

Version 7.2 of VSAERO

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Version 7.2 of VSAERO supersedes Version 7.1. This release consists of the updated code with improvements described below, a PowerPoint presentation on CDROM, a Version 7.2 User's Manual, and 55 testcases (six new). Version 7.2 has been tested for 69 cases under the following operating systems: AIX 4.3, AIX 5.1, HPUX 11.11, HPUX B.11.22, IRIX 6.5, Linux 2.4, OSF V4.0, SunOS 5.8, and Windows XP.

INCLUDE FILES

Input is read from a file with .IN suffix, for example, lb435.IN. File names with blanks in them may not work. On Linux systems, the file type is ASCII. On Windows, Word recognizes it as a plain text file. If a Windows input file is improperly transferred to Linux, the type is "ASCII with CR line feeds" and this type will cause an input error.

Input data shared by multiple input files, for example, the patch geometry, can be placed in a separate ASCII file (with any suffix, for example m35.patch) and referred by an INCLUDE directive:

INCLUDE m35.patch

The environment variable "curPATH" must correctly define the path to m35.patch. The delivered vsaero command file defines curPATH as the same location as the .IN file. Included files can also refer to other include files, nested up to 5 levels. The testcase, m35include, illustrates the use of the include directive.

TRAILING-EDGE MATCHING

The wake circulation (and, hence, Kutta condition) is most accurate when the upper and lower shedding panels are equal in length. A typical airfoil is cambered and precisely matching the trailing-edge panels in size has not been trivial. Version 7.2 includes a MATCH feature that adjusts the size of the upper and/or lower panels to exactly match. The result of matching is a much more robust Kutta condition, Figure 1.

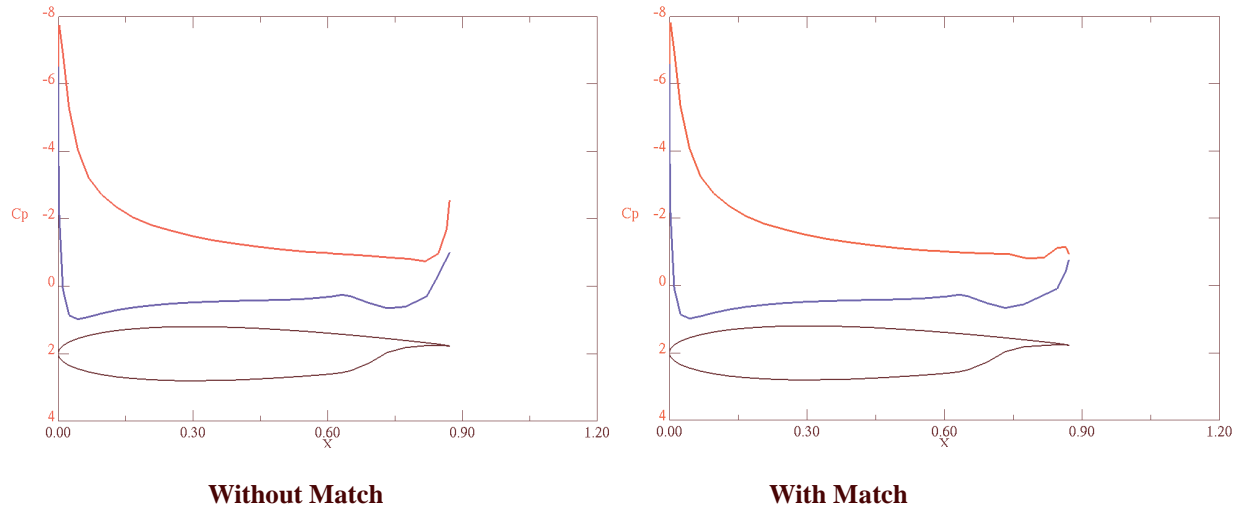


Figure 1. Wing Element Pressure Distribution.

Longitudinal Trim

Version 7.2 will calculate the angle of attack and elevator angle required to trim an airplane in longitudinal flight. The optional TRIM namelist has been added to the input file. The input includes the trim lift and pitching moment coefficients and defines the elevator control surface.

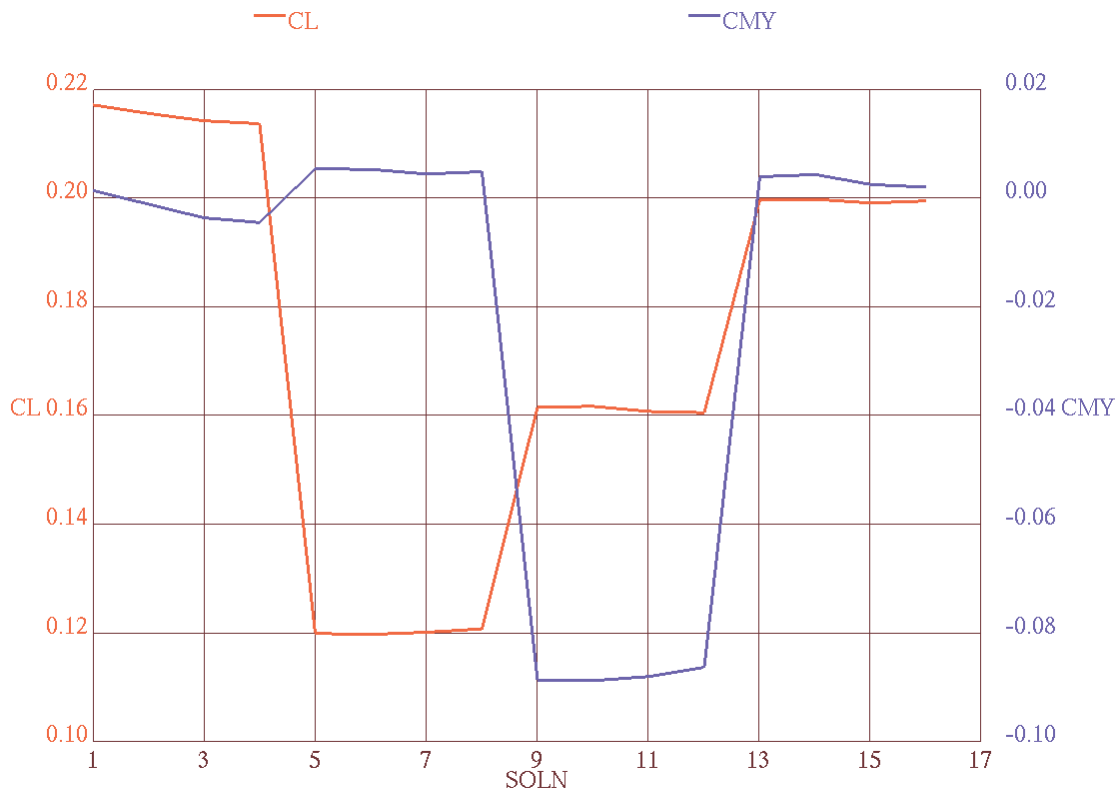


Figure 2. Force History during Pitch Trim.

LSVELP

Previously, the gradient of the potential could be obtained in two ways: two-way parabolic fit (LSVEL=0) or least-squares (LSVEL=2). A third way (LSVEL=3), a corner-point analysis, has been added. Further, the various gradient techniques can be applied to individual patches with LSVELP. LSVELP=0 is recommended for wing patches because it is more accurate for uniform grids. LSVELP=3 is recommended for structured patches with non-uniform grid. Both LSVEL and LSVELP are in the SPCONL namelist.

Oscillatory Aerodynamics

Version 7.2 can calculate pressures on a body oscillating at arbitrary frequency and amplitude. This option includes two operating modes, 5 & 6. Mode 5 is a direct mode in which the pressures are calculated for a specified displacement such as rigid-body pitch. Mode 6 provides the influence matrices for post processing in a structures code such as NASTRAN. It is possible to create an external aerodynamic database for use by NASTRAN. Patran has been modified to spline the VSAERO panels found in the plot file to a structural model. Flutter calculations are possible on the same general shapes allowed by VSAERO instead of the thin doublet-lattice method presently available in NASTRAN.

The oscillatory calculation was recently compared to USAERO, a time-stepping panel method for the DLR F6 model, Figure 3.

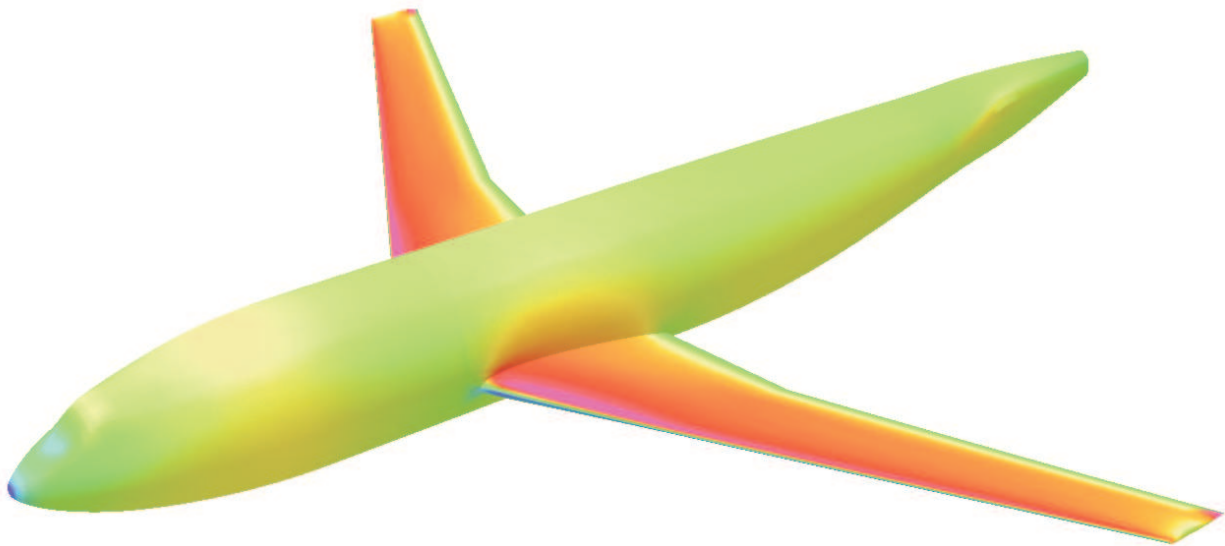


Figure 3. DLR F6 Geometry

Figure 4 shows the comparison of the pressures from VSAERO to those of USAERO for the case of pitching 1 degree at a reduced frequency of 0.25 and Mach=0.3. The cross section is located at $y=-.01$.

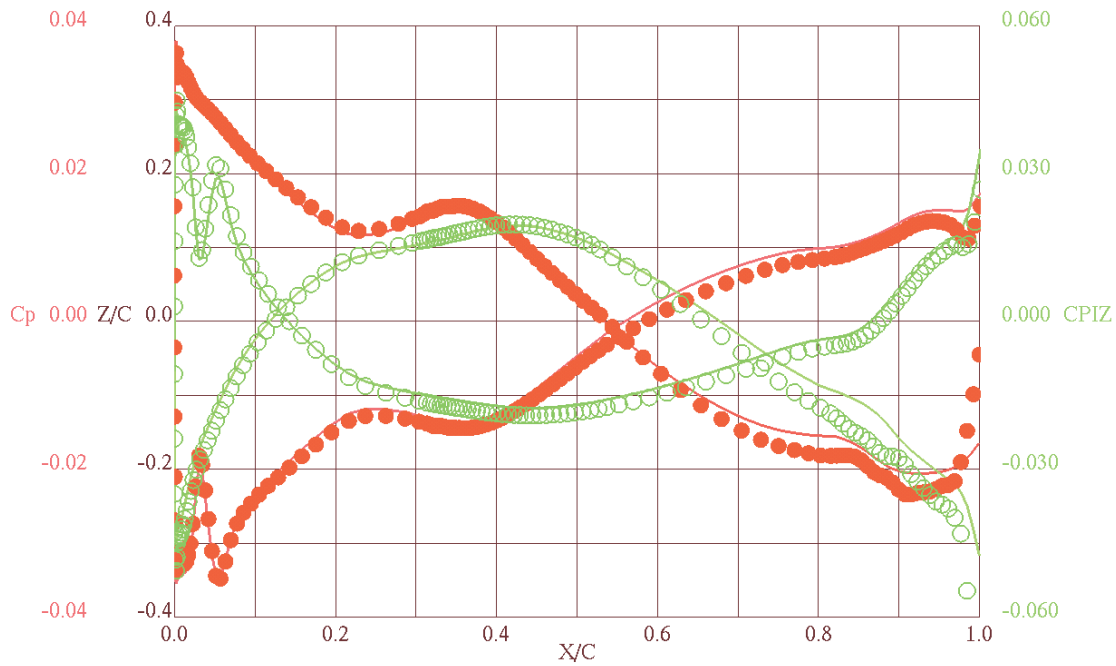


Figure 4. Real and Imaginary pressures from VSAERO (line) and USAERO (symbol)

Figure 5 shows the comparison of the pressures from VSAERO to those of USAERO for the case of heaving 0.1 unit at a reduced frequency of 0.25 and Mach=0.3.

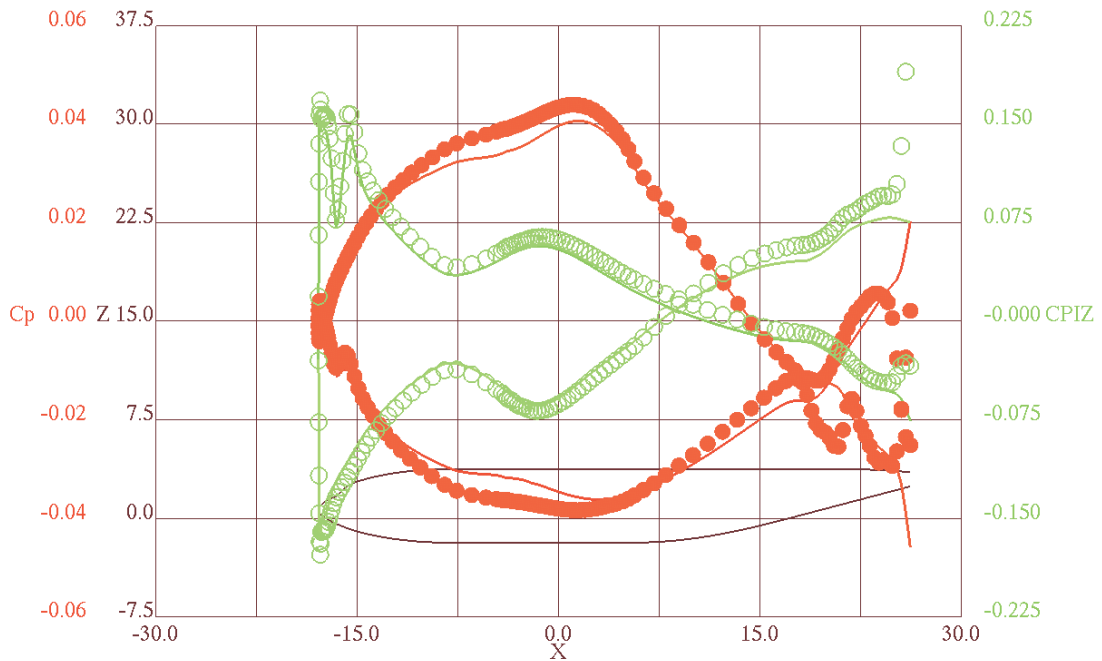


Figure 4. Real and Imaginary pressures from VSAERO (line) and USAERO (symbol)

New Testcases

Trim_pitch is an airplane trimmed at a lift coefficient of 0.2 and zero pitching moment about the center of gravity.

Trim_alpha is an airplane where the angle of attack is changed to reach a lift coefficient of 0.2.

LB435ls3 uses `lsvel=3` on the wing fillet to eliminate spurious pressures caused by the non-uniform grid.

M35include illustrates the use of the `INCLUDE` directive to read the body geometry from a separate input file.

Ejectvs is a store released from a pylon. `FLIDYN` is used to compute the flight dynamics.

Fsf_sq illustrates the matching of trailing edge panels.

Errors Fixed

During quasi-steady calculations (`MODE=31`) the translation velocity was doubly accounted for in determining the circulation of a wake column. The lift of a section due to steady rotation could be affected by 1 or 2 percent.

Off-body streamlines that were started inside the body corrupted the plot file.

The terminator at the end of a string of boundary trip panels, “`END BLSTRN`” was not recognized.