The J2 Universal Tool-Kit - Linear Analysis with J2 Classical

AIRCRAFT MODELLING AND PERFORMANCE PREDICTION SOFTWARE

Key Aspects

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J2 CLASSICAL AS PART OF THE J2 UNIVERSAL TOOL KIT

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Saving Time and Money

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INTRODUCTION

Why Linear Analysis?

The evaluation and analysis of an aircraft design occurs in many iterative cycles as designs are evaluated, eliminated and refined. Historically, standard modes of motion were assessed for stability and control using approximations developed from simplified derivatives. The characteristics of these modes provided insight into the aircrafts behaviour, and an approach to compare different aircraft and different designs resulting in standards.

With the **J2 Universal Tool-Kit**, it is possible to run full non-linear analyses on any aircraft across the complete flight envelope in a fraction of the time it used to take to calculate the modes for a single design point. These simulations are not restricted to a single point and small angle perturbations, but can evaluate the true response of the aircraft to a manoeuvre or disturbance. However, there is still a need to be able to compare the aircraft in terms of their classical behavioural characteristics against standards. It is for this reason that J2 Aircraft Dynamics have added **J2 Classical** into their **J2 Universal Tool-Kit**.

J2 Classical

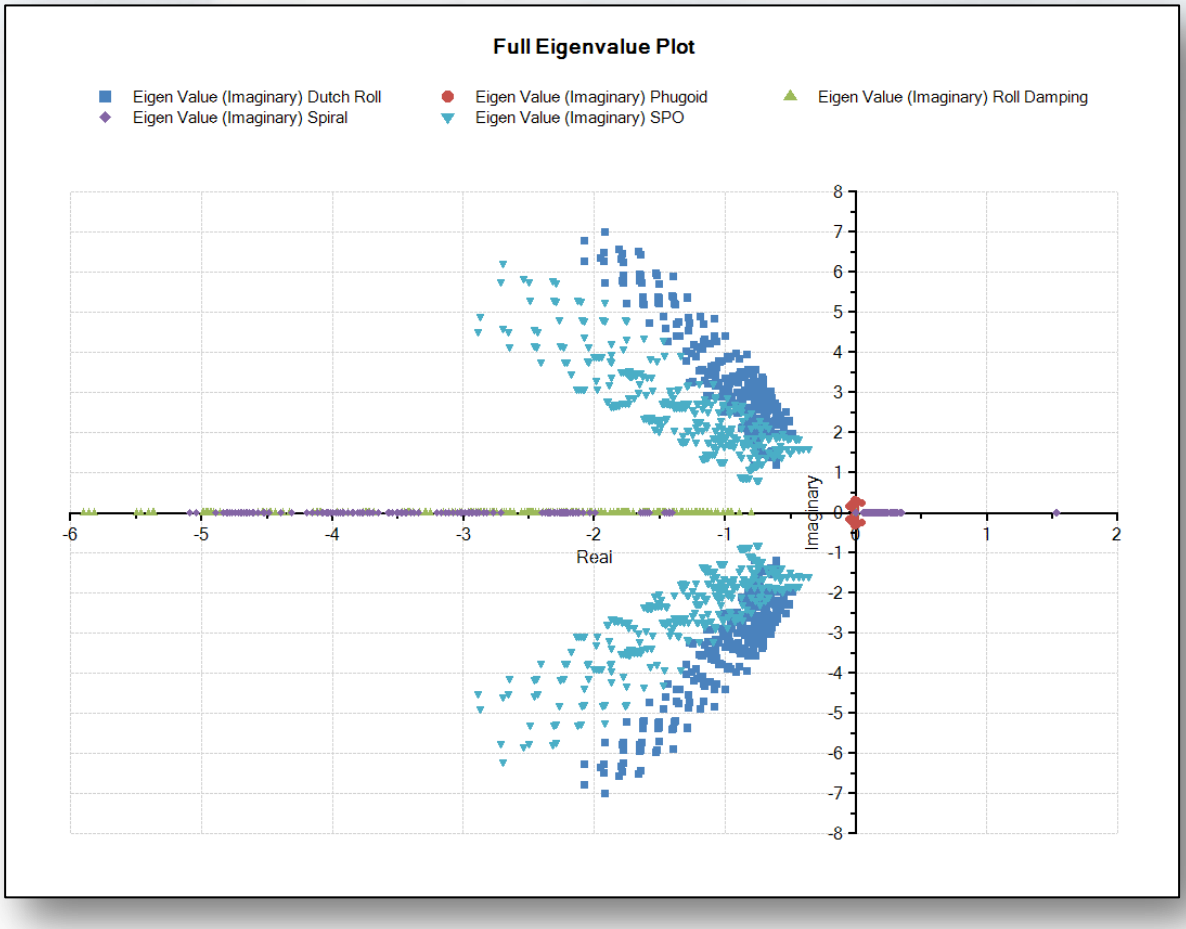
By using **J2 Classical**, a fully integrated component of the J2 Universal Tool-Kit, there is no need to go to any another application to start looking at Linear Analyses and developing algorithms to establish modes of motion. This means that with **J2 Freedom** an aircraft can be initialised (trimmed) at any point in the flight envelope and with J2 Classical, the aircraft is then linearized about this point, a full state space system calculated along with eigenstructure, modes of motion, frequency damping etc. This analysis is not limited, though, to a single point but can be performed across the complete flight envelope in a single mouse click.

J2 CLASSICAL AS PART OF THE J2 UNIVERSAL TOOL KIT

Why go elsewhere?

When linearising an aircraft model, a typical process would have to start from an initial condition and linearise about that point. Getting the initial conditions correct is a very important part of this process as characteristics can vary at different engine and control surface positions, especially at the boundaries of the envelope. With the J2 Universal Tool-Kit and **J2 Freedom** we already have the results for our non-linear aircraft model, trimmed over a complete range of configurations and flight conditions. As such, we can re-use these results and start to linearise our model about these points.

J2 Classical will take the results of previous steady state analyses and linearise the aircraft about that point. At the same time it will calculate a state space set of matrices and all derivatives about the chosen point. From the state space system the eigenvalues and eigenvectors are established, and the subsequent modes of motion that these relate to. All this can be performed on the complete set of trim results in a matter of minutes. From these results we can then look at the stability characteristics.



Full Eigenvalue plot for all modes of Motion across the Complete Flight Envelope

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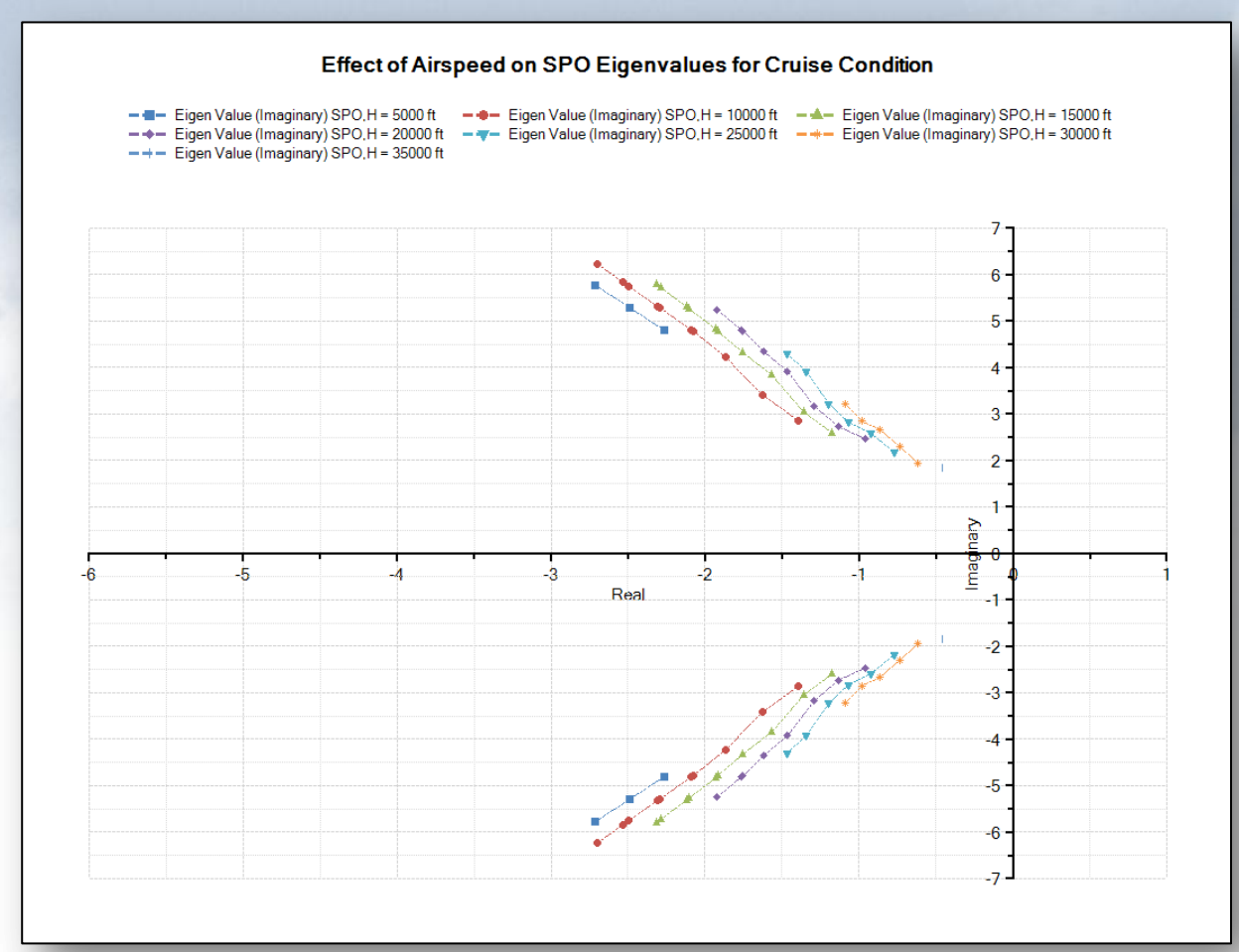
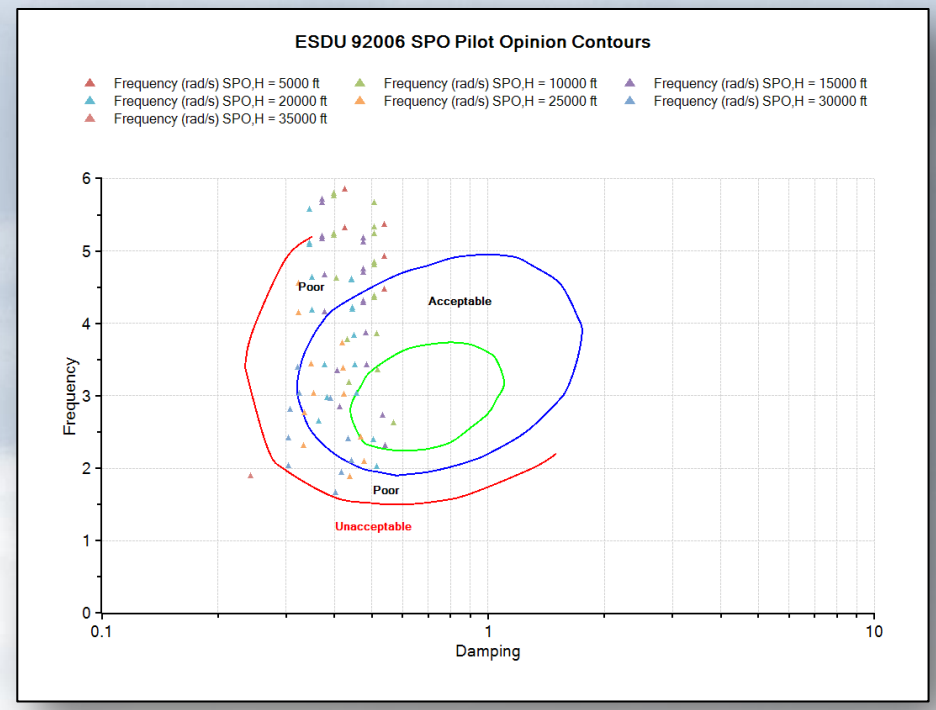
From the full set of Eigenvalues for the complete flight envelope it is possible to establish any key areas of concern, then looking in more detail at the Eigenvalues, for Short Period say, at a given configuration. This means that trends can be found and evaluated.



Evaluating Trends in Short Period Characteristics with Airspeed and Altitude

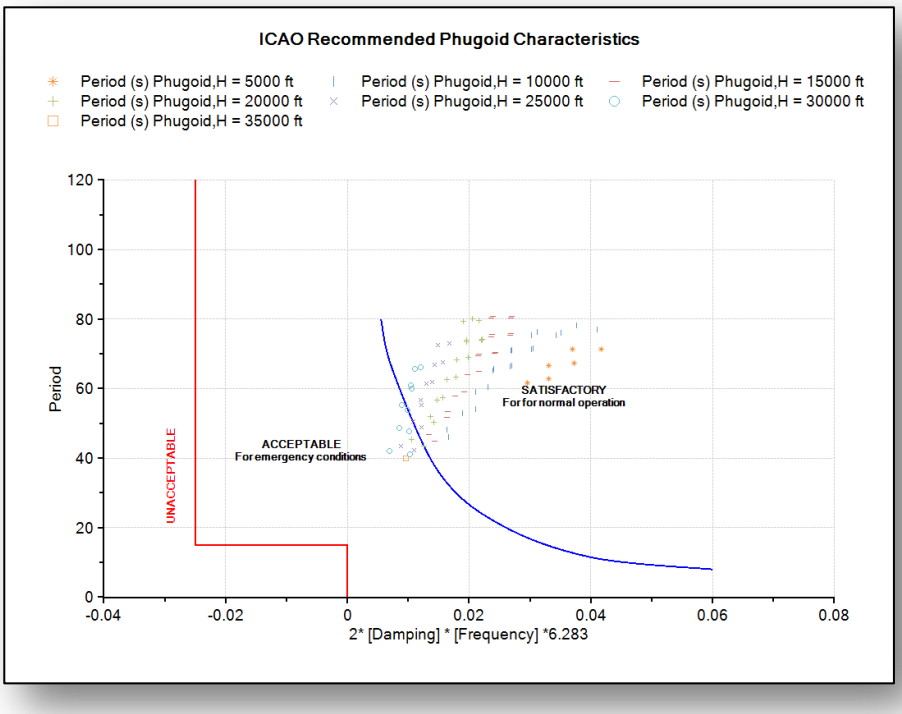
With the pre-defined templates and charts, it is possible to evaluate characteristics against specific industry standards and requirements for the aircraft classification.

These templates can be re-used over and over such that generating standardised charts from any data is a simple few mouse clicks making sure engineers see the right information as quickly as possible.



Inclusion of Templates enables Standardised Charts to be Created and Boundaries and Annotations Added

As well as having the ability to view and plot all the mode of motion characteristics, all the aircraft states, and all the derivatives calculated for the state space matrix, equations can also be plotted and added to templates to create even more detailed charts.



Using Equations to plot the exact characteristics required the templates mean this chart can be reproduced over and over.

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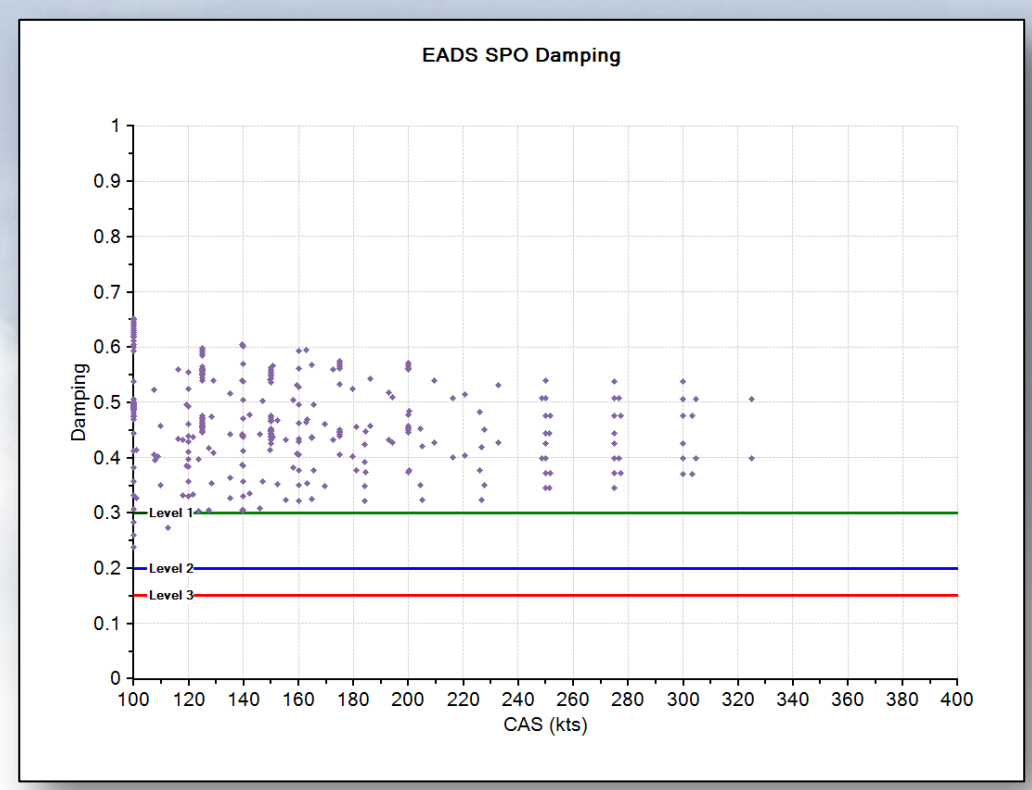
Even create user defined criteria and templates to look at things that are company specific.



Templates can be created by anyone to ensure that exactly the information required is displayed

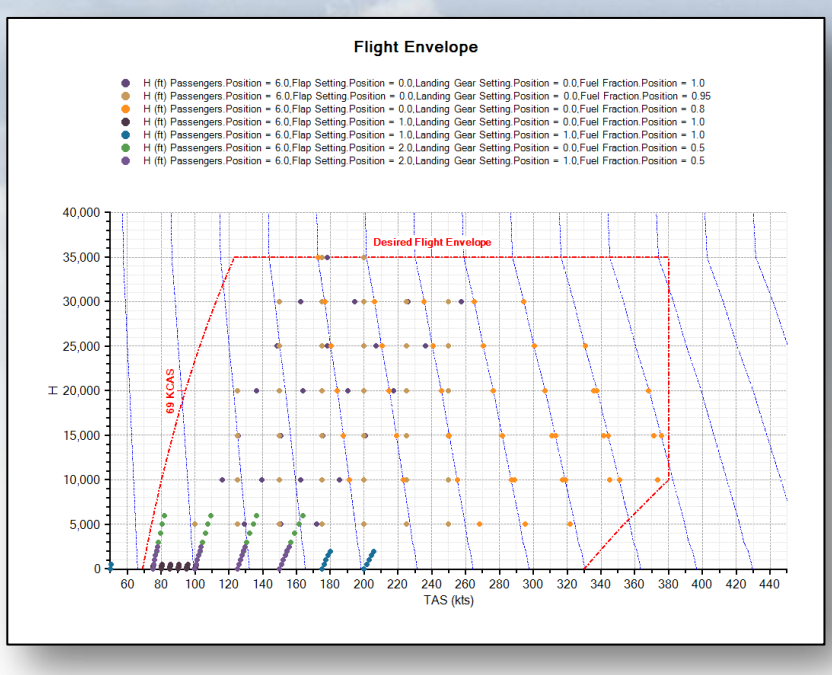
All of this significant analytical work is completed in minutes and can be re-evaluated for every design change or refinement of the data model as more information becomes known about the aircraft.

Whether the user is working at Conceptual or Preliminary design stage or developing Certification procedures and test, the **J2 Universal Tool-Kit** with **J2 Classical** plug-in can be used throughout.

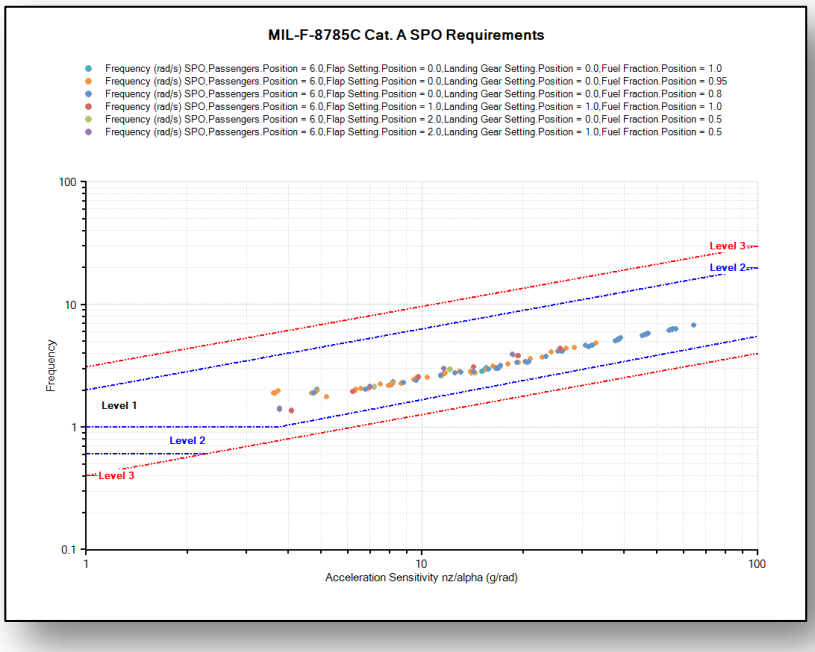
J2 Classical Key Benefit Statement

Saving Time and Money

In using **J2 Classical** the analytical tasks that could take man days/weeks to complete are reduced to man hours. The added benefit of not having to move data in and out of other software tools, with the resultant data transformation and error issues this can produce, can yield further quality improvement and additional time savings.



Full flight envelope covering flaps, landing gear and fuel fractions to…



… complete linear analysis in only a few mouse clicks.

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IT TOOK J2 AIRCRAFT DYNAMICS' AEROSPACE ENGINEERING AND AIRCRAFT DESIGN SPECIALISTS OVER 10 YEARS TO BUILD THE 'CODE' THAT ENABLES THE UNIVERSAL TOOL–KIT TO INVESTIGATE ALL ASPECTS OF AIRCRAFT HANDLING AND PERFORMANCE.
WE HAVE DONE ALL THIS SO THAT YOU DON'T HAVE TO.

This state-of-the-art, but easy-to-use software suite gives you unprecedented power to design and 'fly' multiple configurations of the complete flight envelope in a 3-D virtual environment – all at the click of a mouse! When using the J2 Universal Tool Kit, you can save hundreds of thousands of dollars by streamlining your process, maximizing your analysis capability and reduce the risk of serious project flaws.

At the heart of J2's software is the **J2 Universal Framework**, a cutting-edge configuration control and data management platform that hosts all steps of the design process. Everything we offer begins and interacts with this key framework.

Now it's time to investigate our range of plug-ins. 'Mix and match' their additional design and analysis capabilities using floating licenses. Take control of a bespoke package that perfectly fits your requirements. This way, you get the right functionality and maximise the return on your investment.

ARE YOU READY TO RETHINK THE WAY YOU DEVELOP YOUR AIRCRAFT?

To find out more about **J2 Aircraft Dynamics**, our software and our consultancy services, visit **www.j2aircraft.com**

PLUG-INS

J2 Builder
An easy-to-use graphical interface that rapidly develops aircraft models and builds multiple variants for comparison

J2 Elements
Enables automatic calculation of total aerodynamic coefficients and derivatives through integrated strip theory.

J2 Developer
A Software Development Kit (SDK) for all users to write their own components and libraries with an interface into J2 Aircraft Models.

J2 Freedom
Provides flight dynamics simulation of aircraft data models, allowing you to evaluate the complete flight envelope.

J2 Active
An open COM interface that instantly integrates your existing design packages with the power of the J2 Universal Tool-kit.

J2 Matlab Toolbox
Get the full capability of J2 with Simulink Model files. Manoeuvres from within J2 can be flown on Simulink Models. Run all analyses from within J2 Universal Tool-Kit.

J2 Visualize
Instant understanding and evaluation of aircraft behaviour through data visualization and graphic displays.

J2 Virtual
View any results in a virtual 3-D real-world, to understand what exactly happens during unexplained/complex manoeuvres

J2 Pilot
Using the J2 Pilot plug-in's automatic interfaces/models you can fly aircraft on your. You can also use J2 Pilot interfaces to merge the finished design into pilot training simulators.

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