# P-FLIGHT-MODAL-ENHANCED®

FLUTTER PREDICTION SOFTWARE

AIM OF THE SOFTWARE

From the Ground Vibration Test (GVT) or imported vibration modes, **P-Flight-Modal-Enhanced®** performs a flutter analysis by predicting the evolution of the modal parameters for different flight conditions.

P-Flight-Modal-Enhanced® analysis software covers the subsonic, supersonic and transonic ranges.
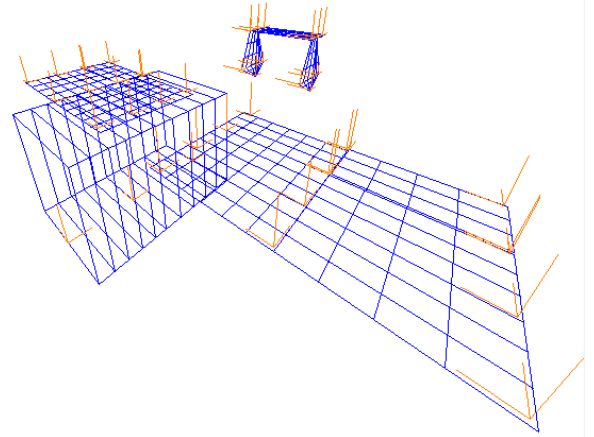
MAIN FEATURES
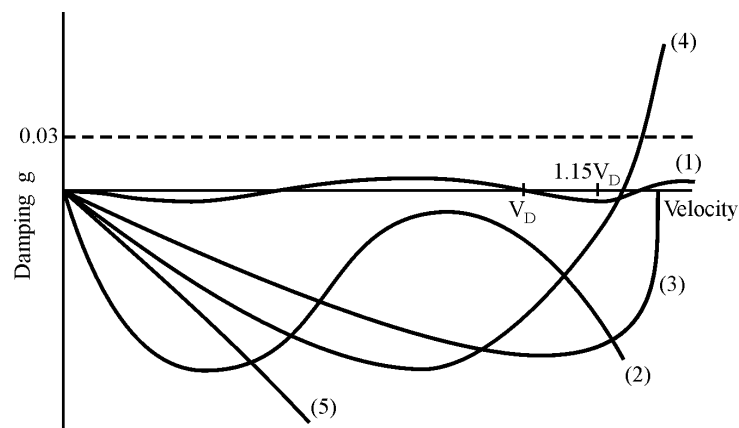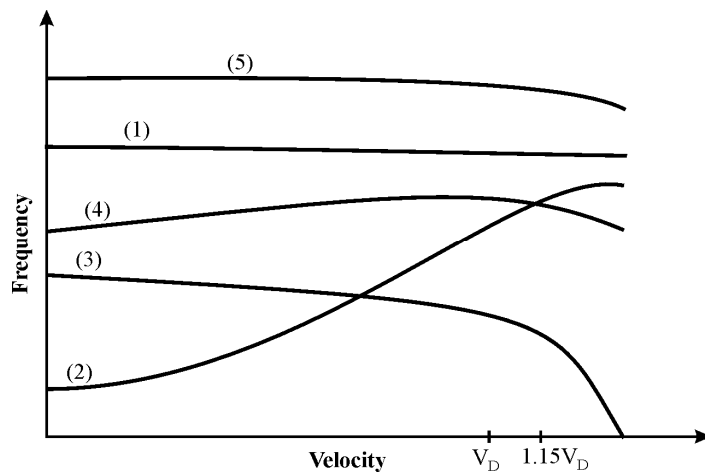
The solution of the typical flutter equation is performed in the subsonic and supersonic ranges by the **p-k** method for constant altitude (different max number) or constant Mach number (different altitudes). The only computational difference between these two cases is the way of computing the aerodynamic influence coefficients, using the **Doublet Lattice Method** in the subsonic range and the **Constant Pressure Panel Method** in the supersonic range.
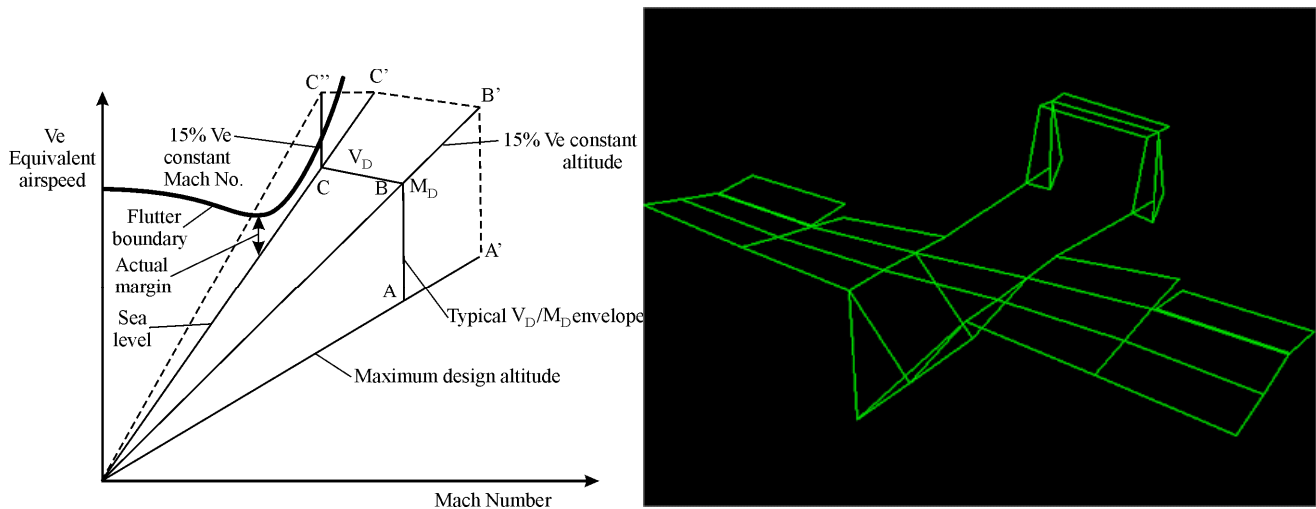
The results are presented as it is recommended in the Aviation Rules CS 25 (part AMC 25.629 – "Acceptable Means of Compliance"). These pictures are: frequencies vs. airspeed (or density), damping factors vs. airspeed (or density), critical velocity vs. Mach number and so on. Such pictures allow not only estimating flutter boundary, but also finding actual margins, necessary for the safety and certification. Flutter modes can be animated using standard P-Win-Modal option.

In the transonic range, **P-Flight-Modal-Enhanced**[®] computes the pressure distributions around the structure by an integration of the Euler equations.

INTERFACES

P-Flight-Modal-Enhanced[®] includes direct dialogue with **P-Win-Modal**[®] Modal Analysis Software. Interfaces with the most common engineering codes are available using the **Pro-Int Universal File Format (UFF) program.**

DATA OUTPUT

The results of calculation are stored to the P-Win-Modal Extended Database and can be printed at any time in text or graphic mode.

SYSTEM REQUIREMENTS

Operating system	Windows XP or greater
Computer system	PC Dual Core or greater

The manufacturer reserves the right to change technical or mechanical specifications of its products at any time.

```
┌──────────────────────────┐        ┌──────────────────────────┐
│ Ground Vibration Test     │        │ Computed vibration values │
│ results                   │        │                           │
└──────────────────────────┘        └──────────────────────────┘
                          │
              ┌───────────────────────┐
              │ Read out of modal     │
              │ parameters            │
              └───────────────────────┘
                          │
              ┌───────────────────────┐
              │ Geometric             │
              │ definitions           │
              └───────────────────────┘
                          │
   M<0.95 or    ┌───────────────┐   0.95<M<1.05
   M>1.05       │     M ?       │
                └───────────────┘
```

Flutter prediction
$$C\ddot{q}+D\dot{q}+Aq+\frac{\rho Vl}{2}Q(k,M)q=0$$

Pressures distribution
$$\frac{\partial \sigma}{\partial t}+\frac{\partial A}{\partial x}+\frac{\partial B}{\partial y}+\frac{\partial C}{\partial z}=0$$

M ?   M<0.95   1.05<M

Steady ?   Yes   No

Sub-sonic case
DLM method

Super-sonic case
CPPM method

Steady flow
computation

Unsteady flow
computation

Frequency and damping
vs. velocity plots

Frequency and damping
vs. velocity plots

Pressure coef.
Steady integral
characteristics & gas
dynamics

Unsteady Fourrier
coefficients

The manufacturer reserves the right to change technical or mechanical specifications of its products at any time.