AIR ACCIDENT CASE HISTORY

Tiger Moth Crash, Witchampton, Dorset

THE UNIQUE CAPABILITY OF THE J2 UNIVERSAL TOOL-KIT WAS USED TO CHALLENGE THE FINDINGS OF AN AAIB REPORT, CITED AS EVIDENCE IN A TRIAL FOR MANSLAUGHTER IN THE UK. THE J2 UNIVERSAL TOOL-KIT WAS ABLE TO ESTABLISH MARKED DIFFERENCES BETWEEN THE PILOTS REPORTED EXPERIENCE THAT RESULTED IN A LOSS OF CONTROL OF THE AIRCRAFT AND THE CONCLUSIONS OF THE AAIB INVESTIGATION.

DISCOVERY

- The j2 Universal Tool-Kit is used to build a full non-linear predictive math model.
- The full physics-based model of aircraft kinematics produced a physically feasible aircraft.
- The flight construction process was able to reproduce the flight path and compare to GPS data over a range of variants.
- It was possible to build a range of flight manoeuvres and mass profiles to match available weight and balance data and compare data patterns produced from each.
- 3-D visualisation enabled views of the dynamic behaviour of the aircraft from all angles, a major aide in helping the jury to gain a better understanding.

CONCLUSIONS

- The flight path reconstruction was verified by the GPS and radar data.
- It is possible to identify the aero engineering data patterns associated with each set of aircraft manoeuvres.
- The time-step capability was able to identify the critical pilot inputs and their effect on aircraft behaviour.
- It was possible to compare various recovery scenarios with and without a stuck rudder.
- The final results from the model are robust and validated by reference to a documented series of steps and checks.
- The model and analytical work were able to clearly support the Pilot's view of events to the satisfaction of the court and the jury.
- Any aircraft model created in j2 can be used directly into a simulator, allowing further Pilot assessment of the manoeuvre and possible recovery scenarios in a safe environment.

Scenario

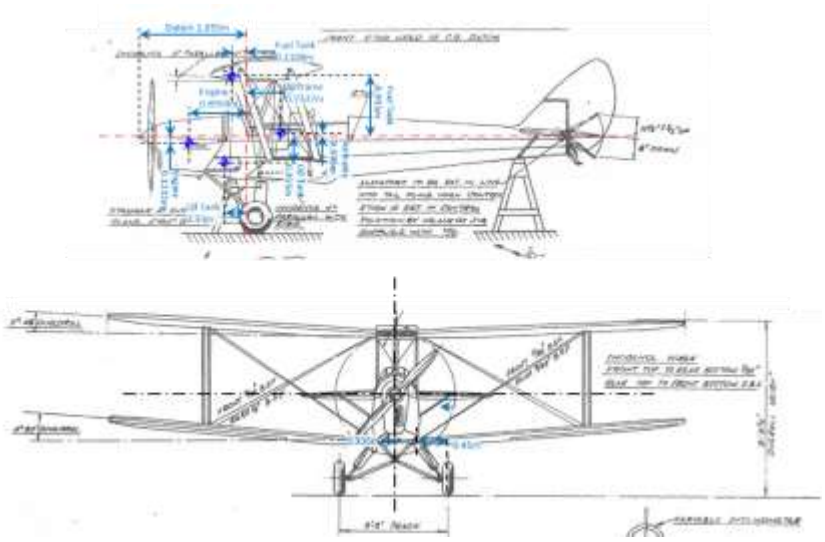
On the 15th May 2011, a leisure flight of a 1941 Tiger Moth aircraft turned into a disaster when the aircraft crashed, killing the passenger and badly injuring the pilot, Mr Scott Hoyle.

In the aftermath of the accident and subsequent investigation by the AAIB, the report found that the incident was the result of pilot loss of control when attempting an aerobatic loop that was not completed. This conclusion was reached despite the pilot claiming to have experienced a stuck control surface (rudder) which remained fully deployed after exiting a left turn manoeuvre to return to the airfield.

This case history walks the reader through the work j2 AAI did in helping to establish what actually happened. It looks at how the j2 Universal Tool-Kit capability was applied to demonstrate how the data patterns produced from analysis of the available data sources matched. This was supported through the flight physics analysis - only possible using the j2 Universal Tool-Kit. The result supported the Pilot's view of events in preference to the conclusions reached in the AAIB report and other prosecution evidence in a court of law resulting in the pilot being found 'Not Guilty' of all charges.

Model Build and Sanity Check

The initial flight physics based model build of the 1941 Tiger Moth used data provided by De Havilland Support and a variety of other named sources. This enabled a high fidelity math model of the aircraft to be built. This model was further `sanity checked' against data accepted as being representative of the DH82A Tiger Moth aircraft. Once this model was further verified by reference to experienced Tiger Moth pilots, the analytical interrogation of the model could begin.



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Model Interrogation Process The first stage was to investigate the performance of a loop. This allowed j2 to investigate the impact of a variety of weights and balances, aircraft speeds and pilot control inputs likely to have resulted in a successful loop being completed.

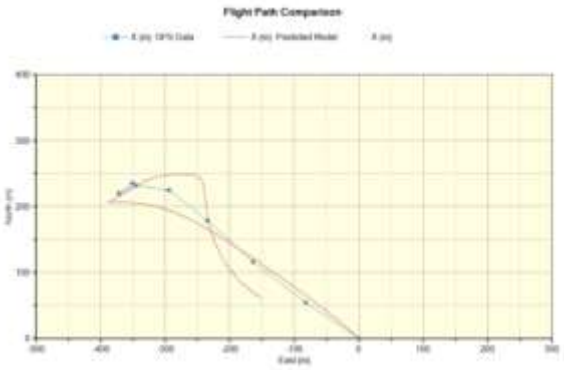
J2 was also able to examine what variations in each of these attributes could result in the aircraft stalling, producing an unsuccessful loop. Through experienced pilot de-briefings, the recovery procedures in order to regain control in the event of a failed loop - assuming no restrictions in the control surface movements.

The **j2 Universal Tool-Kit** is able to reproduce all the aircraft states and surface deflections as a result of the pilot inputs. GPS data was available up to a brief period prior to the crash. This allowed j2 AAI to verify aircraft speeds, headings and data patterns of interest over time. All scenarios presented were compared to this data to establish a strong correlation in characteristics. All results are presented both graphically and in a 3-D Virtual environment.

Accident Scenario Recreation

With alternative hypotheses exhausted, j2 recreated the Pilot's description of events. These were converted into pilot inputs and applied to the full analytical aircraft dynamic model. These events are summarised below:

- Performing a turn from SE to NW when deploying the rudder, a small resistance had to be overcome and this was felt through the force in the pedal.
- On exiting the turn the rudder remained deployed and stuck fully left.
- Once in level flight, the influence of the deflected rudder was causing the aircraft to yaw and roll to the left relative to the direction of flight (NW).
- The Pilot deployed right aileron to control the roll influence.
- The pilot decided to centre the controls to see if this would "free up" the rudder
- On centring the controls, the Tiger Moth then initiated a rapid, nose down pitch, and yaw and roll to the left.
- To assert control the pilot moved the stick back and to the right. This initiated a rapid nose up attitude and loss of air speed which produced a wing stall. The aircraft then entered a spin to the left and the stuck rudder prevented the pilot regaining control.
- The aircraft crashed to the ground rotating to the left.



What was found after the analysis of all suggested scenarios had been performed was that the only solution that matched the available GPS evidence was the Pilot's sequence of events. In all other scenarios the aircraft was able to recover prior to hitting the ground.

More Information

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