# Nomenclature

| | |
|---|---|
| $A$ | cell face area |
| $\tilde{A}$ | coefficient matrix |
| $a$ | speed of sound |
| $B$ | boundary condition state equation Bernstein polynomial |
| $b$ | vector of Bezier control points |
| $C$ | constraints |
| $C_D$ | coefficient of drag |
| $C_L$ | coefficient of lift |
| $L/D, C_L/C_D$ | lift-to-drag ratio |
| $C_p$ | coefficient of pressure |
| $c$ | coordinates of the Bezier curve |
| $D$ | diagonal matrix |
| $E$ | inviscid flux vector |
| $e_o$ | total energy per unit mass |
| $F$ | objective function |
| $\bar{\bar{I}}$ | identity matrix |
| $I_A$ | vector of active constraints |
| $K$ | global stiffness matrix |
| $k$ | grid adaptation spring stiffness number of GMRES restart cycles |
| $L$ | structural load vector |
| $M_n$ | normal Mach number |
| $N$ | vector of direction cosines |
| $nbf$ | number of surface boundary faces |
| $nbface$ | total number of boundary faces |

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|---|---|
| *ncell* | number of unstructured grid cells |
| *ncon* | number of constraints |
| *ndv* | number of design variables |
| *O* | off-diagonal matrix |
| *p* | static pressure |
| | parameter to control spring stiffness |
| *Q* | aerodynamic state vector |
| *R* | aerodynamic state equation |
| $R^+, R^-$ | one-dimensional Riemann invariants |
| $\bar{s}$ | search direction vector |
| *u* | computational arclength |
| *u, v, w* | Cartesian velocities |
| *V* | cell volume |
| *w* | weighting factors |
| *X* | vector of mesh points |
| *x, y, z* | vector of discrete mesh points |

*Greek Symbols*

| | |
|---|---|
| | line search step length |
| | free-stream angle-of-attack |
| | vector of design variables |
| | ratio of specific heats |
| $_{ij}$ | Kronecker delta |
| | normal velocity |
| | feasible direction push-off factor |
| | trailing-edge included angle |
| | adjoint vector |
| | Lagrange multipliers |
| | direction cosine component |
| | relaxation parameter |

*Subscripts*

| | |
|---|---|
| *b* | boundary face value |
| *f* | value at the cell face |

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|---|---|
| *i* | cell index |
| *j* | face index |
| *k* | design variable index |
| *o* | interior cell value |
| *TE* | trailing-edge |
| *x, y, z* | physical coordinate direction |
| | free-stream condition |

*Superscripts*

| | |
|---|---|
| *m* | design cycle number |
| | subiteration number |
| *n* | nonlinear flow solution iteration number |
| | incremental iterative iteration number |
| *T* | transpose |
| *x, y, z* | physical coordinate direction |
| -1 | inverse matrix |
| ± | right and left states |