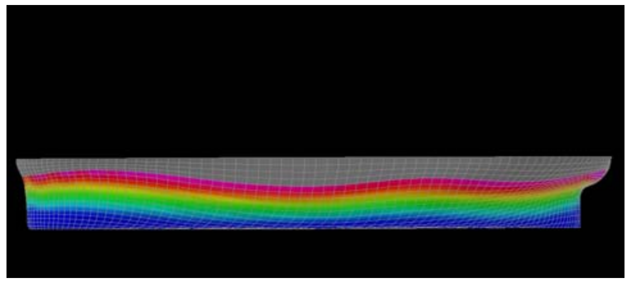
FLIDYN™

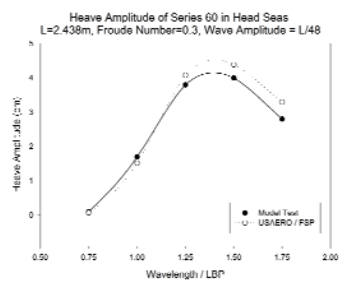
Flight Dynamics Program

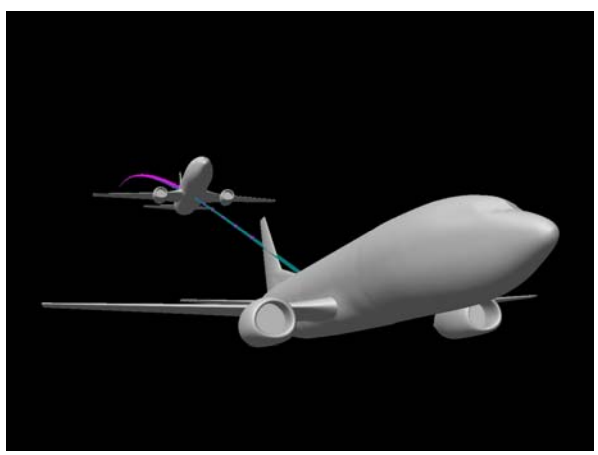
FLIDYN (FLIght DYNamics) solves the six-degree-of-freedom equations of rigid-body motion. Applications include marine seakeeping sink and trim and aircraft flight response to classical stability perturbations and control surface deflections. The relative trajectories and orientations of multiple bodies can also be computed by FLIDYN when coupled with appropriate CFD codes that can supply time-accurate forces and moments for each body.

FLIDYN includes two major options for computing accelerations response and trajectories. First, a Coefficient Method is included that allows forces and moments to be obtained quickly from user supplied coefficients and derivatives. Second, a Time-Stepping Method is included that requires CFD predictions of forces and moments at each time step. In both cases, the Euler equations of motion are accurately and efficiently solved by higher-order, explicit and/or implicit Adams-Bashforth and Adams-Moulton integration methods.

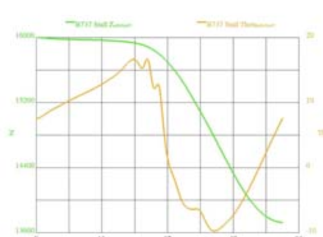


USAERO-FSP-FLIDYN
Series 60 Sink & Trim





Boeing 737 Stall
Recovery Using
Wind Tunnel
Coefficients



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In the Coefficient Method, a flexible input data structure allows for any combination of coefficients and derivatives. Options for constant derivatives (e.g., CLalpha, CMalpha) and non-linear coefficient and derivative tables dependent on one or two variables (e.g., CL = CL(alpha,Mach), CLalpha = CLalpha(alpha,Mach)) allow the most general maneuver simulation. Typically, coefficient data tables are based on empirical methods, CFD calculations, wind tunnel or flight test measurements, or combinations of various sources. In particular, AMI's VLAERO+ program exports coefficient data that can be read directly by FLIDYN. Of course, since aerodynamic forces and moments are obtained by table interpolation in the Coefficient Method, classical stability and control analysis, control surface response, and even nonlinear aircraft maneuvers are quickly computed by FLIDYN.

In the Time-Stepping Method, FLIDYN includes a CFD plug-in feature that allows data sharing between the two codes. In this case, the CFD code supplies FLIDYN with computed forces and moments for each body at each time step while FLIDYN integrates the equations of motion and supplies the CFD code with the current position, orientation, velocity and linear and rotational accelerations. Various input options allow the user to prescribe the time history of motion of each body, quickly verify user input by computing the flight path in a vacuum, and select which bodies in the simulation to include in the flight path prediction. Current capabilities of the Time-Stepping Method include:

- Up to five frames in motion allowed
- External forces include aerodynamic, gravity, buoyancy, thrust, ejector, and optional user-supplied external forces
- User prescribed force history for thrust and ejectors
- Two ejectors per body allowed
- Autopilot with two control surfaces
- User-supplied autopilot option

Applications of the Time-Stepping Method include ship sink and trim, aircraft formation and maneuver, store release, cargo deployment, and ejector seat predictions. Such applications are fully supported by AMI CFD codes. In particular, VSAERO-FLIDYN offers subsonic, quasi-steady, USAERO-FLIDYN offers low subsonic, unsteady, and MGAERO-FLIDYN offers subsonic/transonic/supersonic, quasi-steady flight path predictions. Alternatively, FLIDYN's custom plug-in capability allows coupling with any CFD code.

Output

In addition to output of the time-history predictions, FLIDYN exports OMNI3D plot file data. For the Coefficient Method, FLIDYN allows the user to select an additional OMNI3D plot file that includes the aircraft geometry. In this manner, OMIN3D can animate both the Coefficient and Time-Stepping Methods of flight path computation.

Documentation

Complete user's manual and supporting documentation describing the underlying theory, input variables (defaults, options, and suggested values) and example problems with input and out description are supplied.

Questions?

For more information about FLIDYN, please contact:

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