

# J2 Aircraft Dynamics Case History

## Cassidian – Detailed Design and Analysis

AIRCRAFT MODELLING AND PERFORMANCE PREDICTION SOFTWARE

### KEY BENEFITS

- Aircraft Designers no longer have to write code/scripts in order to run multiple analyses.
- The powerful analytical toolset can run thousands of test cases in minutes.
- Conceptual and Detailed engineering design teams are able to use the same aircraft modelling environment. Saving significant time.
- Detailed Design teams can analyse and visualise manoeuvres and failure scenarios across the complete flight envelope.
- **j2 software** is easily networked onto any company system without access or permission issues arising and can be accessed remotely.
- **j2 software** was able to debug existing trusted FORTRAN library models with ease, exposing tables, derivatives and formulae within the **j2 Builder** environment means that aspects of the model causing problems can be easily found and corrected without the need to recompile any code.

### THE GOAL

Cassidian's goal was to model mass, inertia and control systems whilst harnessing the knowledge in its legacy modelling system. Cassidian selected the **j2 Universal Tool-Kit** because the software was able to integrate seamlessly with their existing aerodynamic modelling code base which was running in FORTRAN. This was a vital link as significant and valuable knowledge resided in the legacy modelling system. Additional mass, inertia and control systems could then be “superimposed” onto the aerodynamic models, through the **j2 Universal Tool-Kit**, to provide complete aircraft systems solutions.

### CASSIDIAN VALIDATION

#### Stage 1 – Model Validation

Two models were built to compare these cases:

- **Model 1:** j2 were provided with a comprehensive set of data tables, and equations that defined the aerodynamic characteristics of the aircraft across the complete flight envelope including an Experimental Axis System used within Cassidian as part of their model definition. **j2 Builder** was used to construct a model using the data including look-up tables, derivatives and expressions that already existed.
- **Model 2:** Was constructed using a FORTRAN library containing the aerodynamic data, and integrated with the same mass, inertia and CG characteristics as the model 1. Both models were run and results compared over a range of steady state conditions. Discrepancies between the two models were identified, further analysis showing that all errors occurred in the original legacy FORTRAN library which therefore required updating and recompiling. Because of the flexibility of the **j2 Developer** interface, the updated FORTRAN libraries were immediately integrated into the j2 model and the cases re-run and evaluated instantly.



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Steady state cases were then evaluated over a range of data points and compared to actual flight test data. Further Classical linear analysis was performed on both models to identify modes of motion, frequency and damping characteristics and results assessed against actual flight test data.

## Outcome

Both models showed very high and acceptable levels of fidelity when compared to the real aircraft.

## Stage 2 - Dynamic Behaviour Analysis

An actual crash scenario test case was selected that could not have been evaluated using the existing, legacy, Cassidian software tools. This scenario was to model the effect of a lateral gust on the aircraft during final approach with rudder free. The **j2 Universal Tool-Kit** analysis showed an unstable, uncontrolled response on the aircraft resulting in a crash which was consistent with what had occurred with the real aircraft. As a further demonstration of the **j2 software** capability, additional cases were run at higher aircraft approach speeds instantly. The outcome was that at a higher final approach speed the aircraft would have remained stable and in control.

These cases were presented to the Cassidian engineers and management using the functionality embedded in **j2 Visualize** (charting) and **j2 Virtual** (3-D playback facilities) to provide a real understanding of aircraft behaviour.

## CLIENT VALUE RETURN

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Such was the success and accuracy of the **j2 software**, Cassidian have been able to greatly accelerate the speed with which they can go and crucially have removed a number of error sources associated with import/export regimes using the previous legacy system.

*"Our evaluation of the j2 software revealed a considerable potential in quality and turn-around time improvement in the conceptual and detail design. There is no doubt that now we have adopted j2 we can significantly shorten the design and analysis cycle within Cassidian. It also opens up further gains elsewhere in the design process to regard and to exploit the true multidisciplinary of aircraft systems."*

**Stephan Hitzel**  
**Dr.-Ing.,**  
**Expert Aerodynamic Design and Numerical Methods at Cassidian**

j2 AIRCRAFT DYNAMICS' AEROSPACE ENGINEERING AND AIRCRAFT DESIGN SPECIALISTS HAVE DELIVERED A 'FULLY CODED' AND INTEGRATED SOLUTION THAT ENABLES THE j2 UNIVERSAL TOOL-KIT TO INVESTIGATE ALL ASPECTS OF AIRCRAFT HANDLING AND PERFORMANCE.

.....NO MORE CODING FOR ANALYSES.

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 thousands of man hours by streamlining your process, maximizing your analysis capability and reducing 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 j2 offer begins and interacts with this key framework.

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.

IMAGINE IF YOU COULD PREDICT THE FUTURE? NOW YOU CAN.....

To find out more about **j2 Aircraft Dynamics**, our software and associate consultancy programme, visit [www.j2aircraft.com](http://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 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 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 Classical

**J2 Classical**, a fully integrated component of the **J2 Universal Tool-Kit**, 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.



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