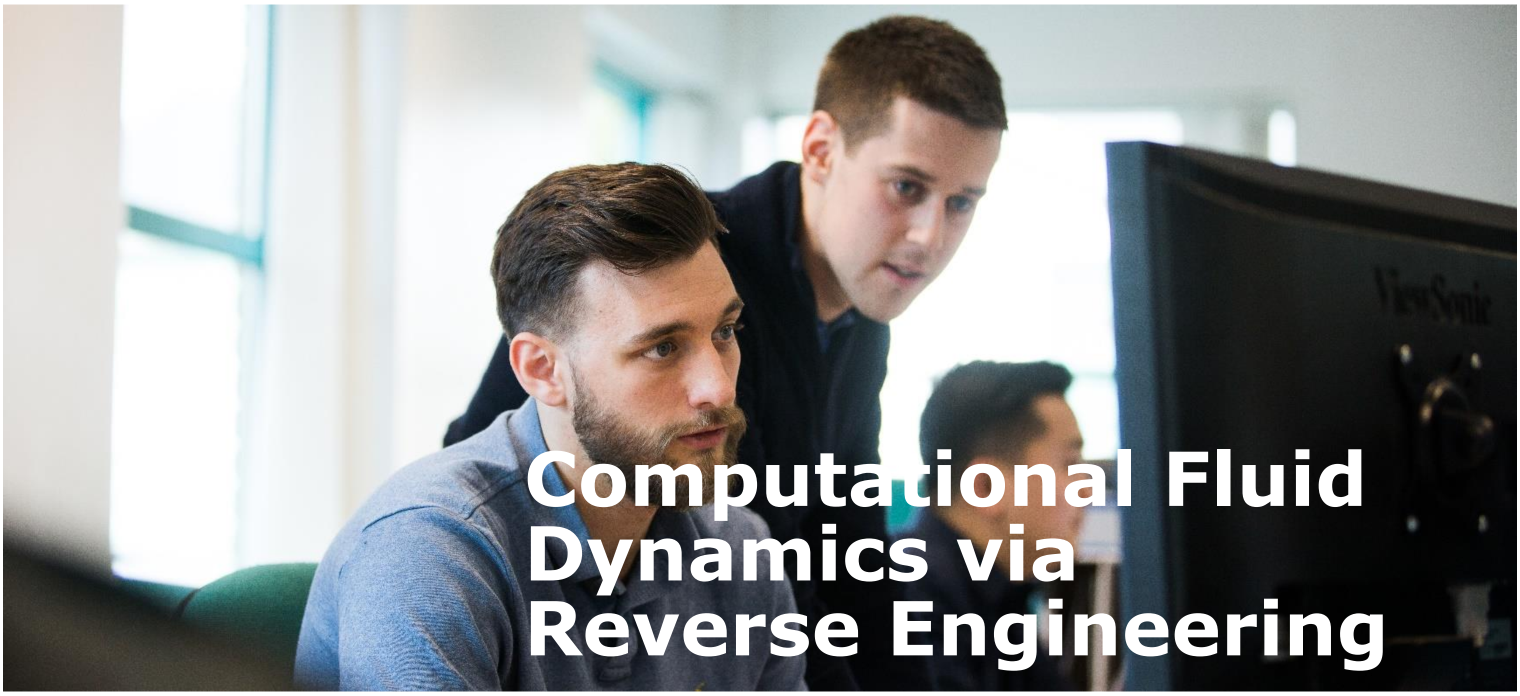


Computational Fluid Dynamics via Reverse Engineering

Case study

Fluid dynamics has always been important for design, research, development and impact analysis for industries such as aerospace, automotive, oil and gas, power generation and pharmaceutical. Traditionally, fluid dynamics properties have been provided via wind tunnel testing. The application of computational fluid dynamics (CFD) analysis has made it possible for fluid flow effects to be investigated at lower cost, more flexibly and in shorter timescales compared to conventional wind tunnel testing. Given EASL's specialised expertise in computational methods and extensive experience in structural integrity assessments, we can provide authoritative advice on CFD analysis.

Our solution

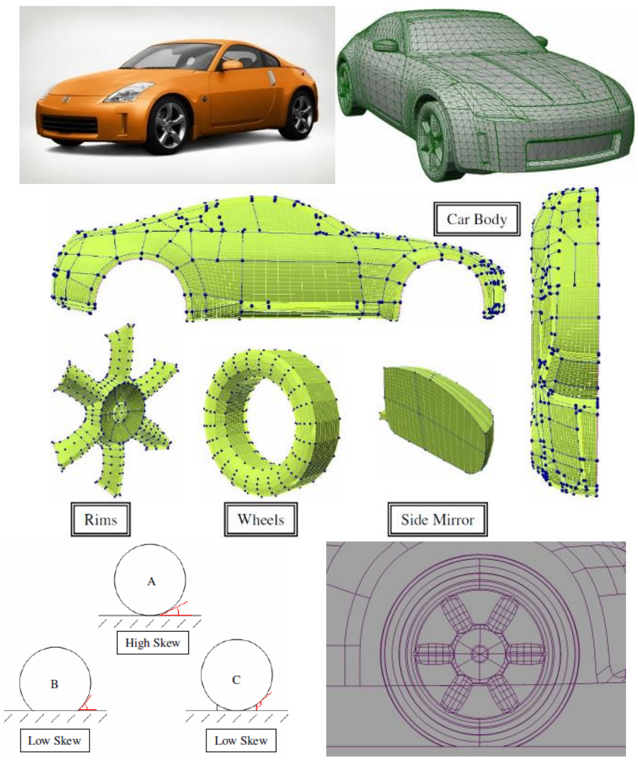
We resolve performance issues, gather design inputs and produce concepts using CFD for many industrial components and structures including some of the following examples:

- Boilers/ heat exchanges and relevant internal components;
- Turbine blades; and
- Valve efficiency.

EASL's historic knowledge of reverse engineering methods enables the capability in replicating the most complex feature to be used in CFD. In this study a full size vehicle was idealised.

Reverse engineering

The method requires scanning of a subject model and, in this case, a full size vehicle was idealised. The scanned model was then subsequently refined to remove details and features not significantly affecting the analysis and to ensure elimination of all surface errors due to faults during scanning process. The model optimisation was required to reduce computational resources and improve the overall project turnaround time.



This reverse engineering method is particularly useful for design modification where fluid flow properties of the existing design can be replicated and compared against different operating scenarios.

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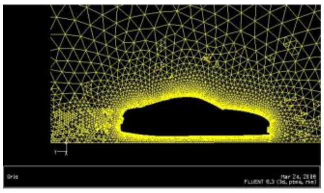
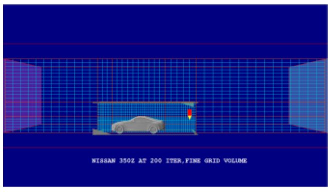
CFD

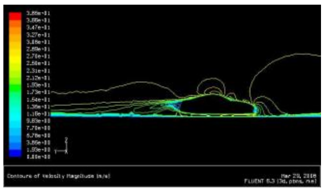
A series of different CFD and surface modelling packages including Fluent, CFX, PHOENICS, PolyWorks, Alias, GAMBIT and TGrid were used in the study. The study compared the analytical results from the different CFD packages with experimental results. The capability and ease of use of each CFD package was also examined.

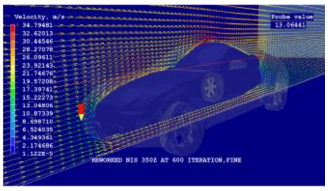
Different meshing methods (including Fluent's mesh adaptation), turbulence models and solution control were explored to optimise convergence and enhance accuracy of the CFD results.

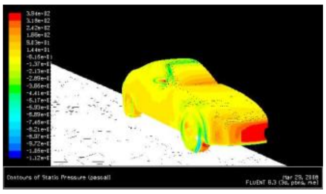
Simulation results such as pressure, temperature, velocity, skin friction distribution on model surfaces and surrounding domain along with streamlines were examined and extracted. These parameters were determined for subsequent use in structural analysis and design optimisation.

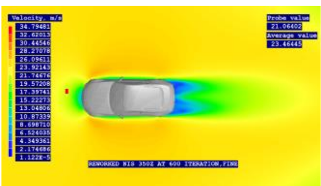






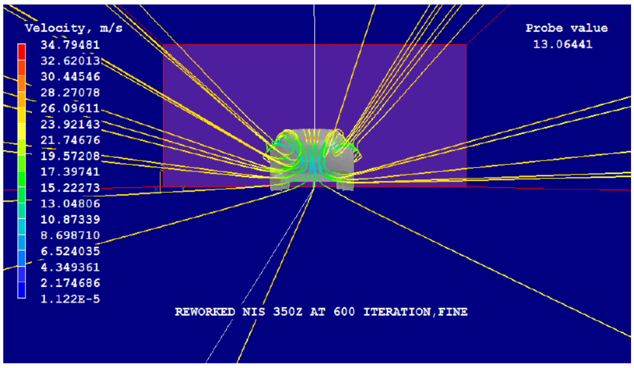


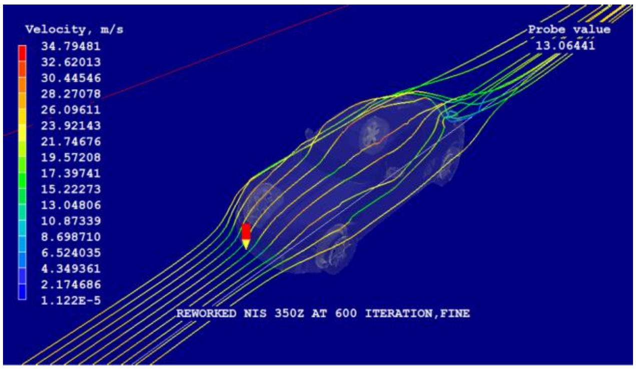


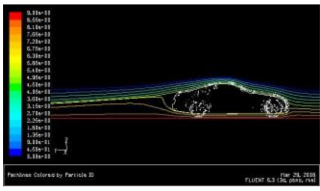


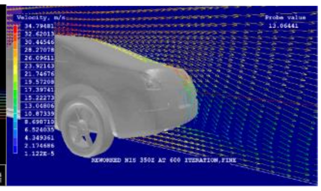
Capability of Methods

- Reverse engineering enables replication of existing geometries and allow for subsequent comparison of CFD simulation results of design modifications.
- The meshing capabilities of Fluent and Gambit were compared, and recommendations about their suitability made.
- Mesh adaptation method available in Fluent was shown to greatly increase the accuracy of the solution results. This method was used to refine the mesh based on static pressure gradients used in numerical calculations.
- Importing CAD geometry into PHOENICS was shown to simplify surface modelling, enabling complex scenarios to be modelled easily and quickly.









Other Applications

This study was used to determine the most efficient methods for CFD simulations for an automotive application. Together with our specialist knowledge in structural integrity engineering and experience across different industries, we are capable of providing solutions to every client's problems using the best approach.

If EASL can help you optimise your plant or component design, give us a call.

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