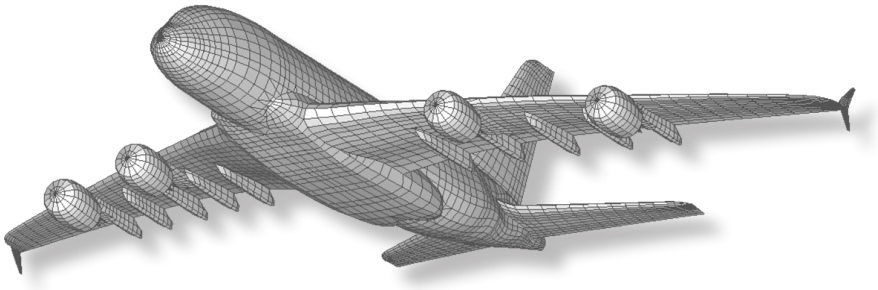
ZONA TECHNOLOGY

Your Home for Advanced Aerodynamic/
Aeroelastic/Aeroservoelastic/Computer Aided
Engineering Software Products and Services



About ZONA

ZONA Technology, Inc. (ZONA) is a privately held company that was founded in 1985 to serve the aerospace community with commercialized software and engineering services. The company's initial business focused on Aeroelasticity. The commercialized software ZONA51, a supersonic aeroelasticity tool is a unique product that was in high demand by the industry. Subsequently in 1990, ZONA and MSC Software Corporation began to co-market this software through the framework of MSC Nastran. Since then, ZONA has carried out extensive Research and Development (R&D) leading to the creation of numerous aerospace related software products. The following lists the software that is available for licensing.

ZAERO

The ZAERO software system is a powerful engineering tool that integrates all essential disciplines required for advanced aeroelastic design and analysis at all Mach numbers.

ZEUS

The ZEUS software system is a ZONA Euler unsteady solver, with a boundary layer option especially designed for aeroelasticians, to perform nonlinear aeroelastic analysis in subsonic, transonic, supersonic, and hypersonic flight conditions.

ZONAIR

ZONAIR is an engineering software used to compute rigid and flexible flight loads of a flight vehicle using a high order panel method as the underlying aerodynamic force generator.

ZMORPH

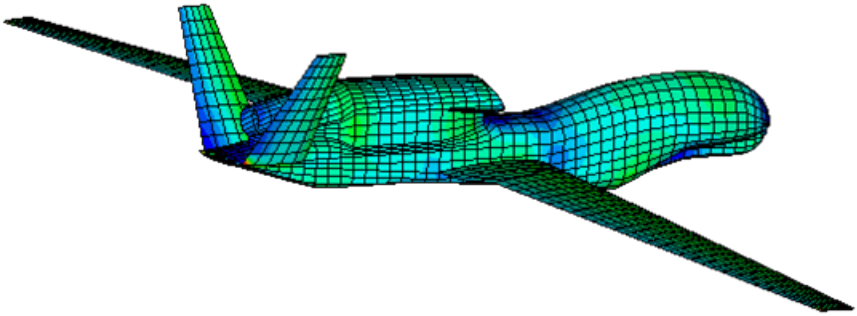
ZMORPH (pronounced zee-morph) allows morphing of Nastran structure GRIDs relative to a baseline configuration. The process simply involves encompassing these GRIDs within box primitives and then altering the box corner point coordinates to stretch and/or move these encompassed GRIDs.

ZAMS

The ZAMS (ZONA Aeroelastic Model Simulator) is an ActiveX control developed to run under IADS developed by Symvionics, Inc. and to display the aeroelastic response of an aircraft during flutter flight testing.

ASTROS

ASTROS (Automated STRuctural Optimization System) supports both the preliminary design stages of new aircraft and spacecraft structures and design modifications that occur later in the product life cycle.



Mission

ZONA Technology's mission is to support the aerospace community through the development and marketing of robust/user-friendly Computer Aided Engineering (CAE) software used in the design and analysis of aircraft and to provide outstanding engineering software analysis services. In addition, ZONA conducts Research and Development (R&D) contracts supported by private aerospace companies, the US Department of Defense and NASA in the areas detailed under Core Competencies. ZONA continuously strives to provide the best CAE software and R&D results within the detailed engineering disciplines. Our products and services enable engineering design and analysis and conceptual/preliminary vehicle designs supporting the aerospace industry.

Core Competencies

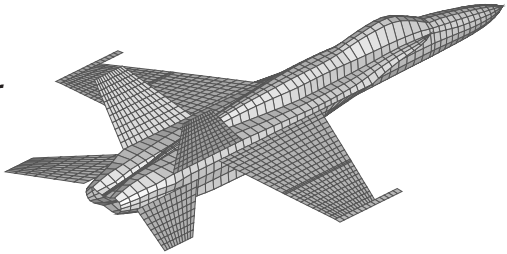
ZONA Technology's expertise lies in the areas of computational aerodynamics, unsteady aerodynamics, aeroelasticity, aeroservoelasticity (ASE), aerothermodynamics, aerothermoelasticity, flutter and Limit Cycle Oscillation (LCO) prediction, aerospace structures, flutter analysis, structural dynamics, Multidisciplinary Design Optimization (MDO), Computational Fluid Dynamics (CFD) dynamic grid generation, Computational Structural Dynamics (CSD)/CFD interfacing, system modeling, system identification, flight dynamic & aeroelastic modeling integration and structural optimization.

ZONA's Team

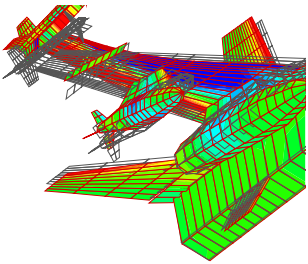
ZONA Technology's full-time staff hold Ph.D's, M.S. and B.S. degrees. Our technical team has well over 100 years of combined aerospace experience in disciplines ranging from unsteady aerodynamics, aeroelasticity, aeroservoelasticity, control, structures, finite element analysis, boundary element methods, computational fluid dynamics, and system identification.

ZAERO Software System

Engineers' Toolkit for Aeroelastic Solutions



The ZAERO software system is a powerful engineering tool that integrates all essential disciplines required for advanced aeroelastic design and analysis. ZAERO supports the following engineering disciplines:



Flutter
Parametric Flutter for Aircraft with Stores
Non-Linear Flutter
Aeroservoelasticity
Gust Loads
Maneuver Loads
Ejection Loads
Trim Loads
Whirl Flutter

A Unified Aerodynamic Influence Coefficient (UAIC) matrix scheme allows for flutter, static aeroelastic and aeroservoelastic analyses to be performed in subsonic, transonic, supersonic, and hypersonic Mach numbers.

A high fidelity geometry package provides for easy modeling of complex aircraft configurations that can include fuselage, stores, engine inlets, etc.

Built-in spline methods establish accurate interfacing between structural Finite Element Analysis (FEA) and aerodynamic models.

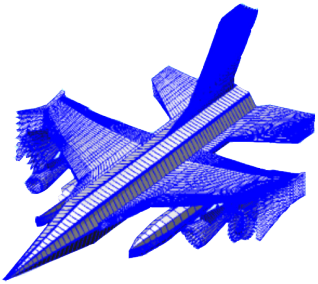
Structural modal results are directly imported from other commercial FEA codes.

ZAERO's modal importer currently supports numerous FEA codes including MSC Nastran, UAI Nastran, CSA Nastran, NE Nastran, ASTROS, I-DEAS, ELFINI, Genesis, and a free-formatted input for use by any other FEA software.

Versatile graphic output capability allows for viewing of all facets of the aeroelastic analysis and design process using a host of commercially available graphic software packages.

ZAERO Engineering Disciplines

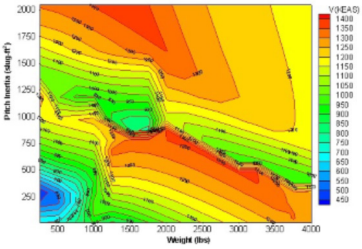
FLUTTER
Linear subsonic, sonic, supersonic, and hypersonic unsteady aerodynamics for wing-body configurations.



FLTPARAM
Parametric flutter analysis of massive number of aircraft/store cases using the mass increment method.

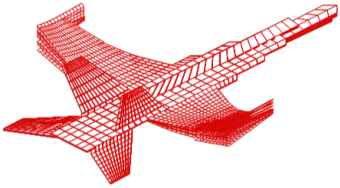
AEROSERVOELASTICITY (ASE) MODULE
Stability analysis of aeroservoelastic system using the state-space approach.

NON-LINEAR FLUTTER MODULE
Transient response analysis of open/closed-loop systems with structural, aerodynamic, or control system nonlinearities.



GUST MODULE
Discrete and continuous gust analysis using time-domain state-space or frequency domain approaches.

DYNAMIC LOADS MODULE
Transient maneuver and ejection loads analysis.

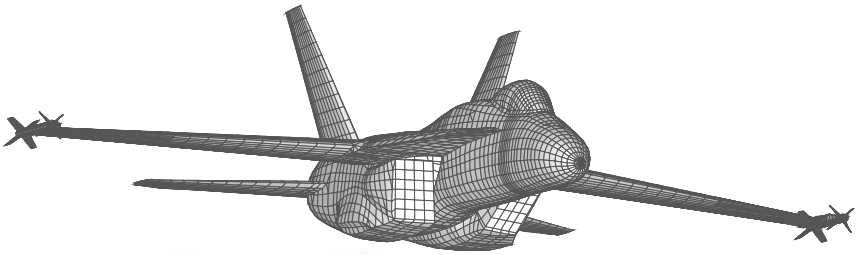


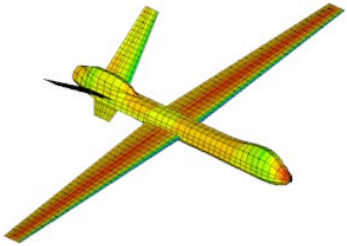
TRIM MODULE
Static aeroelastic analysis for solving the trim systems and computing the flight loads.

ZWHIRL MODULE
Performs whirl flutter analysis in the frequency domain.

ZAERO Features

- **Executive control** allows massive flutter/ASE/Trim/Dynamic Loads inputs and solution outputs
- **High Fidelity Geometry (HFG)** module to model full aircraft with stores/nacelles
- Flight regimes that cover **all Mach numbers** including transonic/hypersonic ranges
- **Unified Mach AIC (UAIC)** matrices as archival data entities for repetitive structural design/analysis
- Matched/non-matched point flutter solutions using **K/g methods** with true damping
- Built-in Flutter Mode Tracking procedure with **structural parametric sensitivity** analysis
- **Nonlinear Flutter Analysis** for open/closed loop system using discrete time-domain state space approach
- **3D Spline** module provides accurate FEM/Aero displacements and forces transferal
- **Modal Data Importer** to process NASTRAN/I-DEAS/ELFINI/ANSYS/etc. modal output
- **Dynamic Memory & Database Management (ZDM) Systems** establish subprogram modularity
- **Open architecture** allows user direct access to data entities
- **Bulk Data Input** minimizes user learning curve while relieving user input burden
- Provides **graphic display** capability of aerodynamic models, Cp's, flutter modes and flutter curves for use with PATRAN/FEMAP/TECPLOT/ANSYS/EXCEL/etc.
- The **ZTRAN** module calculates transonic unsteady aerodynamics for wing-body configurations using an overset field panel method.
- The **ZTAW** module generates a corrected AIC matrix to match the given set of forces/moments or unsteady pressures.

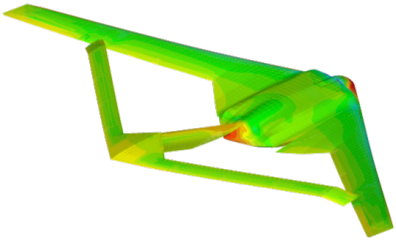




ZAERO is a professional software engineering tool that can efficiently solve your most demanding industrial aeroelastic and aeroservoelastic problems.

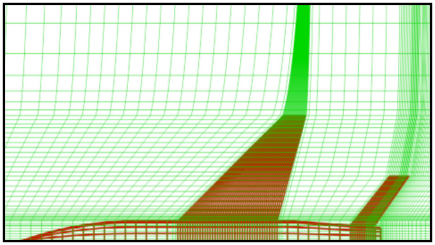
ZEUS Software System

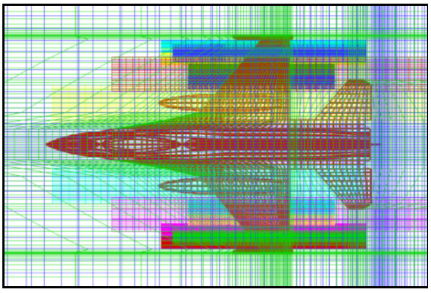
ZONA's Euler Unsteady Aerodynamic Solver

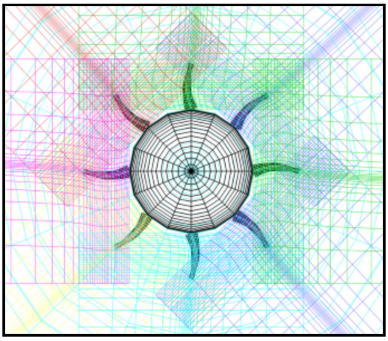


ZONA's Euler Unsteady Aerodynamic Solver (ZEUS) integrates the essential disciplines required for aeroelastic design/analysis. It uses an Euler equation solver as the underlying aerodynamic force generator coupled with a structural finite element modal solution to solve various aeroelastic problems such as flutter, maneuver loads, gust loads, and static aeroelastic/nonlinearities can also be included to perform a nonlinear aeroelastic analysis.

The Euler equation solver solves the Euler equations on a Cartesian grid system using a cell-centered finite volume method with dual-time stepping algorithm for unsteady solutions. The viscous effects are included by coupling the Euler solution with a steady boundary-layer equation. For turbulence closure, the Green's lag entrainment is employed. Because of solving the Euler equations with boundary layer coupling, the requirement of large computing resources by a Navier-Stokes code can be avoided by ZEUS. Therefore, ZEUS provides a good balance between the complete modeling of the flow physics and the computational efficiency.



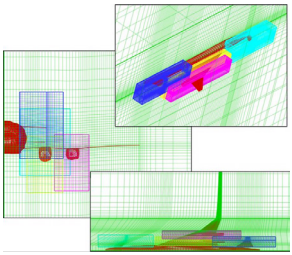




ZEUS Engineering Disciplines

Overset Mesh for Complex Configurations

- Complex configurations can be modeled by multiple blocks of mesh with overlapping regions; the overset mesh.
- Communication of flow solutions among blocks is through the interpolation of solutions in the overlapping regions.
- Solution convergence is achieved by sub-iterations.

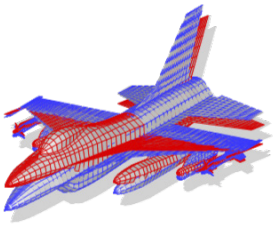


Automated Mesh Generation

- Only the ZAERO panel model is required for input.
- Flowfield mesh is generated automatically by extending the gridlines from the ZAERO panel model to the entire flowfield domain.
- Fuselage, wing with/without tip launcher or winglet, and horizontal tail can be modeled by one block of mesh.

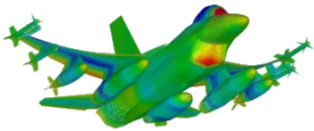
3D Spline Module

- The 3D Spline module establishes the displacement/force transferal between the structural Finite Element Method (FEM) model and the ZEUS surface panel model.



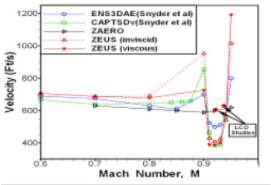
Trim Analysis

- Capable of dealing with determined trim system as well as over-determined trim system (more unknown trim variables than trim equations).
- Generation of flight loads and output of NASTRAN FORCE and MOMENT bulk data cards for subsequent detailed stress analysis.



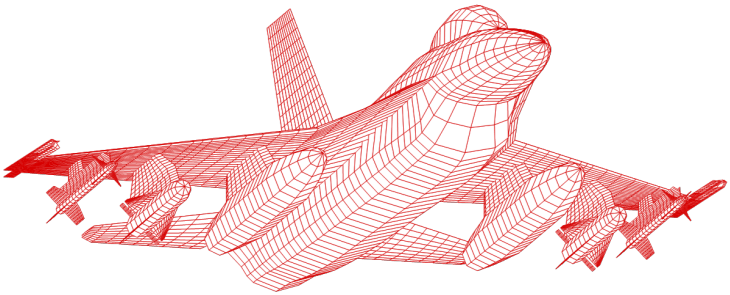
Flutter and LCO Analysis

- Capable of generating frequency-domain generalized aerodynamic force and computing flutter boundary using g-method Transient response analysis for LCO predictions.

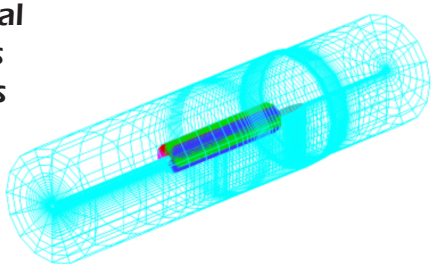


ZEUS Features

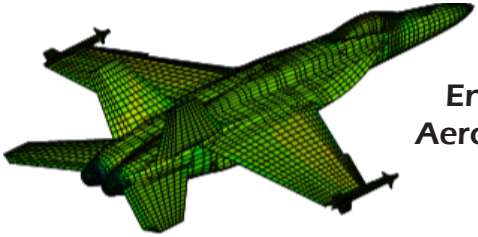
- A CFD code whose program architecture is **specially designed for aeroelastic analysis.**
- Euler solver with **boundary layer option** to provide appropriate balance between the complete modeling of flow physics and computational efficiency.
- **Automated mesh generation** requiring only the surface panel model as input.
- **Overset mesh scheme** for modeling of complex configurations such as whole aircraft with external stores.
- Includes **ZAERO 3D spline module and FEM modal solution importer.**
- **Parallel computation** using OpenMP.
- Generates either **time-domain aeroelastic response** or **frequency-domain generalized aerodynamic forces for flutter and LCO.**
- **Trim/static aeroelastic analysis** solving for the trim variables to satisfy the trim condition and generate section loads.
- **Discrete gust analysis** to compute the transient responses of loads subjected to a given gust profile.
- **Ejection loads analysis** to compute the loads due to store ejections.
- **Nonlinear flutter analysis** to account for the nonlinear structural effects such as free-play, nonlinear stiffness, and damping.



ZEUS integrates the essential disciplines to solve various aeroelastic design/analysis problems



ZONAIR Software System



Engineering Software for Aerodynamics & Flight Loads

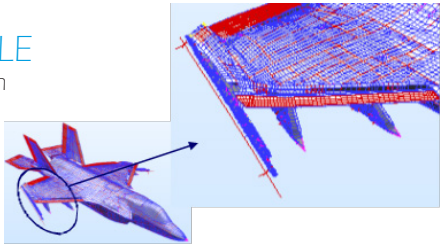
ZONAIR is an engineering software used to compute rigid and flexible flight loads of a flight vehicle. ZONAIR employs a high-order panel-based methodology for computation of aircraft flight loads that can include aeroelasticity and aerothermoelasticity effects.

ZONAIR Engineering Disciplines

- Linear subsonic high order steady aerodynamics for wing-body configurations.
- Linear subsonic and supersonic high order steady aerodynamics for wing-body configurations.
- Linear subsonic, supersonic and hypersonic high order steady aerodynamics for wing-body configurations .
- Static aeroelastic trim analysis for flight loads.
- Aerothermodynamic analysis for temperatures and heat rates in hypersonic flows.

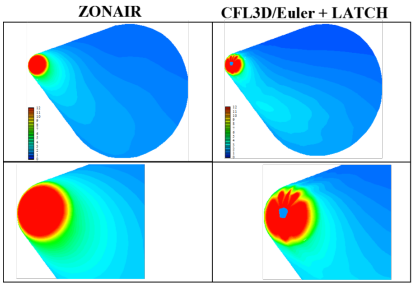
AEROLOADS/TRIM MODULE

Static aeroelastic/trim module provides trim solutions and flexible loads.



AEROTHERMODYNAMICS MODULE

Aerothermodynamic analysis for temperature and heat rates in hypersonic flows.

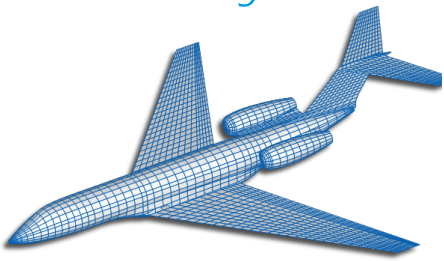


ZONAIR Features

- A unified high order subsonic / supersonic / hypersonic panel methodology as the underlying aerodynamic force generator.
- Unstructured surface panel scheme compatible with finite element methods
- **No Requirement for Modeling Wake Surfaces;** only the specification of the line segments along the trailing edge of the wing and body where the wake surface starts is required.
- Direct adoption of off-the-shelf FEA pre- and post-processors (e.g., PATRAN, Femap, I-DEAS, etc.) for rapid panel model generation
- Vortex roll-up scheme for high angle-of-attack aerodynamics
- **Ground Effects** computes flow field solutions for the visualization of the detailed flow field solutions.
- Flat wake generated from wing cuts into body creating singularities in computations. **Wake Relaxation** generates curved wake surfaces that removes the problem.
- **3D Spline Module** establishes the displacement/force transferal between the structural FEM model and the ZONAIR aerodynamic model.
- **Trim module** for flexible loads and aeroheating module for aeroheating analysis.
- Can import CFD solutions and map the pressure from CFD grids to ZONAIR panels. Based on the mapped CFD Cp as the rigid loads, ZONAIR can compute incremental flexible loads.
- **Pressure Mapping from CFD Mesh to ZONAIR Panels** interpolates the surface pressure coefficient from the CFD surface mesh onto the ZONAIR panels and uses this pressure to generate the rigid loads for trim analysis.
- **AIC correction** using wind-tunnel measured loads for accurate flexible loads generation.
- The AIC Correction Module computes an AIC weighting matrix to modify the ZONAIR computed AIC matrix for accurate flexible loads generation.
- Aerodynamic and loads database for 6 d.o.f. simulation and critical loads identification.
- Provides all stability derivatives including control surface deflections without modifying the panel model.
- Performs a trim analysis and automatically maps the forces from ZONAIR panels to NASTRAN structure grids for subsequent stress analysis.
- Computes flexible loads due to structure flexibility and provide **Elastic-to-Rigid ratios** of all stability derivatives.
- Can perform **Aeroheating analysis** to provide heat rate and temperature solutions on the surface.

ASTROS Software System

A Next Generation Aircraft Design System



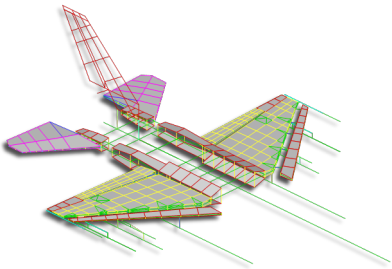
ASTROS (Automated STRuctural Optimization System) supports both the preliminary design stages of new aircraft and spacecraft structures and design modifications that occur later in the product life cycle. ASTROS, based on the world-standard NASTRAN data format, combines finite element modeling and analysis techniques with efficient optimization solutions to deliver significant reductions in the time required to develop superior designs of aerospace structures.

ASTROS offers a single multidisciplinary automated environment to help reduce the time required to develop improved designs. ASTROS integrated all of the engineering disciplines that impact the preliminary structural design phase and can simultaneously design to strength, flutter, displacement, and other requirements. ASTROS considers a wide scope of conditions in a design task and treats multiple boundary conditions, each permitting a range of analysis such as statics, modes, and flutter.

ASTROS Features

- Based on the world standard **NASTRAN data format**.
- **Combines FEA techniques with efficient optimization solutions** leading to significant reductions in time read to develop superior designs.
- Provides an **automated multidisciplinary CAE environment** with the ability to simultaneously consider numerous constraints from each of several disciplines.
- **No limits on problem size.**
- **Efficiently optimizes very large models with many constraints**.
- **Intrinsic constraints** include; Aeroelastic Lift and Control Effectiveness, Panel and Beam Buckling, Fiber/Transverse Strain, Laminate Composition, Tsai-Wu Stress Criteria, Von-Mises Stress, Stability Derivatives, Deflection, Principal Strain Flutter
- **Unsteady aerodynamic and aeroelastic analysis**.
- Employs a **powerful unified environment** for engineering data management and software integration.
- Maintains **maximum compatibility with NASTRAN's bulk data entry input,** so that existing model generators and graphics pre-processor can be used.
- Built-in an **open architecture environment** to fully support direct interface with other engineering software or user added functions.

ASTROS Engineering Disciplines



STRUCTURAL ANALYSIS

The core module in ASTROS is finite element-based structural analysis. This module determines structural response to applied mechanical, gravitational, aerodynamic, induced thermal and time-dependent loads. Response quantities include: Stresses, Strains, Displacements, Strain Energies, Natural Frequencies, Mode Shapes.

AERO LOADS ANALYSIS

An advanced high order panel method based on proven procedures simulates the aerodynamic loads for all flight regimes. Using advanced aerodynamics modeling capabilities, ASTROS provides an efficient alternative to CFD and wind-tunnel based loads data.

LOAD CONTROL AND TRIM OPTIMIZATION

To address complex air vehicle requirements, ASTROS provides a nonlinear trim solver to trim control configured vehicles with redundant control surface configurations.

CONTROL RESPONSE

Modern aircraft, with their emphasis on thin flexible wings, require the calculation of the interaction between control system and the structural response early in the design process. Feedback systems are increasingly being used to control the aircraft's structural behavior for gust and maneuver load alleviation, fatigue life improvement, ride control or flutter suppression.

MULTIDISCIPLINARY DESIGN OPTIMIZATION

ASTROS performs both design and analysis using mathematical optimization techniques to find a lightest weight design that meets given design criteria.

SENSITIVITY ANALYSIS

ASTROS calculates derivates for a response function to drive the redesign of a structure. Sensitivity analysis is based on analytic derivatives. Both direct and adjoint variable methods are employed (as appropriate) to achieve the most efficient computations.

ENGINEERING DATA MANAGEMENT

ASTROS is based on a powerful unified environment for engineering data management and software integration. Using a comprehensive set of utilities users can efficiently store, retrieve and display data interactively.

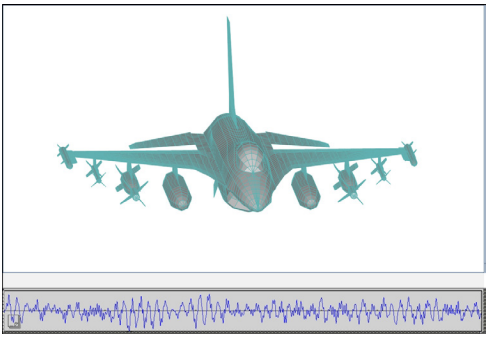
ZAMS Software System

The ZONA Aeroelastic Model Simulator (ZAMS) is an ActiveX control developed to run under the IADS® real-time and post-test display and analysis software developed by Symvionics, Inc. ZAMS is used to display the aeroelastic response (i.e., motion) of an aircraft during flight test or during playback of recorded flight test data.

ZAMS can provide flight test engineers within the mission control room the ability to rapidly visualize, in a near real time capacity, aircraft structural oscillations when the aircraft is excited by:

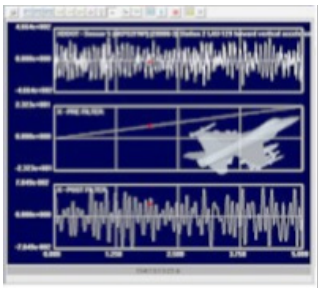
- pilot induces control surface commands
- air gust
- Limit Cycle Oscillation (LCO)
- flutter
- any external disturbance that perturbs the onboard accelerometers

Based on aircraft accelerometer responses obtained in IADS® during flight test, ZAMS uses these accelerometer responses to compute/display the aeroelastic deformation of the structure. A few seconds of flight test data are buffered by ZAMS to perform the required computations.



ZAMS options include:

- display of the pitch/roll rigid body motions
- amplification of the computed displacements
- display of the control surface motions
- zero-displacement "node-line" tracking to characterize the type of aeroelastic motion, as well as sensor information plots to visually verify the adequacy of the computed sensor displacements



Licensing

- Licenses are purchased on an annual basis.
- No one-time, paid-up licenses are available.
- Annual licenses include software upgrades as they become available.
- Up to 20 hours of customer service is included in the annual license fee (by telephone, fax, email, etc.). Additional support will be charged at ZONA's Time and Material (T&M) rate.
- ZONA will assist new users by telephone/fax/email to ensure their success in running the test cases in the documentation (i.e., turn-key operation) at no cost to the user.
- All prices are in U.S. dollars. Prices are subject to change without notice.
- US companies with 500 or less employees are eligible to receive a discount.
- Academic pricing is available with an academic licensing agreement.

To license software, email purchase orders to licenses@zonatech.com.

Engineering Services

For more than 30 years, ZONA has been providing engineering software analysis services in the areas of aeroelasticity, aeroservoelasticity, and multi-disciplinary optimization.

With customer supplied Nastran models, vehicle drawings, and required analysis specifications, ZONA will set up required software models, perform the engineering analyses using its commercial software codes, and deliver professional standard engineering reports that comprehensively document the setup/analysis process performed and all results obtained. If desired, software input and output results are also provided as deliverables.

To set up a service contract for engineering services, please call 480-945-9988 or email info@zonatech.com

Support

Up to 20 hours per year of customer service by telephone, fax, email, etc. is included in each annual license fee. Additional support is charged at ZONA's T&M rate.

License Support

For ZONA software licensing support or questions, **please call 480-945-9988 or email: licenses@zonatech.com**

Technical Support

For technical software support or software questions, **please call 480-945-9988 or email: support@zonatech.com**

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