CASE STUDY: CADfix Fuels Bloodhound SSC's 1,000 mph Land-Speed Record Attempt by Streamlining CAD Data Integration

CADfix

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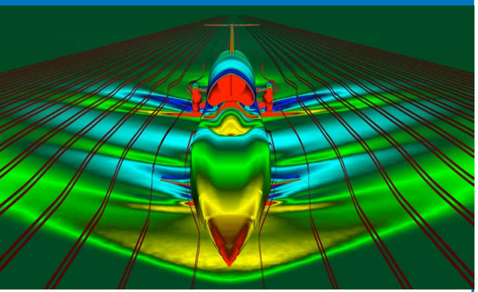
- Professor Oubay Hassan, Swansea University



Overview

In 2005 when Bugatti launched the Veyron, the first 1,000 horsepower road car and the first that could top just over 400km/h (~250mph), British motorsports broadcaster, Jeremy Clarkson, doubted that anyone would attempt such an ambitious feat of engineering again. Developing a car capable of speed of 1,609km/h (1000mph) would prove to be a major engineering challenge that requires the best engineering software tools.

The team responsible for the aerodynamic simulation of BLOODHOUND Supersonic Car (SSC) knew they had the software tools to meet such demanding conditions. However, without CADfix they would have stumbled at a far more basic hurdle.

Challenges

The number of engineering students in the UK was falling. Reasoning that interest in engineering has historically peaked with high-profile projects such as Concorde and the lunar landings, Lord Drayson, UK Minister for Science and Innovation, was on the lookout for a new scheme that might have a positive effect. A meeting with land speed giant Richard Noble, driver of the jet-powered Thrust2 for a land speed record that held for 13 years, ignited a spark.

Noble led the next team to a land speed record in 1997 when driver of the Thrust SSC, Andy Green recorded a speed of 763.035 mph, a record that stands today.

For the next challenge, at the urging of Drayson, Noble decided to not only beat the land-speed record but to blow it out of the desert by reaching 1,000mph. By setting a lofty goal Noble believed he could inspire a new generation of young engineers. Thus, the BLOODHOUND SSC project was born.

Taking a car to such speeds is a phenomenal challenge. In fact, 1,000mph is faster than the low-level air-speed record. Hitting this kind of speed is more than just brute force and aerodynamics. Many of the designers and engineers on the BLOODHOUND SSC team worked on Thrust SSC and were familiar with the challenges. They knew that a complex assembly of thousands of individual parts must be optimized so that everything is stable at every speed from subsonic through the crucial transonic phase to supersonic. Any weak links in this chain could spell disaster.

A team in Bristol took overall responsibility for decisions about the shape and construction of the car, while the crucial aerodynamic simulation function fell to the engineering department at Swansea University.

Professor Oubay Hassan of Swansea University, awarded the MBE for his work on Thrust SSC, led the team charged with the task of simulating the performance of the car and its constituent parts. "For the Thrust project we used a combination of simulation and physical testing using a 1:25 scale model," he explains. "The results from the testing and the successful run of the car served to verify the figures we got from our simulation. This time around, the extreme nature of the project and the design window we were presented made physical testing impracticable. Simulation has taken center stage."

The simulation tool used for the project was FLITE, the computational fluid dynamics (CFD) system developed at Swansea for use in the aerospace industry. FLITE has been developed to simulate even the most extreme fluid flow scenarios and was one of the reasons Noble approached Professor Hassan for help on Thrust SSC.

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For all its advanced capabilities, however, FLITE remains very much a specialist technical engineering tool, and does not feature the kind of CAD integration you would expect of a mainstream CAE solution. "FLITE is a dedicated meshing and solving application, and it's very good at what it does," explains Professor Hassan. "But, while we're experts on engineering software we haven't evolved a CAD interface. In order to work with the geometry coming out of the design team we'd have had to write a new converter or input it all by hand. And given the tight development schedule this would have been too much of a challenge."

Solution

The solution came in the form of CADfix, the data translation and repair tool from ITI TranscenData. Using the CADfix API, the Swansea team developed an integration between the FLITE surface mesh generator and CADfix, that would act as a critical link between the design team's NX CAD data files and the geometrical mapping required for the FLITE algorithms.

In addition to facilitating a direct interface to the complex NX design geometry, the CADfix integration meant that specialist CADfix geometry processing functions, such as the suppression of unwanted small features and the correction of poor surface parameterizations, could be applied to ensure that the optimum geometry was available for FLITE meshing and analysis.

"Geometry import was a serious headache," adds Professor Hassan. "Before CADfix we were having to rebuild geometry inside our system. This was not only unsatisfactory but also hugely time-consuming. We could easily spend a week preparing geometry for analysis. With CADfix we were ready to go within hours." Towards the end of the design phase CADfix really came into its own, facilitating between 20 and 30 simulations of a critical element of the car's rear suspension in a particularly tight timeframe.

Result

Without CADfix smoothing the data transfer between design geometry and analysis mesh this degree of fine tuning would have been impossible and the optimum design would not have been reached. Professor Hassan estimates that without CADfix the rebuilding of geometry would have added approximately twelve months to the BLOODHOUND SSC simulation. As he explains, this would have jeopardized the whole project, "The project leaders were adamant that the entire design cycle was completed within a year. Without CADfix this would have been impossible."

The design phase for BLOODHOUND SSC was completed on time. The simulation work that CADfix made possible means that, although this project does indeed represent an amazing engineering adventure, it was not quite a journey into the unknown.

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