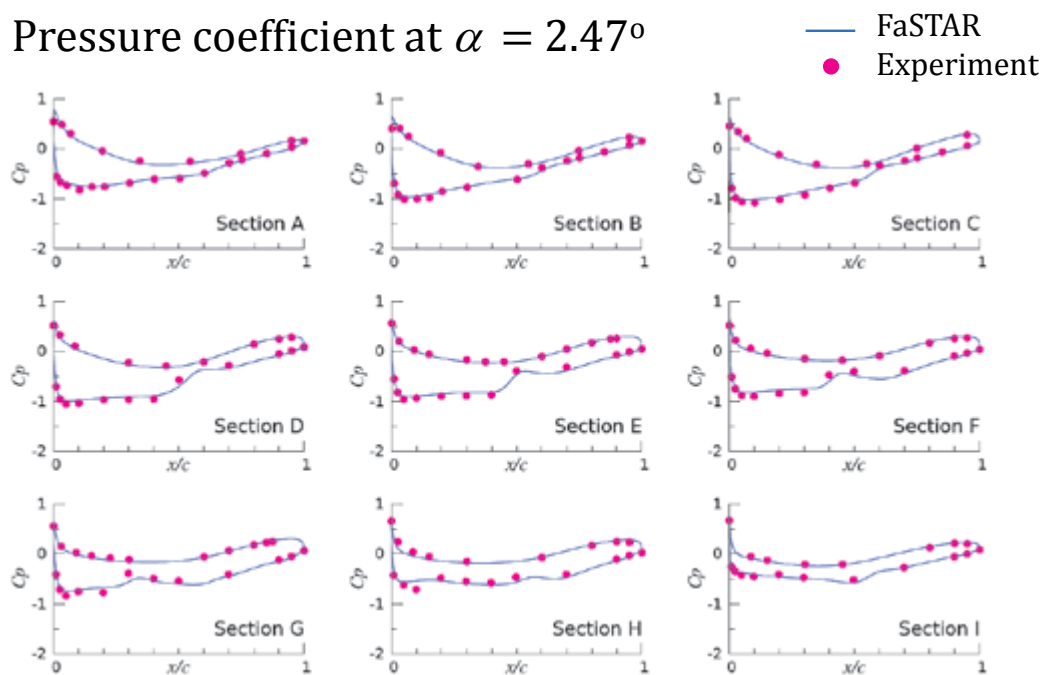


**VINAS**  
Visual Integration & Numerical Analysis System

10  
[www.vinas.com](http://www.vinas.com)

### 3. Result

- Pressure coefficient at  $\alpha = 2.47^\circ$

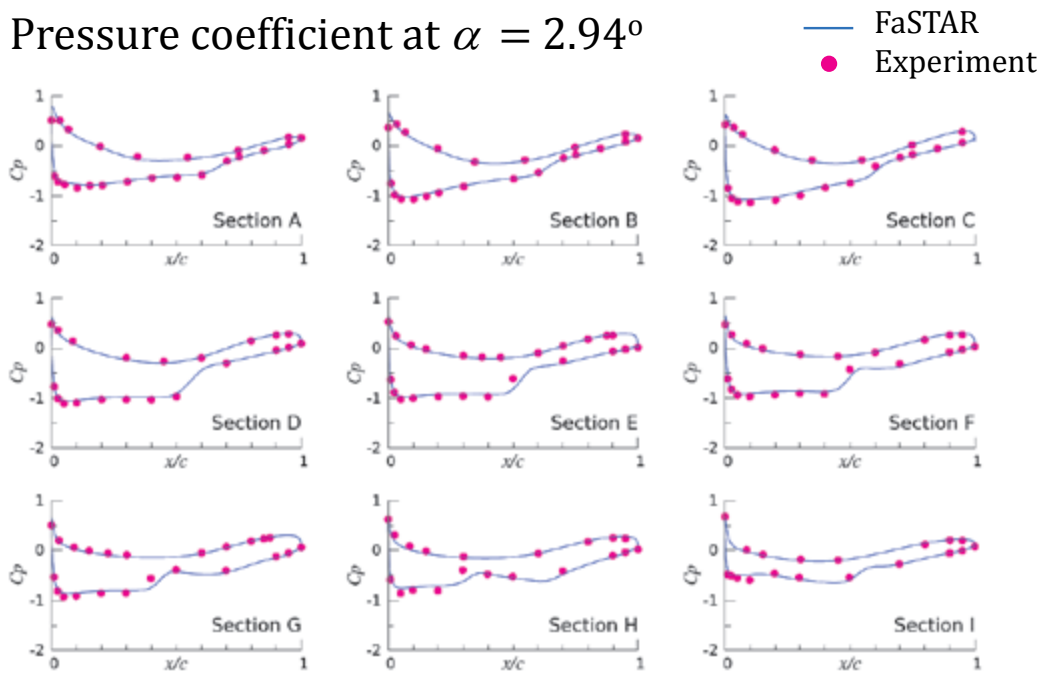


**VINAS**  
Visual Integration & Numerical Analysis System

11  
[www.vinas.com](http://www.vinas.com)

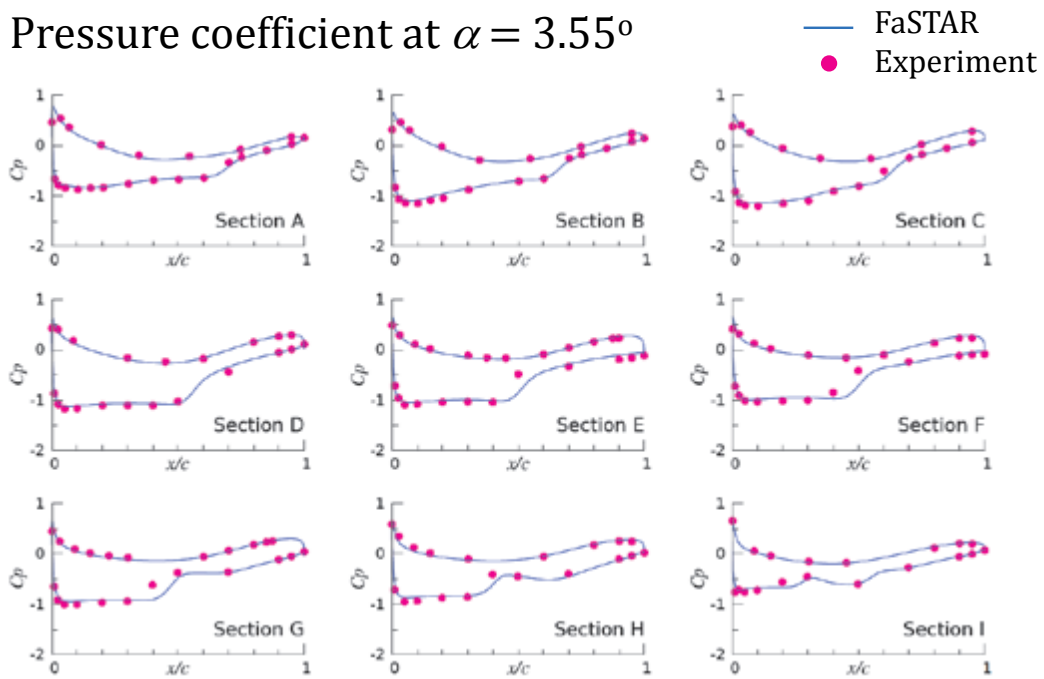
### 3. Result

- Pressure coefficient at  $\alpha = 2.94^\circ$



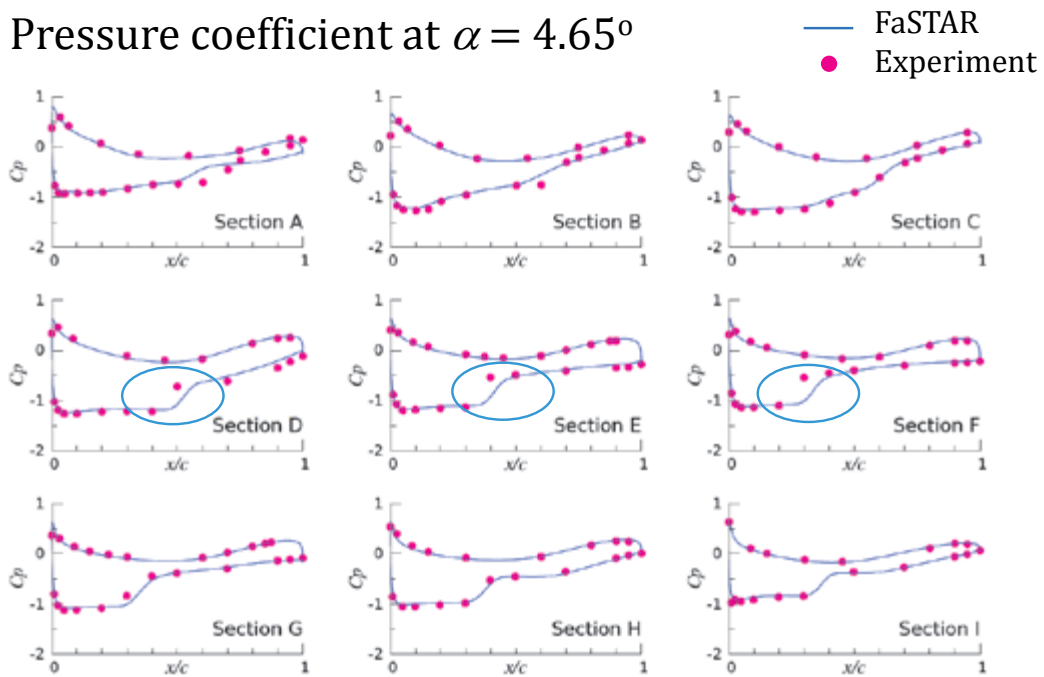
### 3. Result

- Pressure coefficient at  $\alpha = 3.55^\circ$



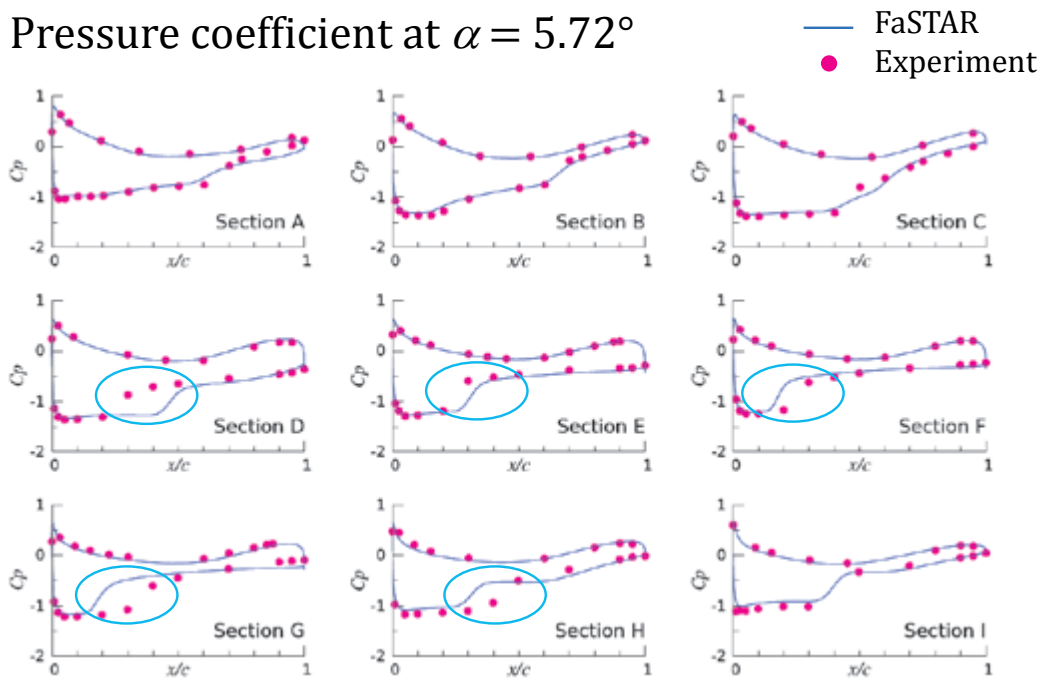
### 3. Result

- Pressure coefficient at  $\alpha = 4.65^\circ$



### 3. Result

- Pressure coefficient at  $\alpha = 5.72^\circ$

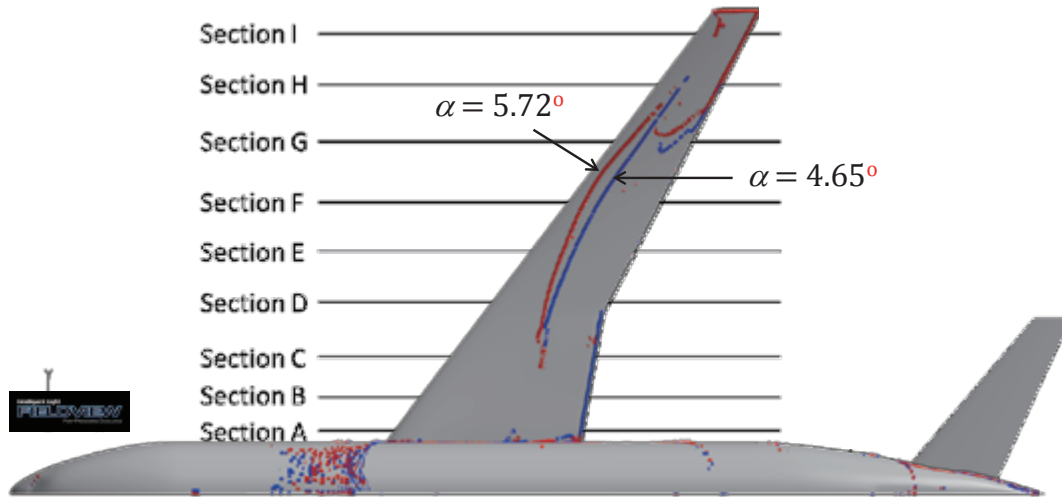




### 3. Result

---

- Separation line



### 4. Conclusion

---

- The prediction of aerodynamic performance of NASA-CRM using FaSTAR on the grid generated by UPACS was carried out
- FaSTAR predicted well the aerodynamics of the model in comparison with experiment data
- There is a discrepancy between the predicted pressure coefficient and experiment data in the separation regions. The discrepancy may be is due to the inherent of RANS model