CFD analysis of NASA CRM using the Commercial code Advance/FrontFlow/red

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CFD code

Advence/FrontFlow/red (AFFr)

- ✓ Pressure Based Solver (SIMPLE method)
- ✓ Unstructured Mesh
- ✓ Finite Volume Method
- ✓ Turbulent Model : LES ,RANS

The AFFr code has been originally improved and developed by AdvanceSoft corporation based on the CFD code FrontFlow/red, which was developed in Frontier Simulation Software for Industrial Science(FSIS) project supported by IT program of Ministry of Education, Culture, Sports, Science and Technology(MEXT),JAPAN.
The Original FrontFlow/red is Open source code, and you can download it from following URL.
http://www.ciss.iis.u-tokyo.ac.jp/dl/

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Run Summary

- ✓ M=0.847
- ✓ Re =2.26E6
- ✓ AoA simulated = -1.79, -0.62, 0.32, 1.39, 2.47, 2.94, 3.55, 4.65, 5.72deg
- ✓ Grid : HexaGrid (provided by JAXA) 13,329,362 nodes
- ✓ Sting : No

XEON E5-2650 v4 @ 2.20GHz
Intel FORTRAN
24cpu
120h
120GB

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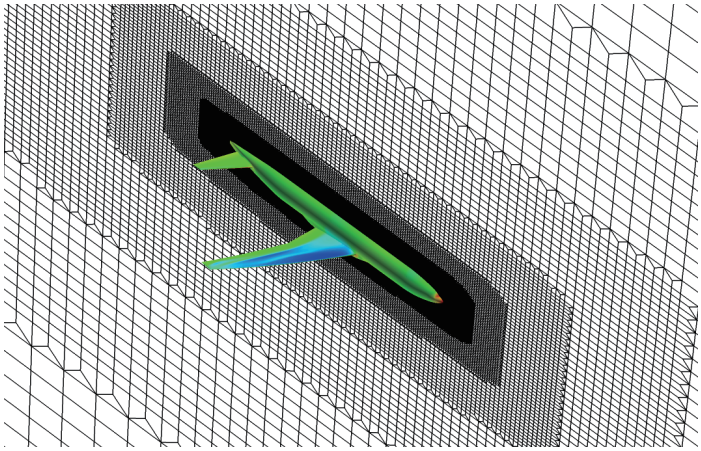
Computational Mesh

- ✓ HexaGird Medium size (provided by JAXA)
- ✓ Cell Center Discretization method
- ✓Y+ ＜ 0.2



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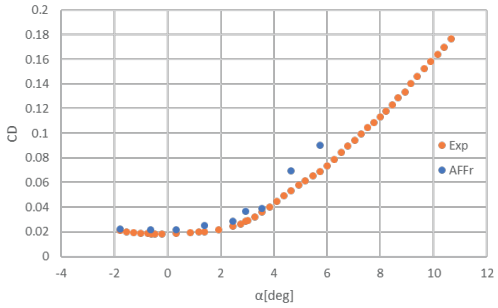
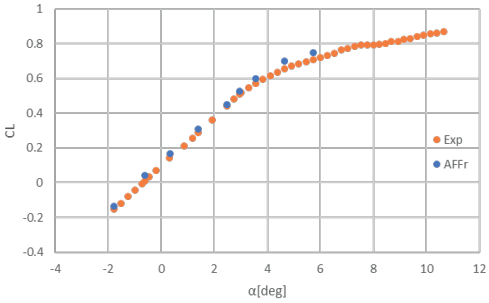
Numerical method

CFD solver	Advance/FrontFlow/red
Governing equation	Compressible Navier –Stokes equation
Turbulent model	SST k－ω
Discretization in time	Euler implicit
Convection term	2nd order up wind +Slope Limiter
Viscous term	2nd order center
Pressure-velocity coupling method	SIMPLEC method
Equation of State	Ideal

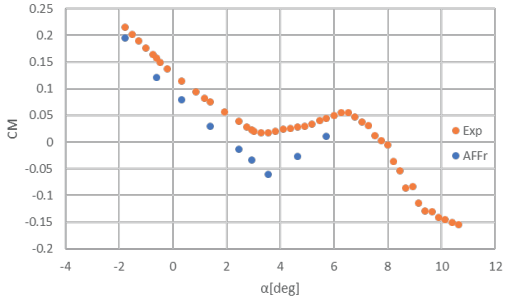
Results CD, CL, CM



α－Cd



α－CL

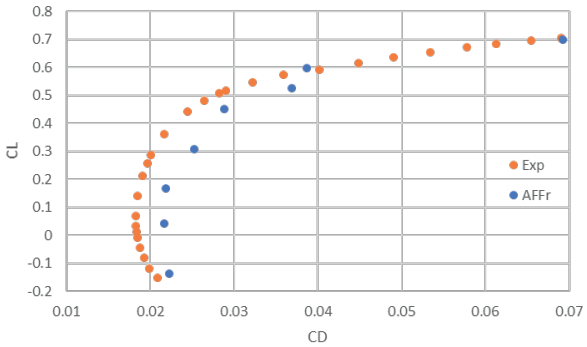


α－Cm

・CD and CL
At high AoA, slightly larger than exp .

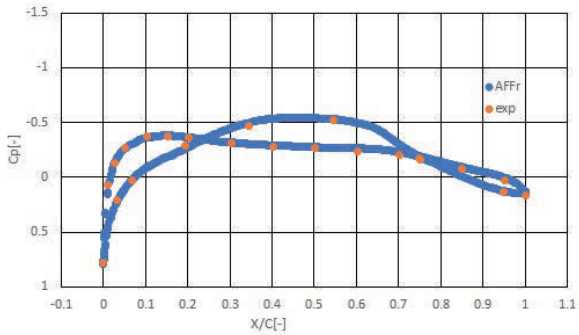
・ Cm
Numerical results are smaller than exp.

Results CD-CL



CD-CL

Results Cp -1.79[deg]



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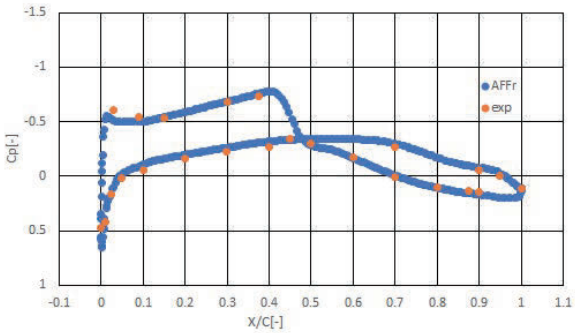

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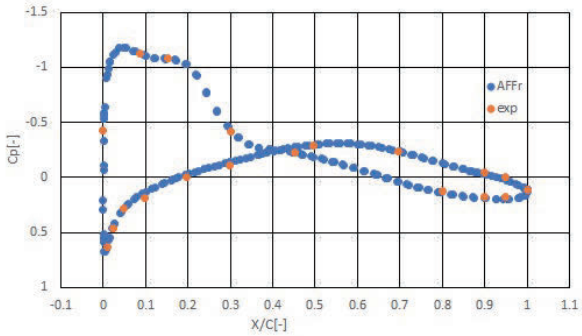
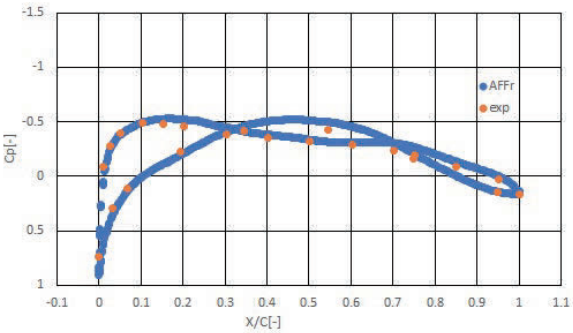


Section I

・These numerical results agree well with exp.

Results Cp -0.62[deg]



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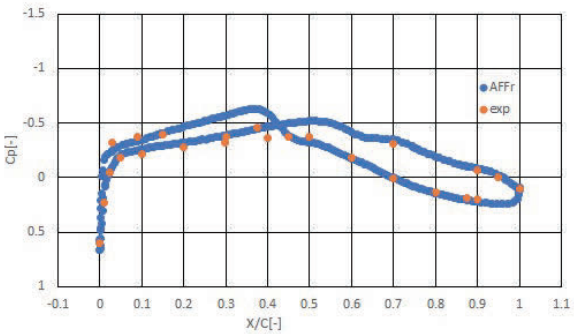

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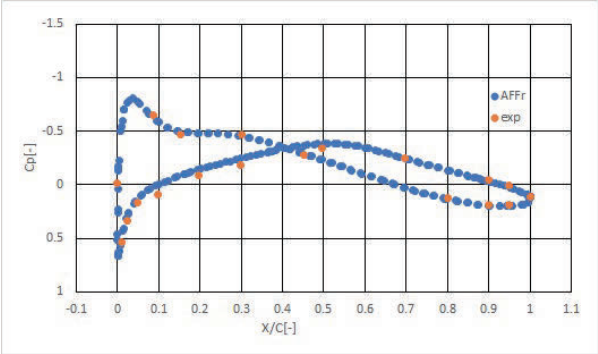
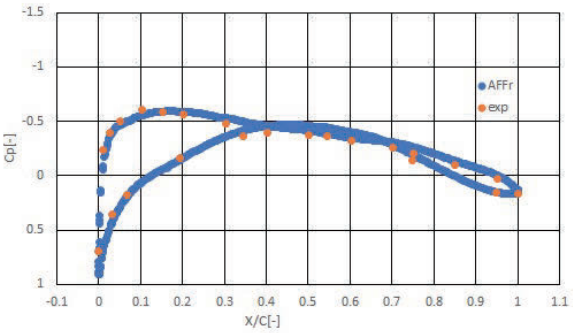


Section I

・In section E, near x/c=0.4, numerical results do not correspond with experimental results.

Results Cp 0.32[deg]



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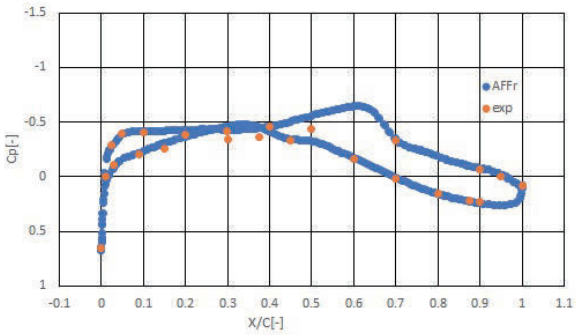

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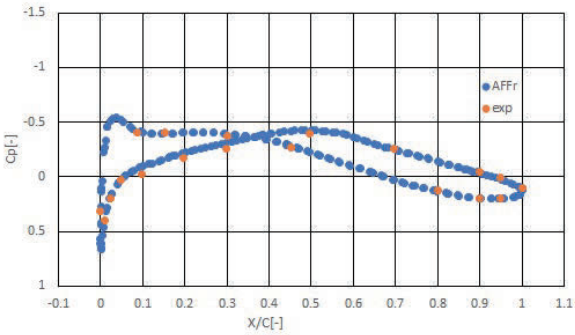
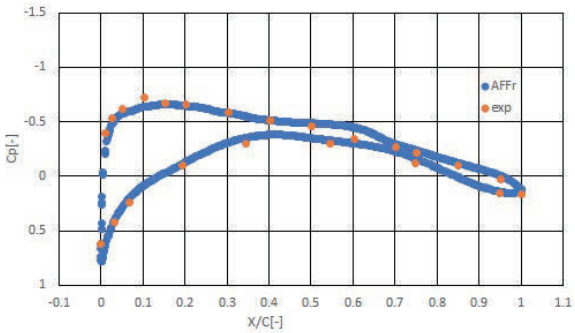


Section I

・In section E, near x/c=0.4, numerical results do not correspond with experimental results.

Results Cp 1.39[deg]



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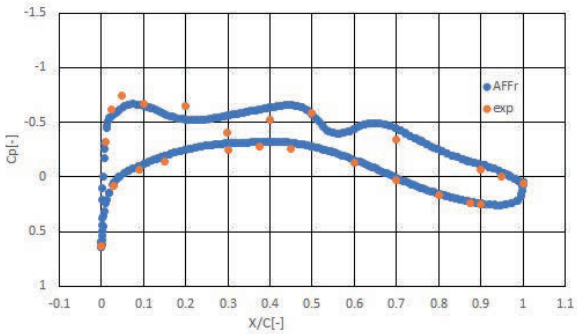

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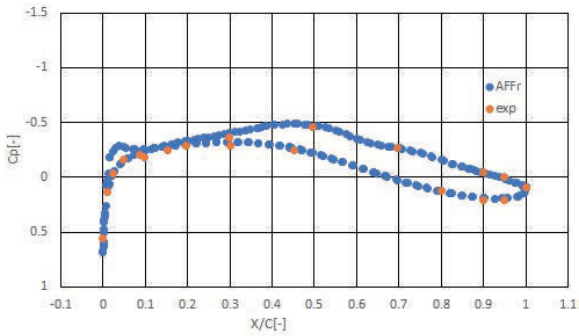
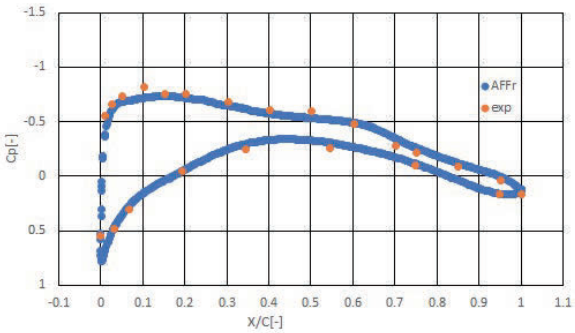


Section I

・In section E, at the upper side of the wing ,near x/c=0.3, numerical results do not correspond with experimental results.

Results Cp 2.47[deg]



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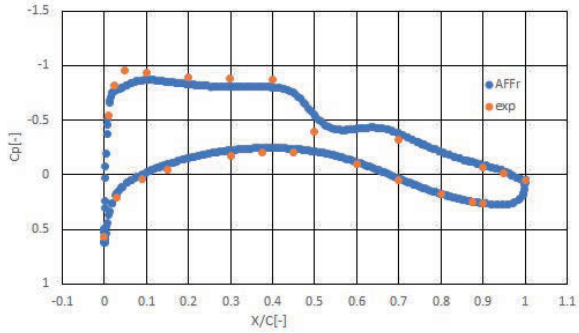

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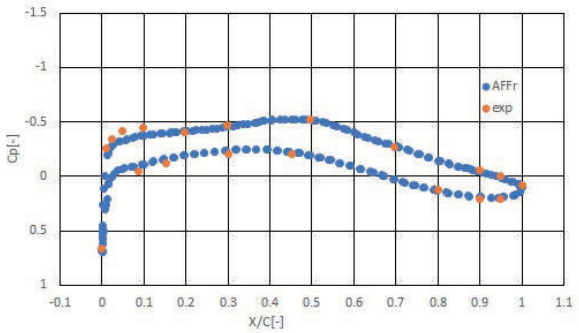
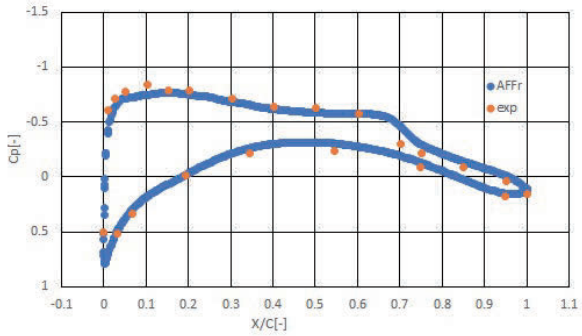


Section I

・At the upper side of the wing ,where x/c<0.4, numerical results are smaller than experimental results.

Results Cp 2.94[deg]



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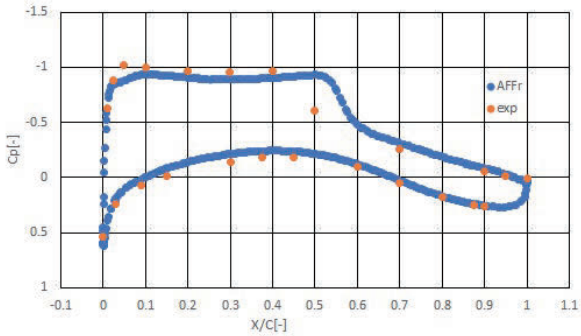

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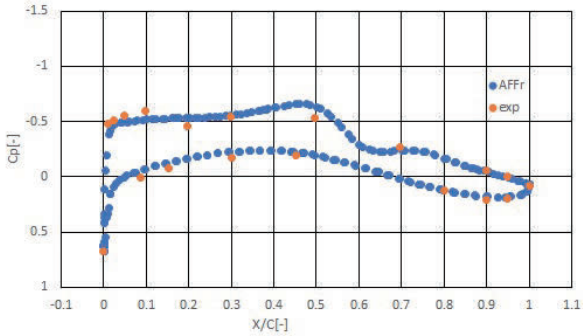

Section I

・At the upper side of the wing ,where x/c<0.4, numerical results are smaller than exp.

・In section E, at x/c=0.5, the numerical result does not correspond with exp.

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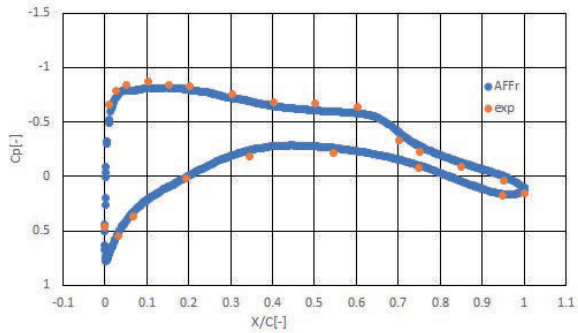
Results Cp 3.55[deg]



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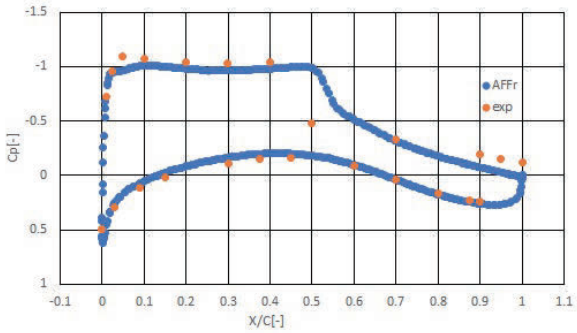

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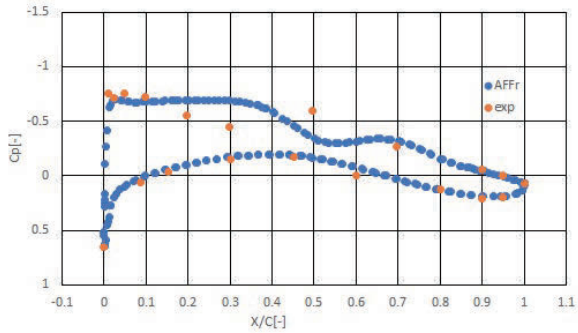

Section I

・At the upper side of the wing ,where x/c<0.4, numerical results are smaller than exp.

・In section E and I, near x/c=0.5, numerical results do not correspond with exp.

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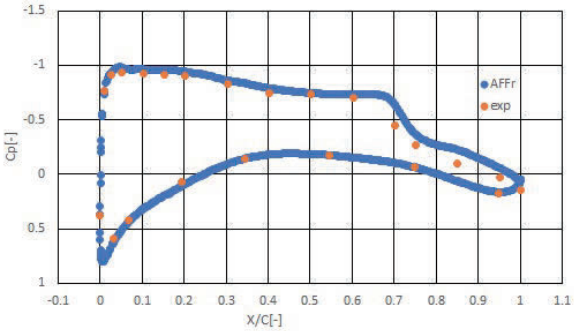
Results Cp 4.65[deg]



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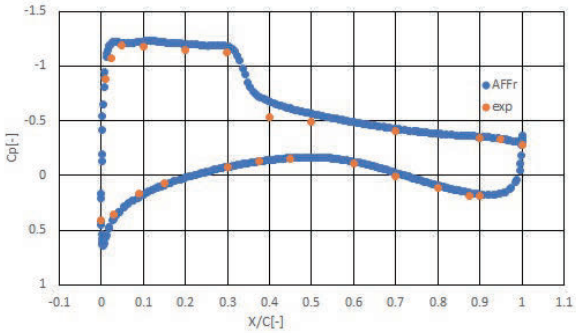

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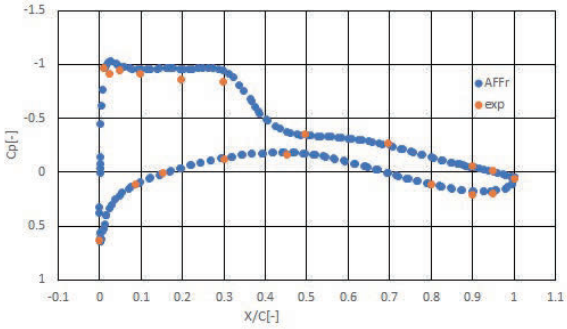
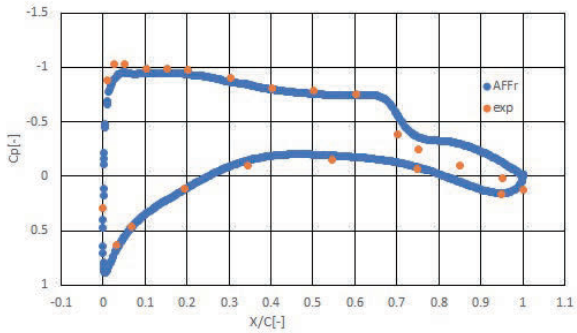


Section I

・At the upper side of the wing ,where x/c<0.3, numerical results are larger than exp.

Results Cp 5.72[deg]



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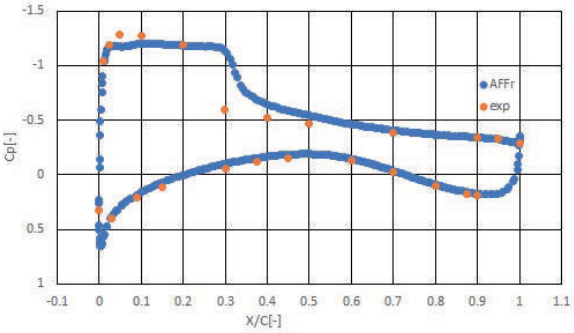

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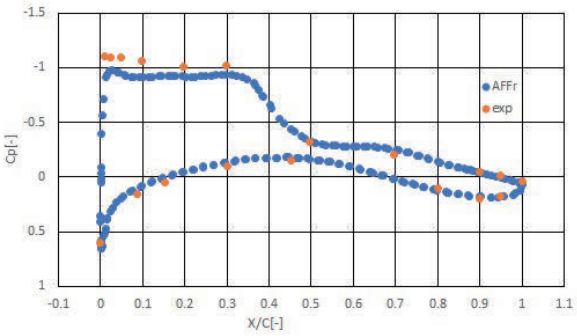

Section I

・At the upper side of the wing ,where x/c<0.3, numerical results are smaller than exp.

・In section E, at x/c=0.3, the numerical result does not correspond with the exp.

Conclusion

・We successfully performed NASA CRM calculation using with pressure based solver.

・Numerical results almost correspond with experimental results.

・In section E, near x/c=0.4, it is difficult to correspond numerical results with experiment results.

・If we can join in the next meeting, we would like to investigate the following issues.

- ✓ Grid resolution convergence
- ✓ Sting effect
- ✓ LES