



# Utilization of PSW package for preliminary calculation of small aircraft

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# Content

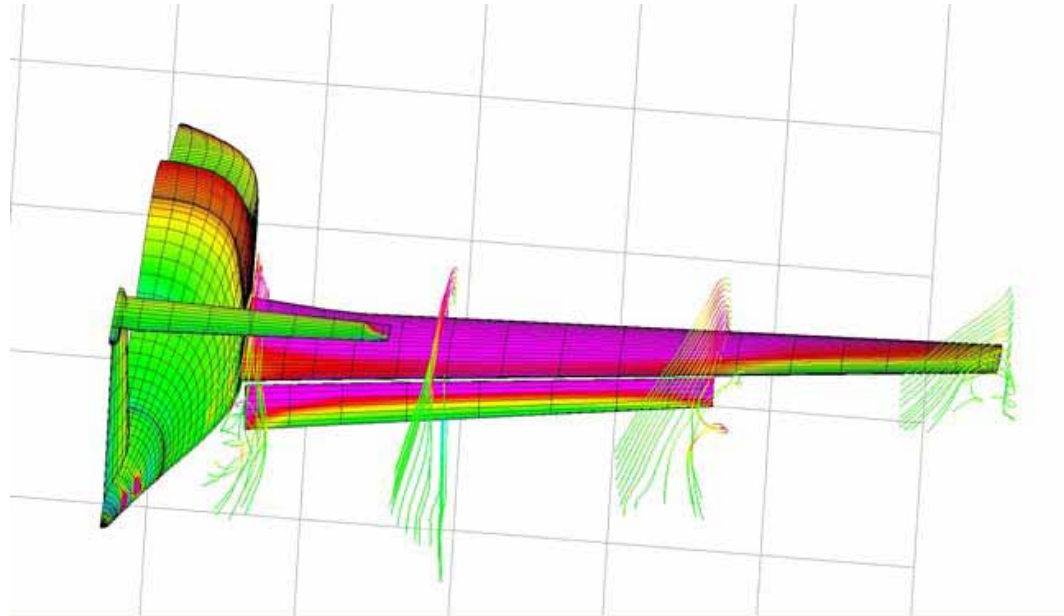


- Introduction
- Meshing → LOFTSMAN
- Calculation → CMARC
- Post-processing → PMARC
- Conclusion

# PSW



- Package of three programs
  - LOFTSMAN
  - CMARC
  - POSTMARC



# LOFTSMAN



- Geometry
- Meshing
- Export into CMARC



# LOFTSMAN - geometry



- Geometry types
  - Body → fuselage
  - Airfoil
  - Wing → wing, tail unit
  - Symmetric or unsymmetric
- Body → type A
  - type B
  - complicated shape
- Airfoil → coordinates
- Wing → airfoils
  - geometry

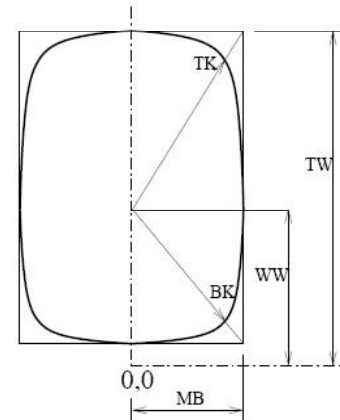
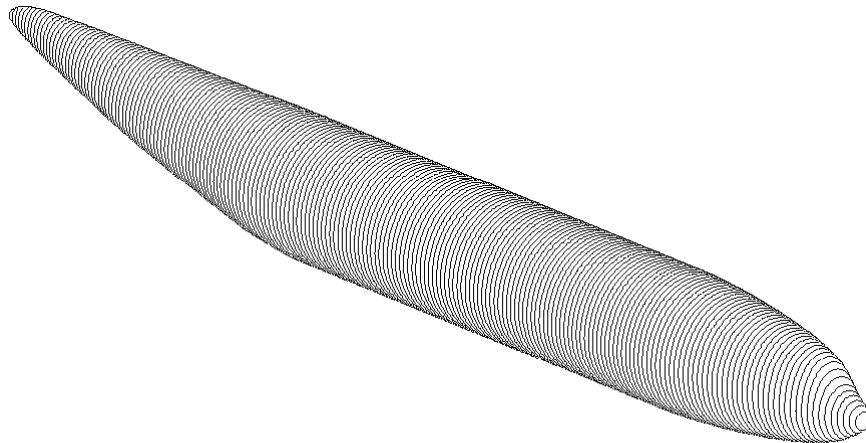
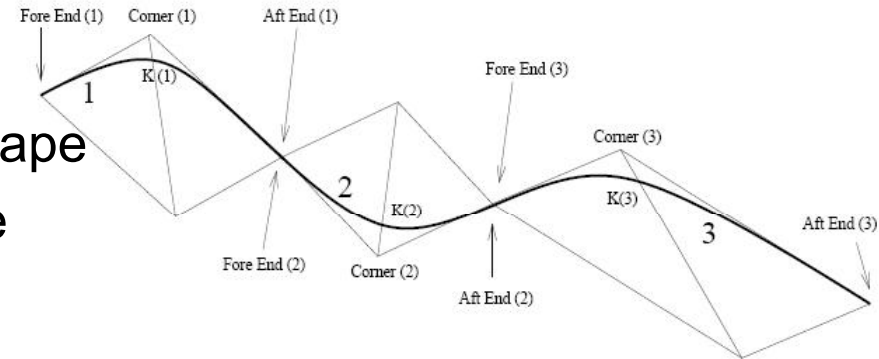


# LOFTSMAN - geometry



## ➤ Body

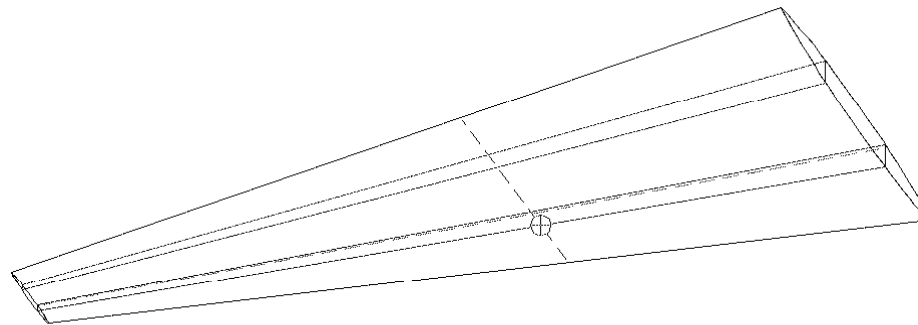
- A type → almost arbitrary shape
- B type → symmetrical shape
- Complicated shape



# LOFTSMAN - geometry



- Wing
  - cross section
  - airfoil coordinates in particular cross sections
  - wing axis position

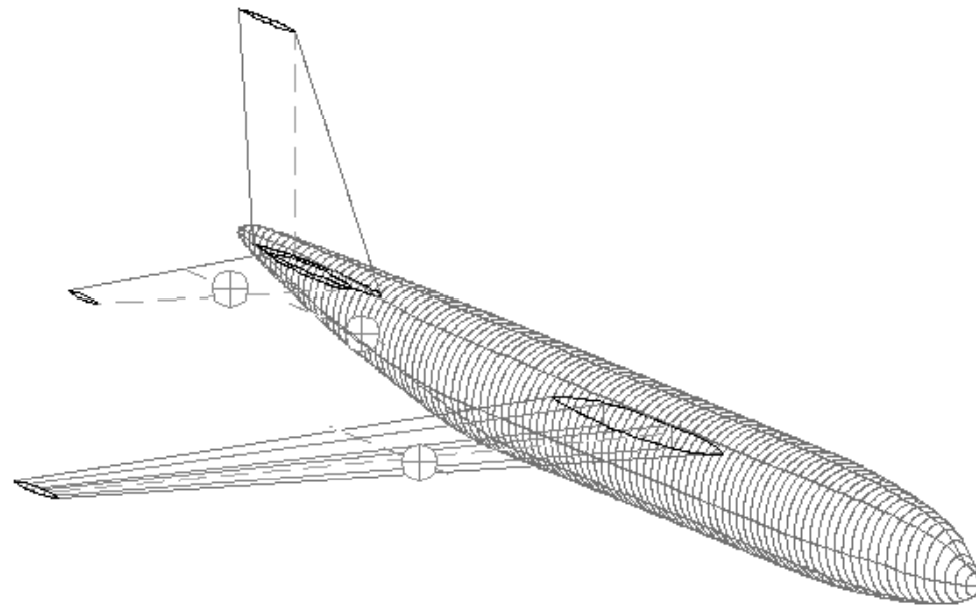


# LOFTSMAN - meshing



➤ Loading geometry

➤ Editing geometry



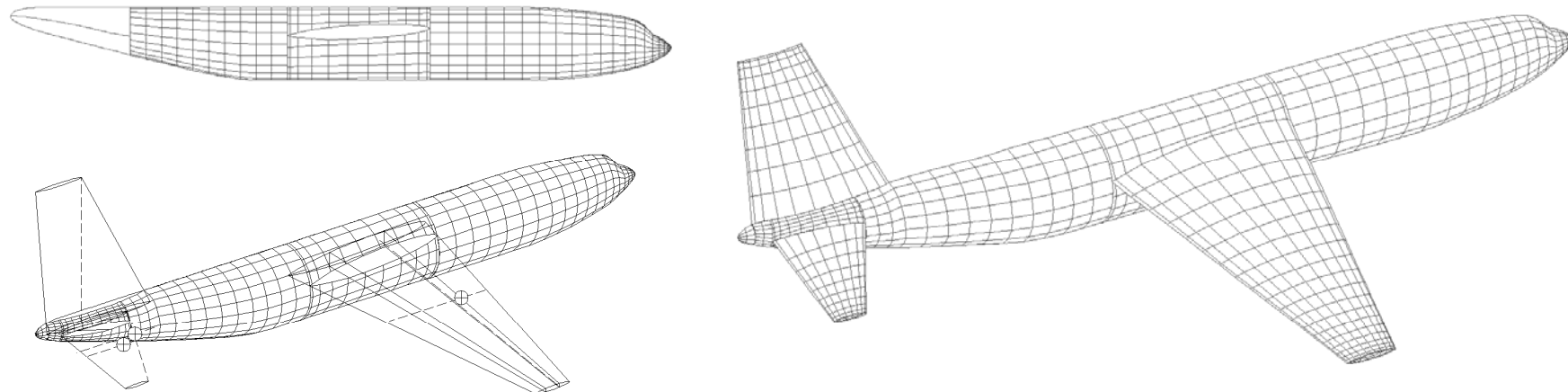


# LOFTSMAN - meshing



## ➤ Meshing

- Partition of the meshing geometry
- Creation of the patches → intersection lines
- Meshing



# LOFTSMAN - export



- Automatic export
  - Possibility of wake definition
  - Wing tip is needed to add
  - Some errors occur
  
- Manual export
  - Creation .IN file by hand
  - Fill in some template .IN file → heading
  - Adding of the patches



# CMARC



- 3D panel method
  - Inviscid, incompressible, ...
  - Low order panel method
  - Compressibility → POSTMARC
  - Stability analysis
    - Deflection of control surfaces → rotation surface normals of panels
    - Stick-fixed cases → control surfaces deflection is varied → trimmed condition
  - Input geometry and surface mesh from LOFTSMAN or other meshing program



# CMARC



- Inviscid vs. Viscous analysis
  - Empirically supported 2D methods
  - Displacement thickness is calculate in every iteration
  - Induce drag → Trefftz plane
  - Lift and moment coefficients are more accurate than drag coefficient



# CMARC



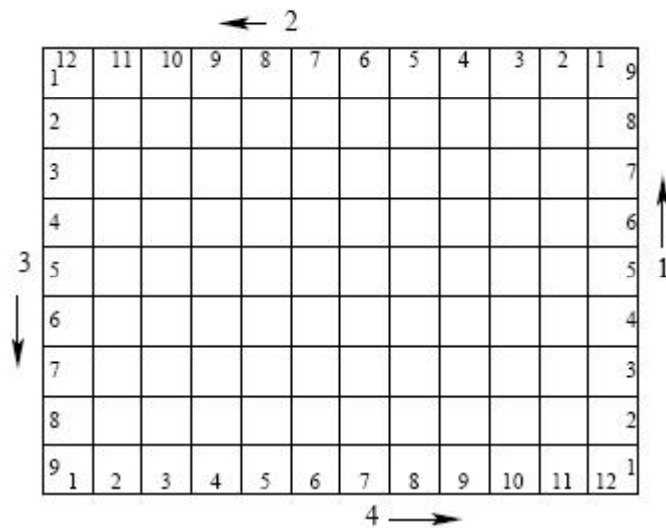
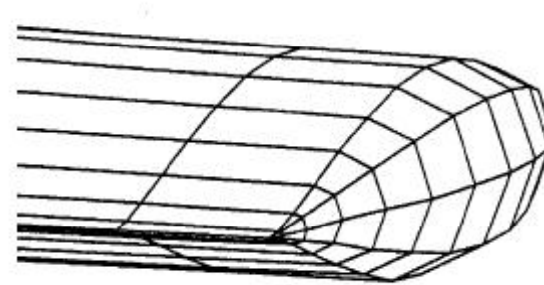
- **.IN file**
  - Heading with the definition of the flow properties
  - Patches with the panels
  - Wake definitions
  
- **Heading**
  - Flow properties definitions (speed, AoA, Mach number, ...)
  - Movement definition
  - Panel tilt
  - Boundary layer calculation
  - Time step and number of the step
  - Units



# CMARC



- Wingtip
- Patches

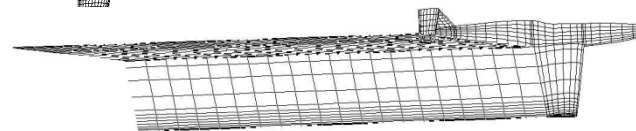
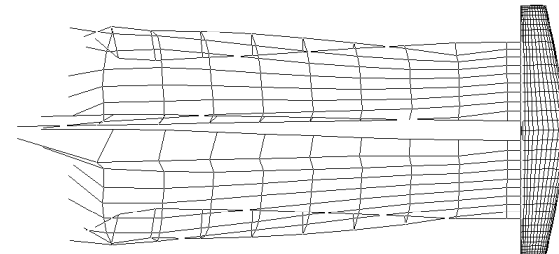
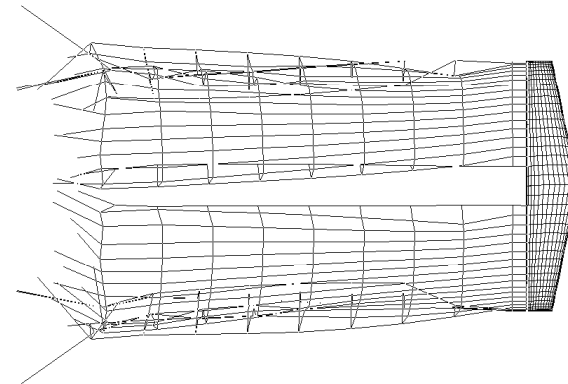
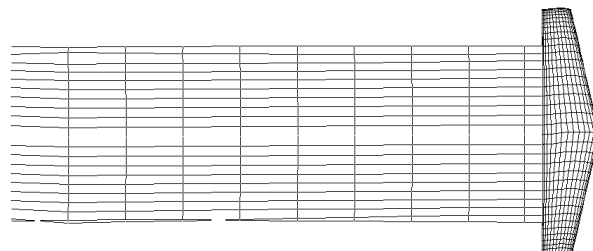
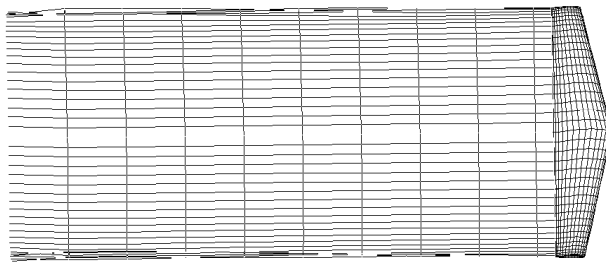


# CMARC



## ➤ Wake

- Definition of separation line
- Range of the wake



# CMARC



- Running CMARC
  - Debugging mode
  - Computing mode
  - Batch mode





# POSTMARC



- Separation line visualization
- Wake display
- Contour plot
- Contour lines
- Surface flow direction and streamlines
- Streamlines
- Integrated forces and moments
- Stability analysis
- Output

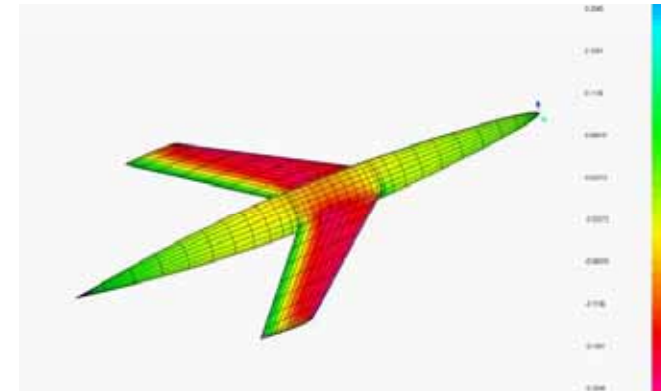
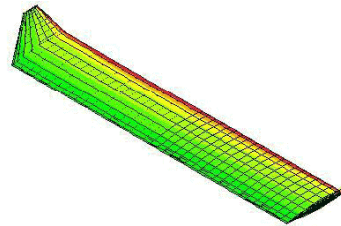


# POSTMARC



## ➤ Examples

Coefficient of Pressure



# CONCLUSION



- PSW package of program is able to used for preliminary design of small aircraft
- Some errors occur during export mesh from LOFTSMAN
- Some limitations
  - Small angle of attack
  - Linear region of lift curve
  - No intersection between the wakes





Thank you for your attention

Questions?

