Recent Development of ICFD Pre and Post Processing in LS-PrePost®

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Abstract

As the usage of ICFD module of LS-DYNA grow widely, the requirements of Pre and Post processing dedicated to LS-DYNA ICFD module become more and more urgent. Since early 2014, we've been working on ICFD post processing module in LS-PrePost with LS-DYNA developers. It's now available in LS-PrePost in version 4.3. This new ICFD post processing module is object-oriented, works in both 2D and 3D case. Currently, following functions are included: Section Plane(line), ISO Surface (curve), Stream Line, Vector Plot, Level Set, Data Extraction(Point, Line), Line Integral Convolution(LIC), Attached/Separated Line, Vertex Core. The Pre Processing module of LS-DYNA ICFD module is also under design and development, aims to help traditional ICFD users transfer to LSDYNA ICFD application easily.

Background

Since the R7.0 release in 2012, LS-DYNA automatically includes a CFD solver for incompressible flows (ICFD solver). Since then, its growth of users has been steady and new developments and improvements are constantly added.

A typical CFD analysis can be decomposed in five steps :
1. Setting up the geometry
2. Building the mesh
3. Setting up the problem parameters
4. Solving the problem
5. Post treating the results

In order to handle Step 3 and 5 specific GUI and developments have been added to LS-PrePost 4.3, providing users robust and easy to handle tools for an more pleasant experience and in some cases, for a easier introduction to CFD.

ICFD Post Processor Introduction

The new CFD GUI is accessible through the MS button. Its main feature is the introduction of an object oriented Tree structure which allows the user to handle each part separately and to apply several options on it.
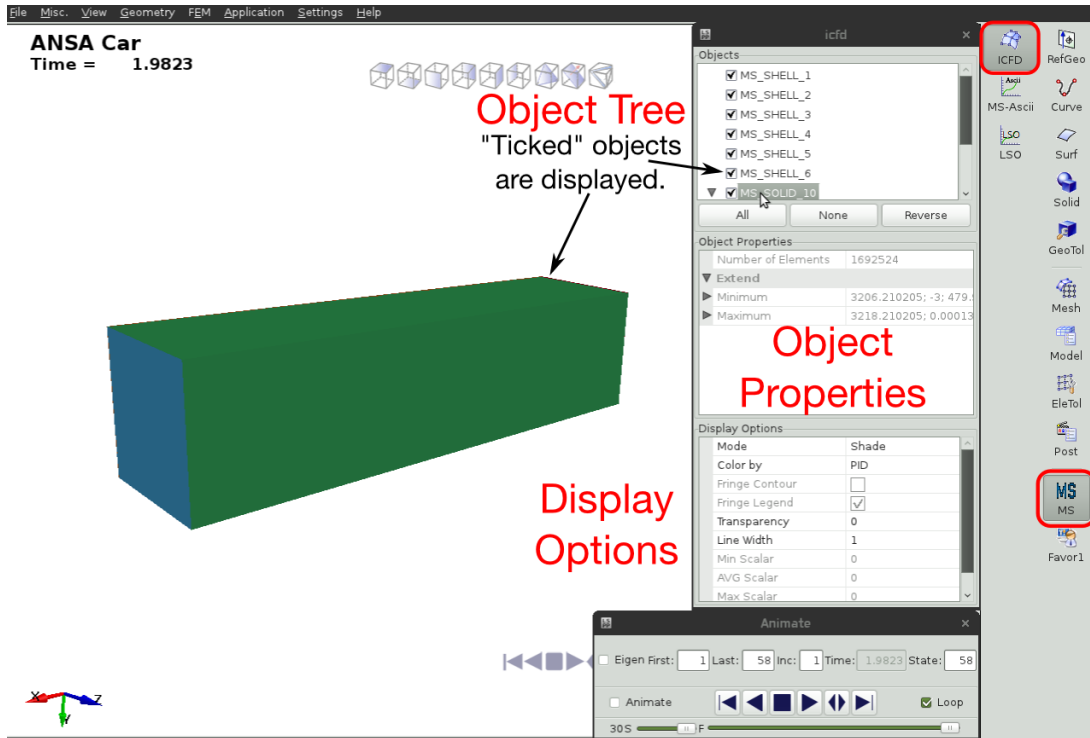
In the present case, the surface parts composing a road vehicle are displayed, colored by the pressure field, along with the domain floor, displayed in Wire mode.
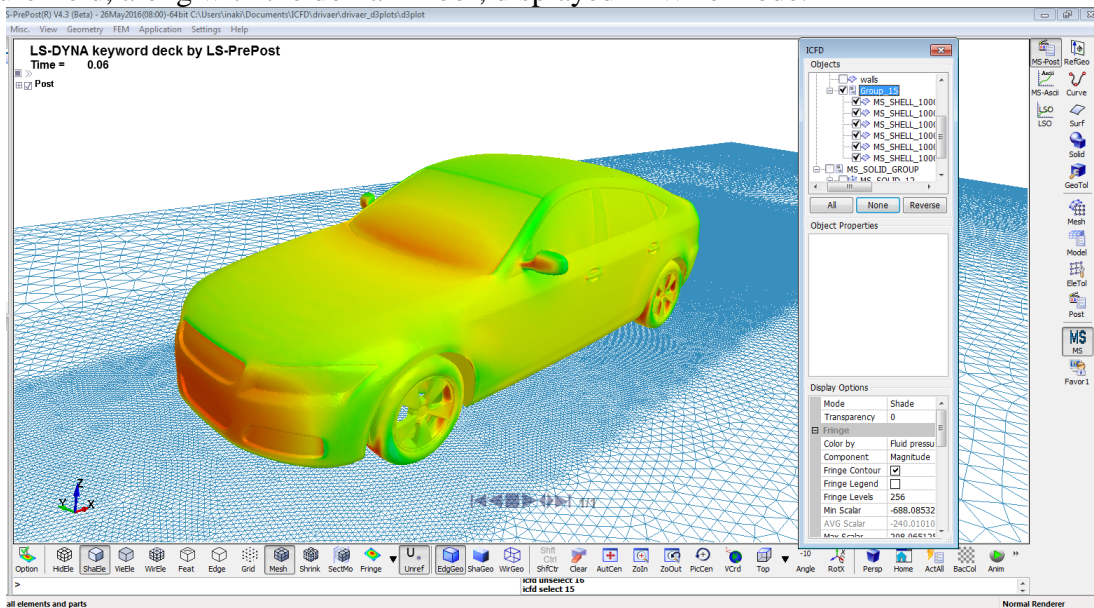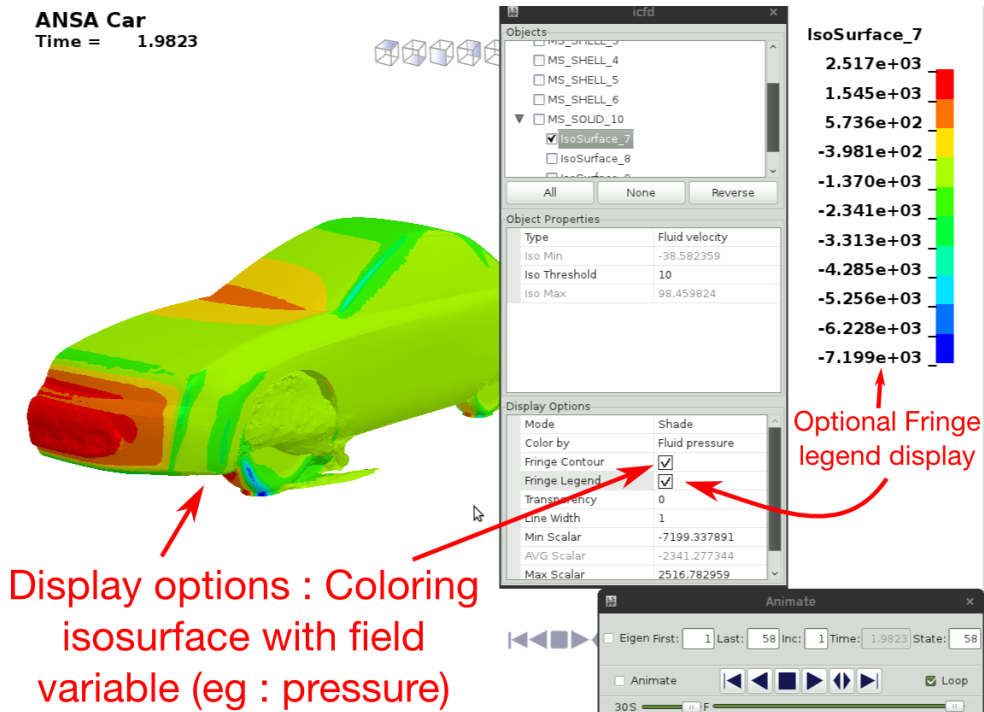

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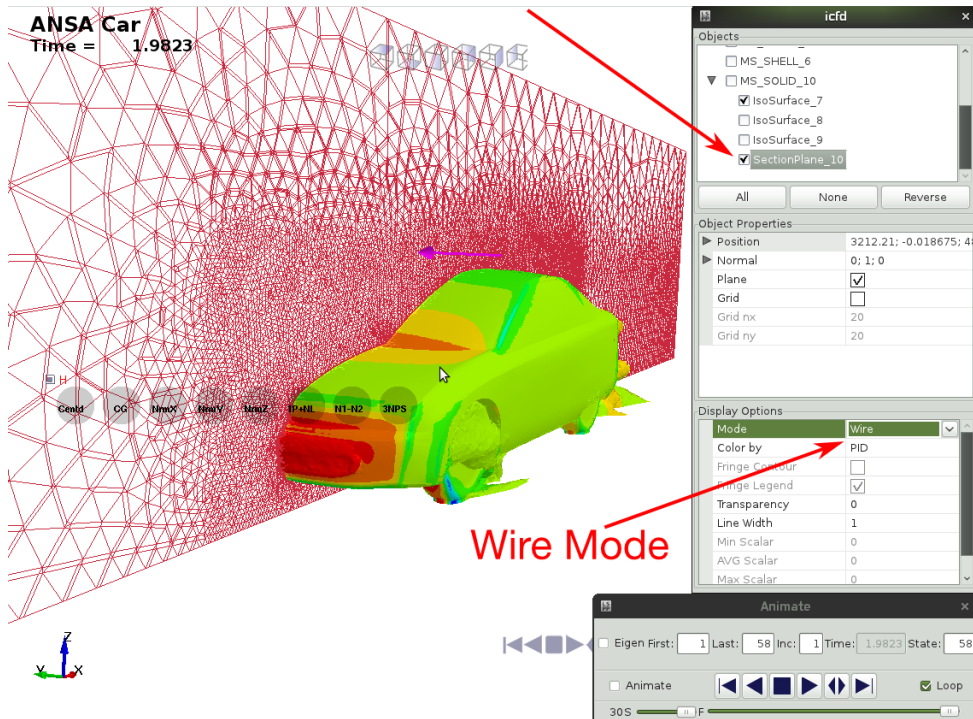Menu which allows the user to create new objects
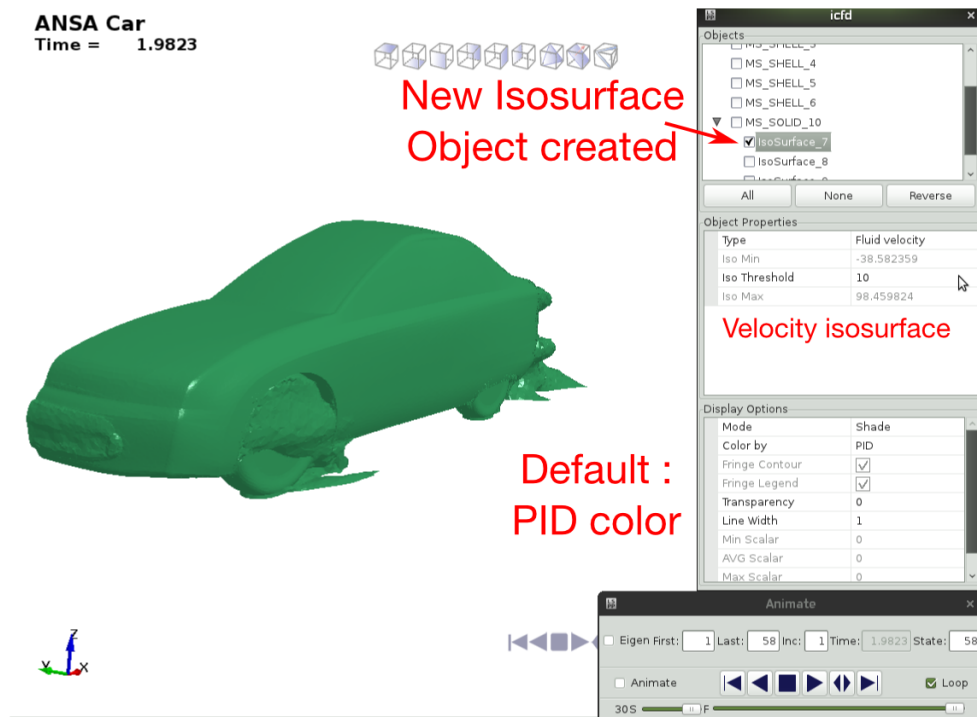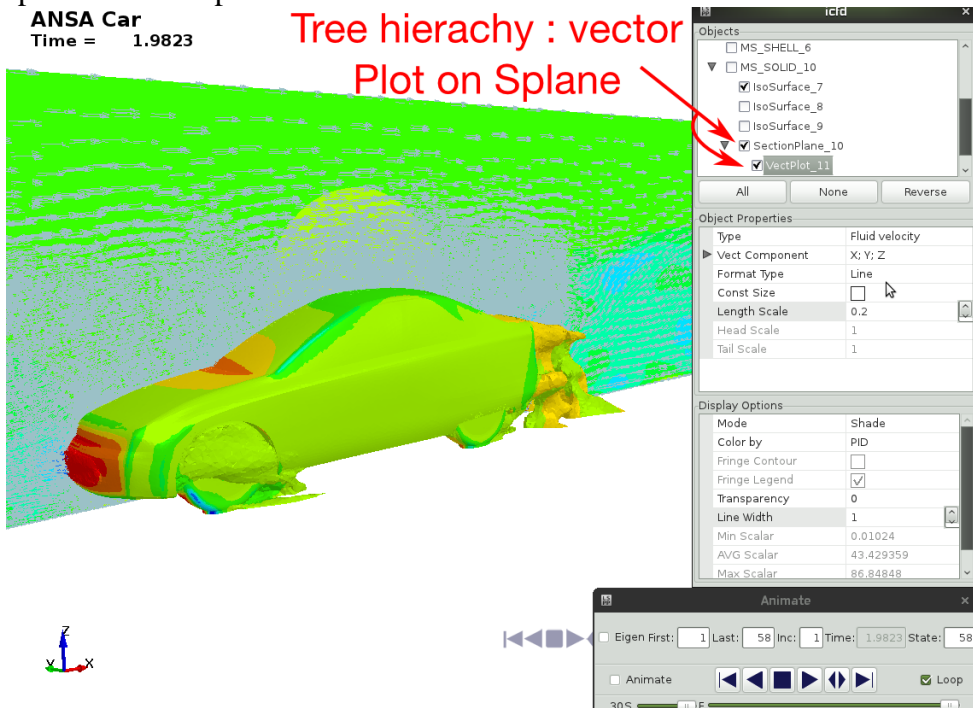

Objects created can be modified.
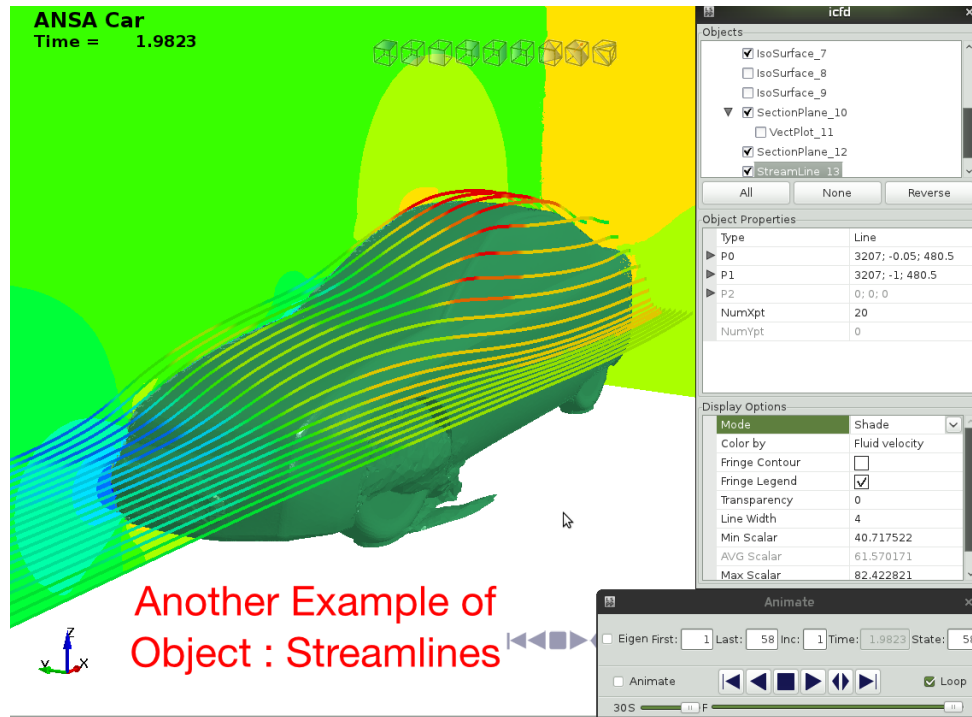


Section plane can be created.

Vector can plot on section plane.

Stream line can be created.

Several new objects can be created, each one of them with their own independent properties.

In the present case, a section plane, streamlines and an isosurface have been applied on the fluid volume. Note that the Streamline and Section Plane have been colored by velocity and that they both have their own independent fringe bar.
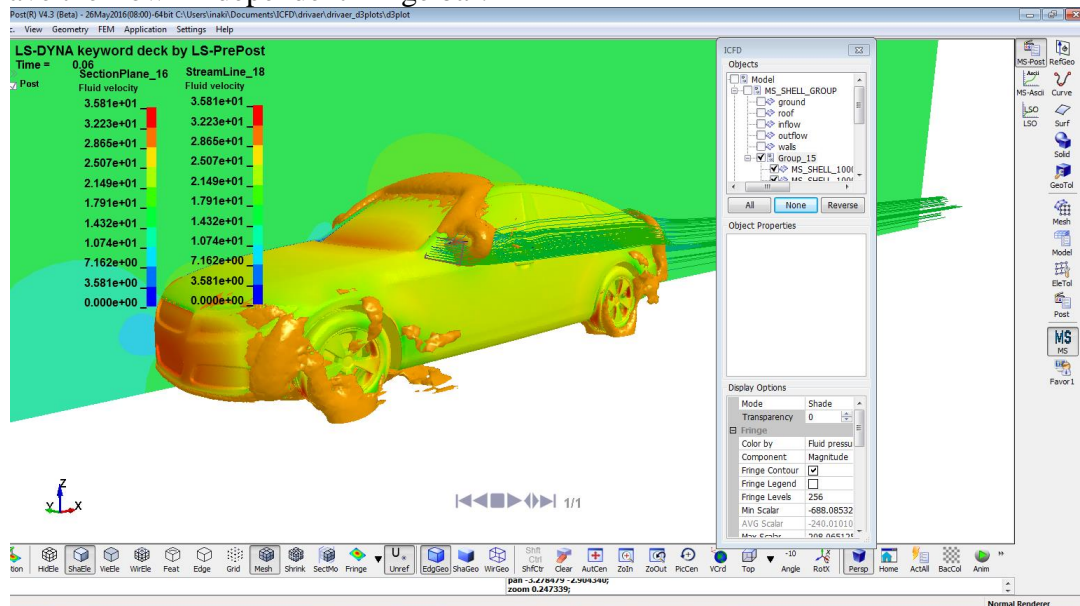

Here is another example, this time, Vectors and Streamlines objects have been created by applied on the Section Plane rather than on the volume. Again, the streamlines have been colored by velocity.
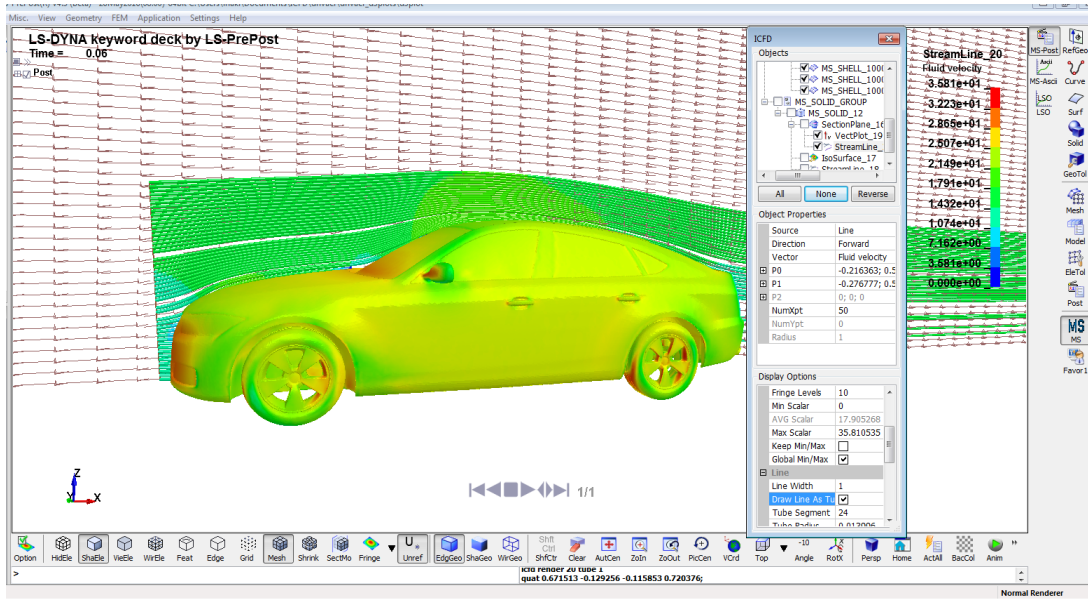
More advanced tools are available for a always better comprehension of the flow. In the present case, the Vortex Cores are captured and displayed allowing the user to very quickly identify regions of interest, where flow separation or turbulent effects may occur.
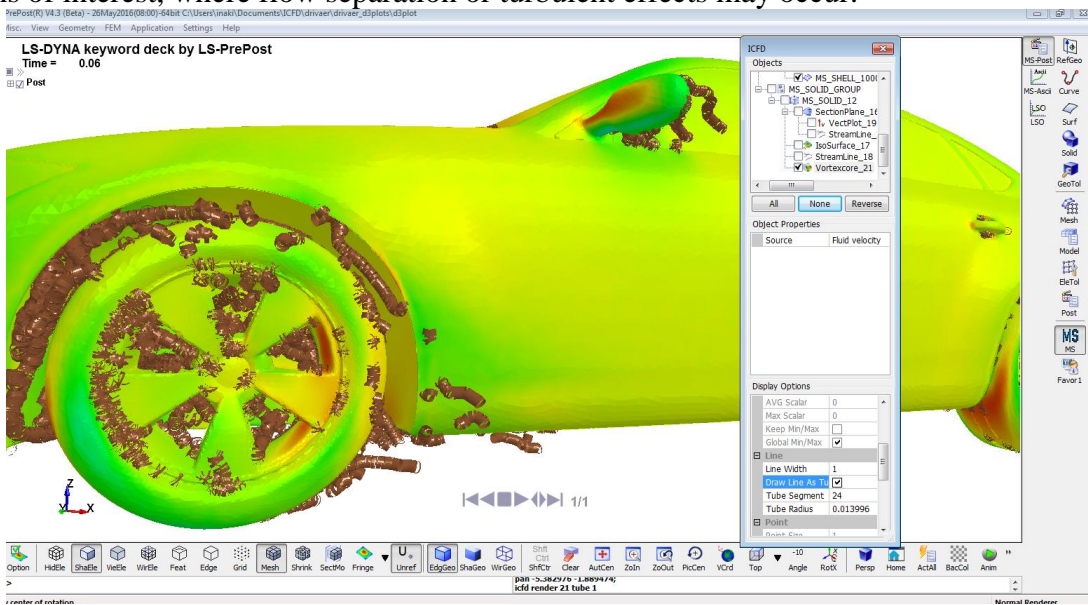

Data extraction is also made easier. In this case for example, the Pressure along the vehicle body is plotted function of the distance. This is a very typical CFD post-treatment.
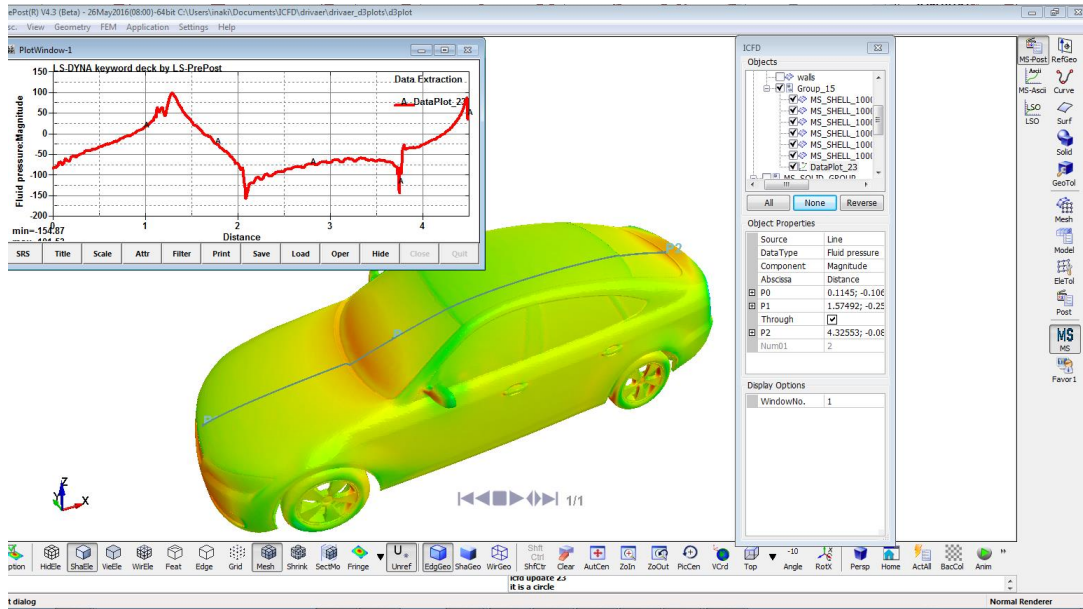
ICFD Pre Processor Introduction

A specific interface in order to set up a CFD input deck is also under development. It follows a similar Tree structure and it aims at providing the CFD user with a friendly environment to define his problem and allowing him to easily check his models for error and inconsistencies between keywords.
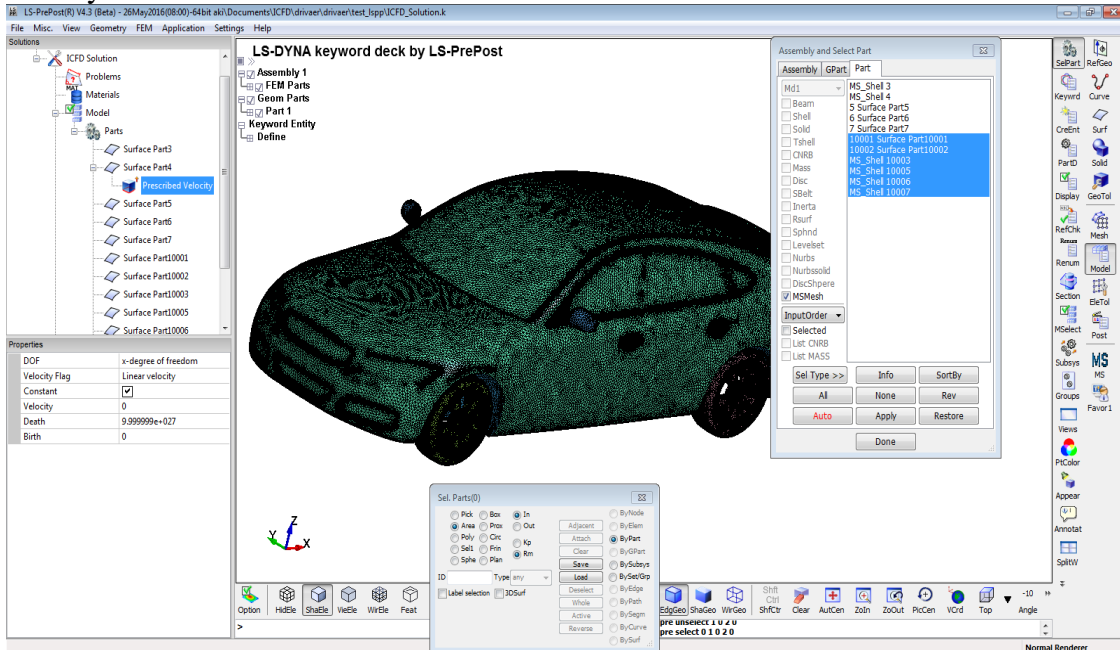
Summary

The ICFD Post-Treatment GUI has been implemented in LS-PrePost 4.3 providing users with flexible tools to analyze their CFD problems.

It is important to note that this CFD GUI is also compatible with EM outputs/ CESE outputs and also provides some post treatments for solid mechanics.

In parallel to the Post treatment GUI, a unique interface for setting up CFD problems is also under development