ICSC 2017

CAE for virtual product
CAE for innovation
CAE for process transformation

iconCFD

オープンソースベースCFDソフトウェア

～実際の適用事例とプロダクトの開発状況～

Introduction of the latest ennovaCFD

iconcfd
Modularized ● Industrialized ● Customized

Ennova
Scalable Simulation Delivered

Agenda

Ennova
Scalable Simulation Delivered

- Function of ennovaCFD
- Analysis example using ennovaCFD
  - Environment assesment analysis
  - Aero Dynamics with moving belt wind tunnel
  - Air multiplier with macro function
- ennovaCFD as a general meshing tool
- Next release

Function of ennovaCFD

- General function for pre/post processing
  - Geometry import
  - Repairing of geometry
  - Meshing
  - Analysis Setup
  - Post processing
- Special tool
  - Aero Dynamics tool
  - Evironment Assesment tool *
- Macro function and Batch run *

*v1.7 new release

We continue to improve on existing functions, especially improve mesher and geometry repairing tool.

Function of ennovaCFD（Cont.）

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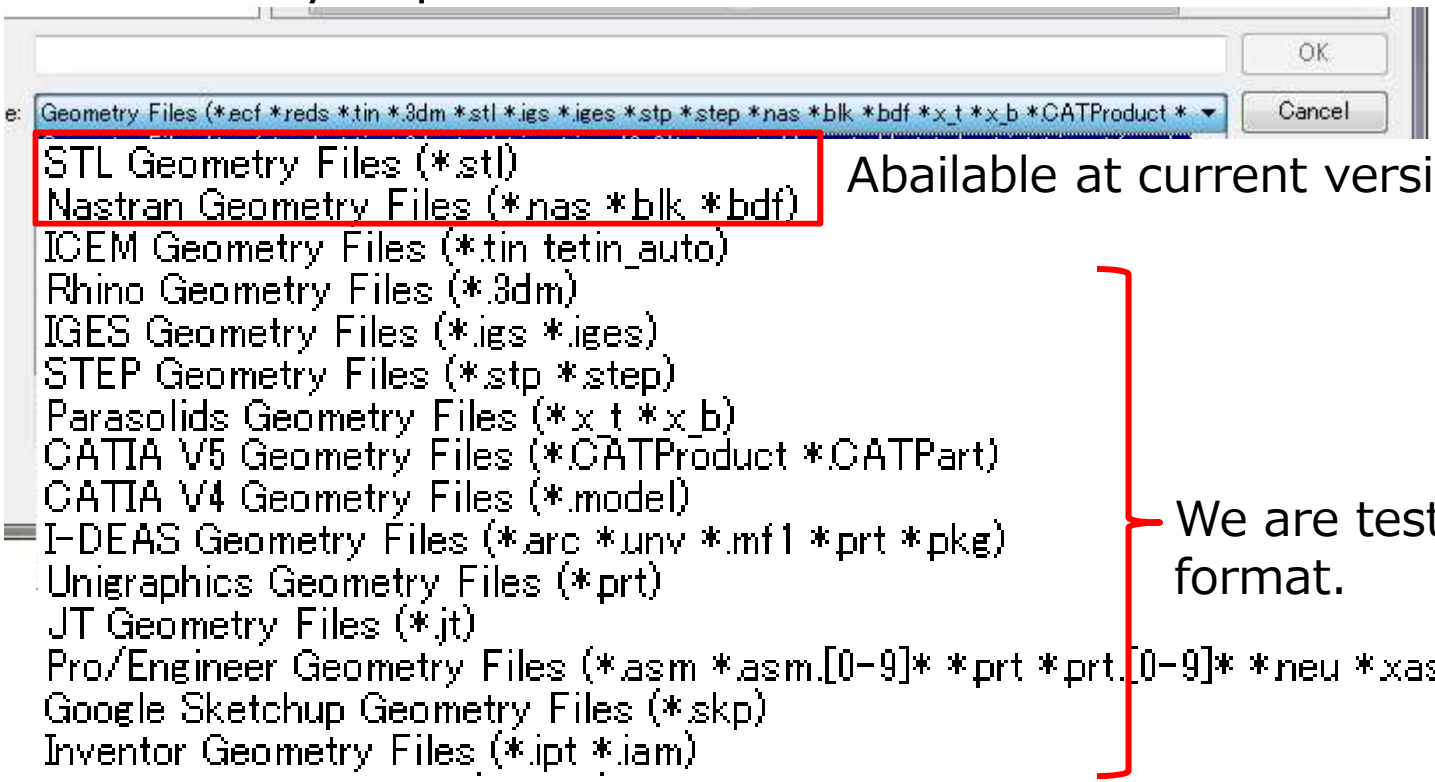
- Geometry import



Abailable at current version(V1.6)

We are testing these format.

In addition to intermediate formats such as STEP, IGES, Parasolid,ennovaCFD will be able to import the native format of CATIA,I-DEAS,UG,Pro-E.

Function of ennovaCFD（Cont.）

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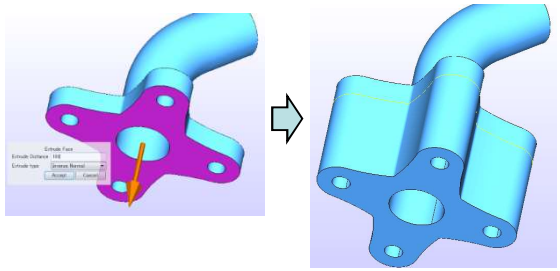
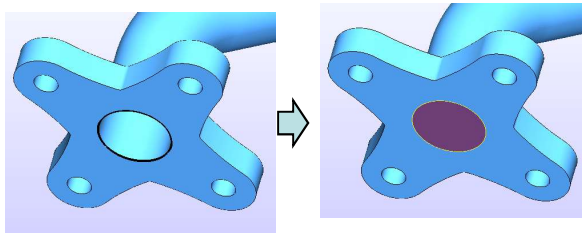
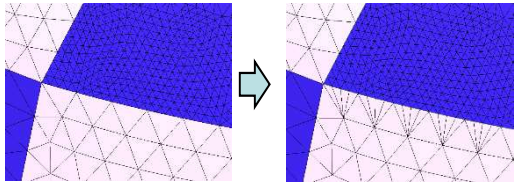
- Repairing of geometry
  - Even if there are incompleteness in the import data, it can be modified on ennovaCFD by using repairing function , such as face extrusion, edge zipping, hole filling, crossing face cutting, and primitive shape creation function.



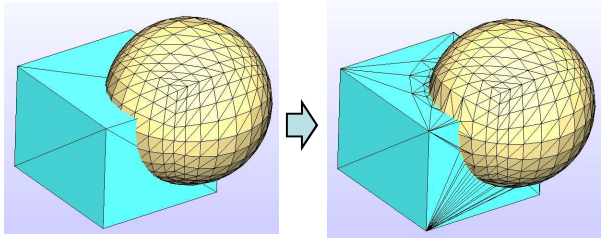
extrusion



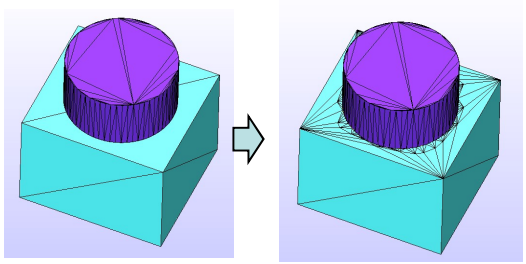
Hole filling



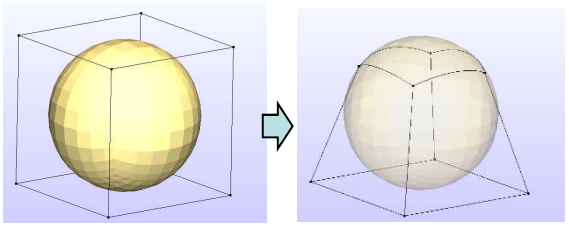
Edge zipping



Intersecting



Imprinting

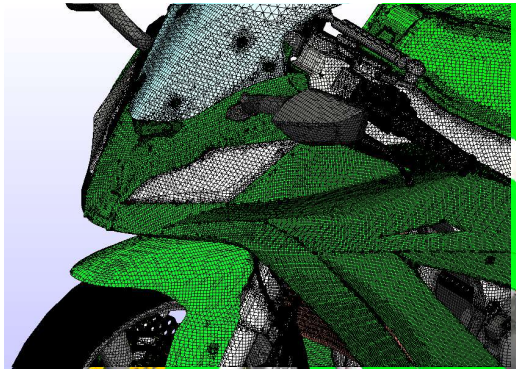


Projection of edge

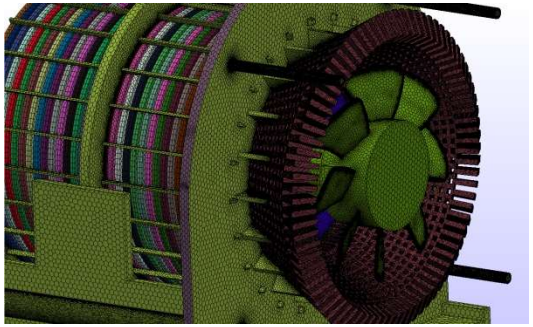
Function of ennovaCFD（Cont.）

Ennova
Scalable Simulation Delivered

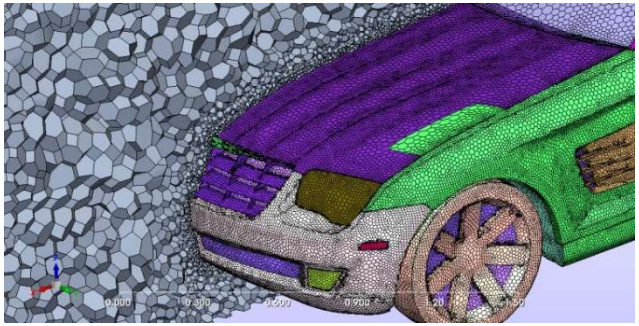
- Meshing



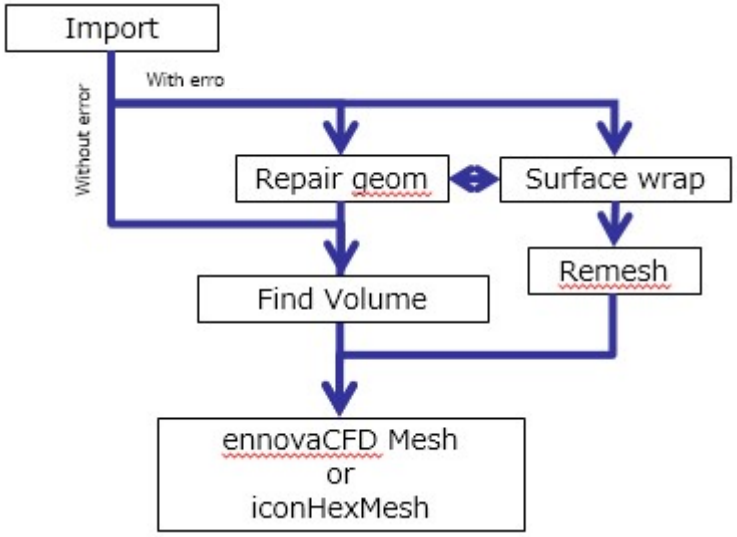
shrinkwrap Surface wrap

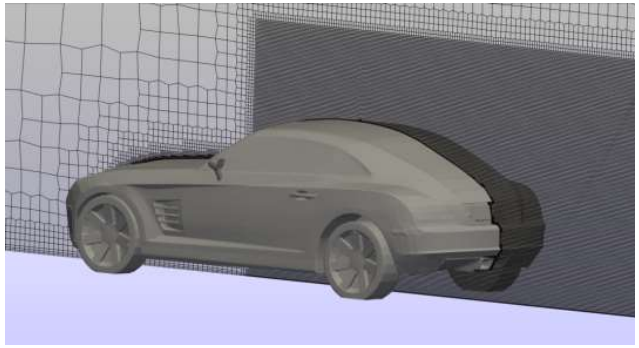


Tetra mesher



Polyhedral mesher





iconHexMesh

ennovaCFD has prepared multiple meshing approaches so user can choose the appropriate meshing approach for each theme.

Function of ennovaCFD（Cont.）

Ennova
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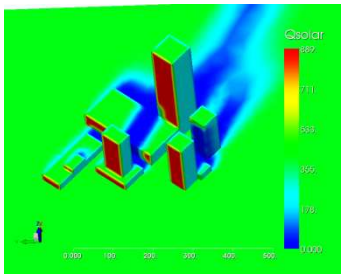
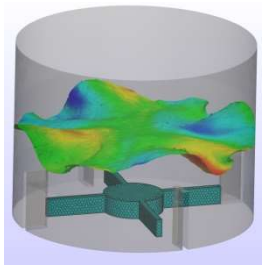
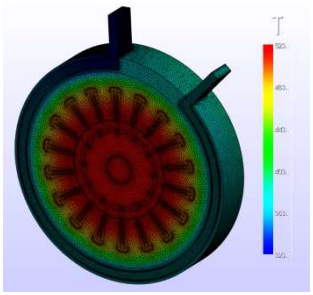
- Analysis Setup
  - Steady/Transient
  - Compressible/Incompressible
  - Turbulence model
    - RANS（Std k-ε、Realizable k-ε、k-ωSST、SpalartAllmaras ）LES、DES
  - SubModel
    - MRF,Porous,Heat Source
  - Conjugate heat transfer
  - VOF
  - Radiation
  - L2P
  - Sliding mesh



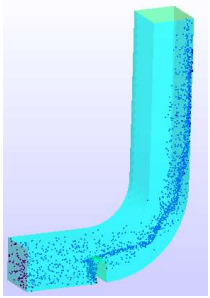
Radiation



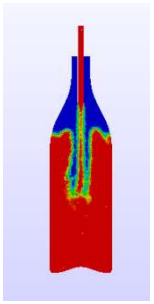
VOF+Sliding mesh



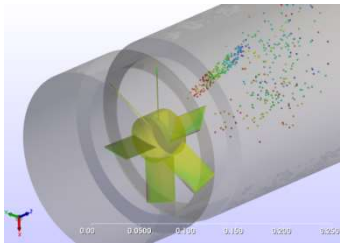
CHT



L2P



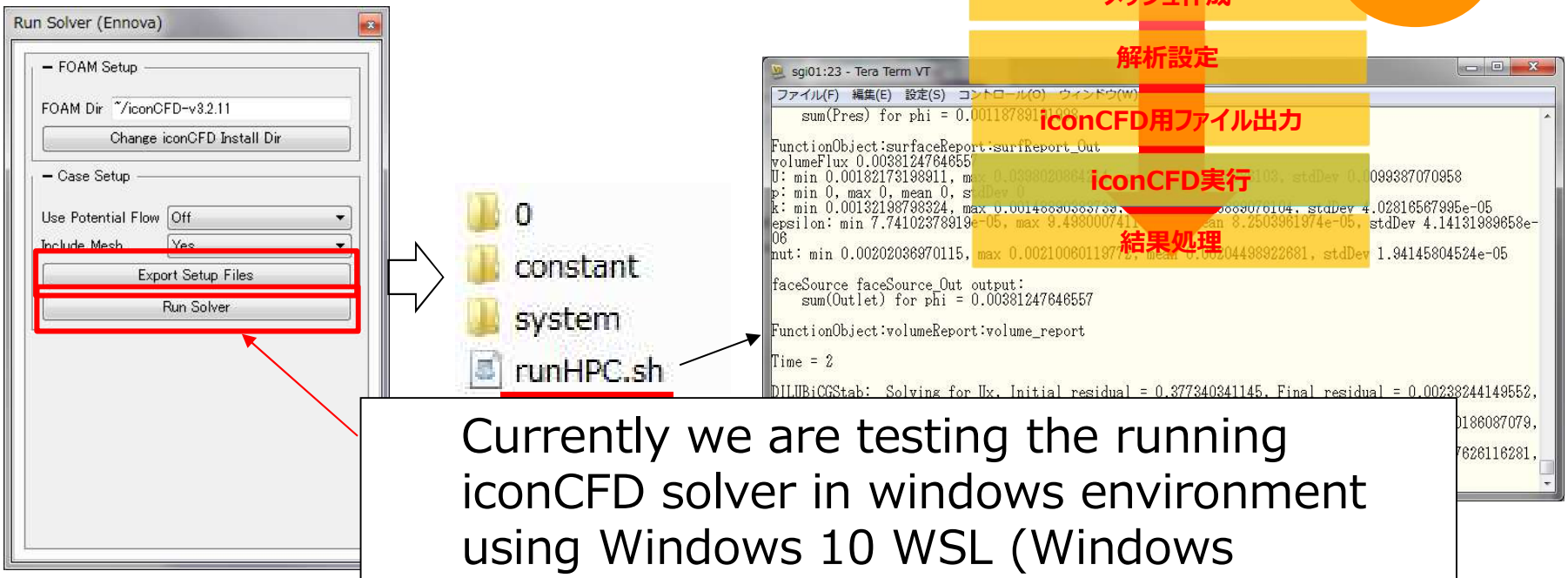
VOF



L2P+Sliding Mesh

Function of ennovaCFD（Cont.）

- Export iconCFD files and Run solver
  - It outputs the iconCFD file (mesh data, boundary conditions, properties, calculation parameters, etc.) and run script.
  - By executing the script, iconCFD solver is execut



Currently we are testing the running iconCFD solver in windows environment using Windows 10 WSL (Windows Subsystem for Linux).

Function of ennovaCFD（Cont.）

Ennova
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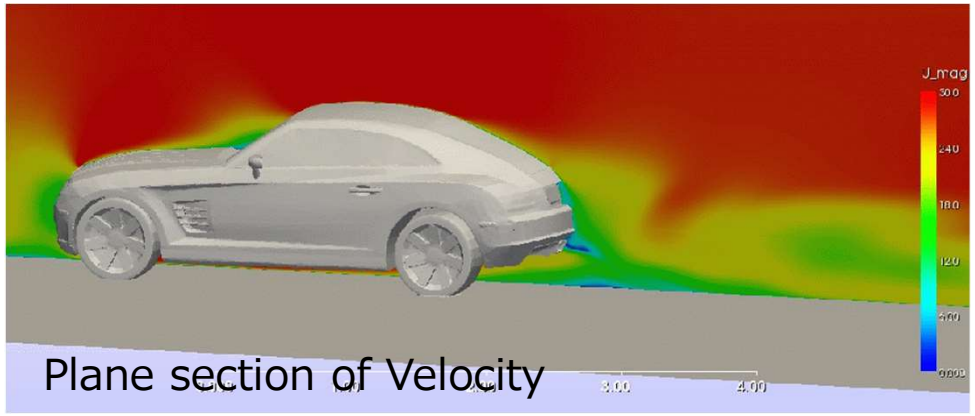
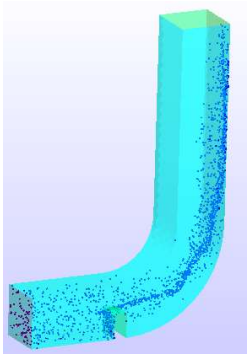
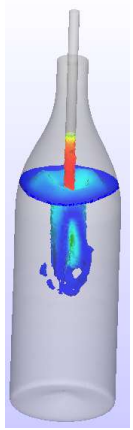
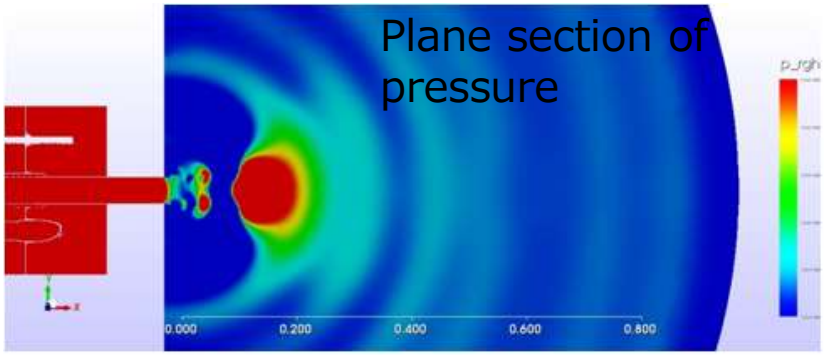
- Post processing
  - ennovaCFD has a standard post processing function, you can read the result file of iconCFD directly and visualize it.

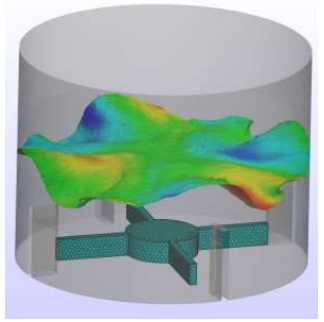


Plane section of Velocity


Droplet


Threshold




isoSurface

Analysis example using ennovaCFD ： Environment assessment analysis

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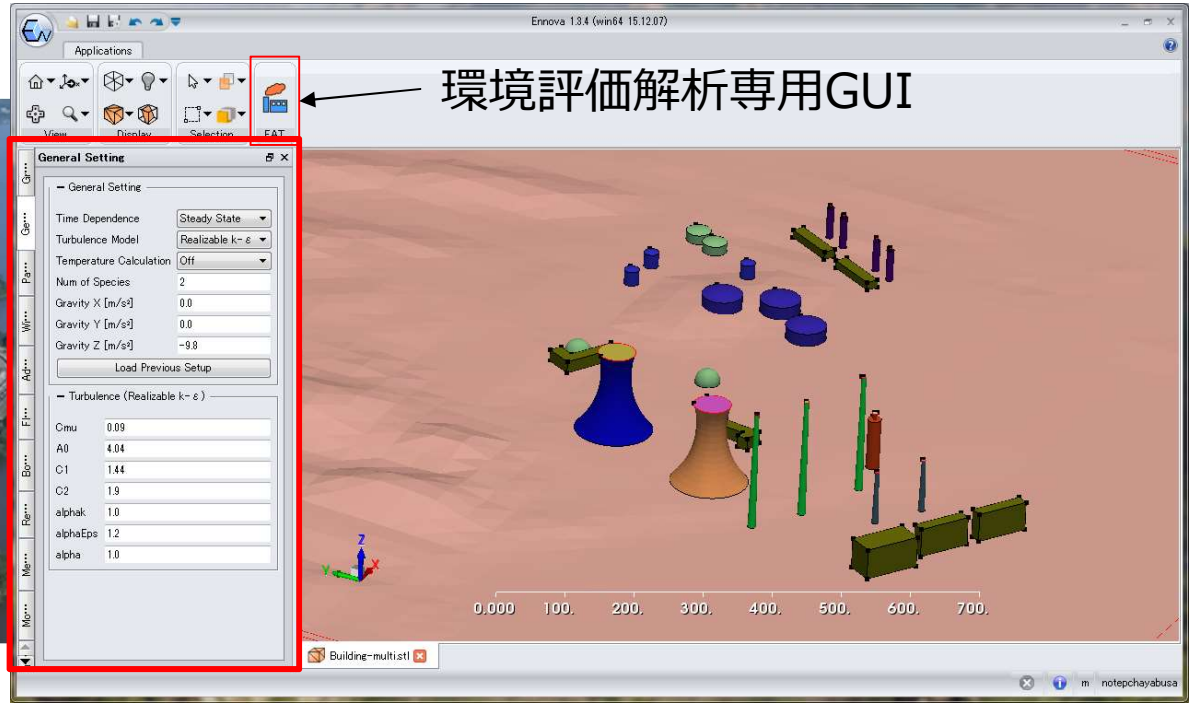
- Environment assessment analysis such as wind environment analysis around building is one of the analysis themes suitable for iconCFD because the calculation scale becomes huge.



Chalk Point power generation plant

引用論文：Robert N. Meroney, “CFD prediction of cooling tower drift”, *J. of Wind Eng. and Ind. Aerodynamics*, 94-6, pp. 463–490 (2006)

Analysis example using ennovaCFD ： Environment assessment analysis

Ennova
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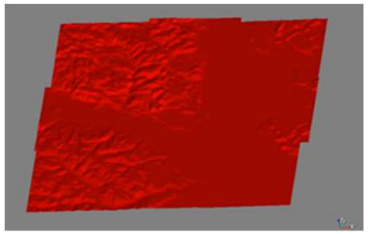
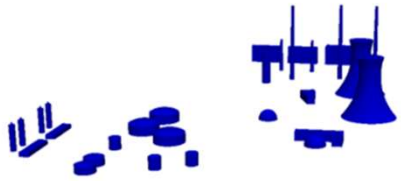
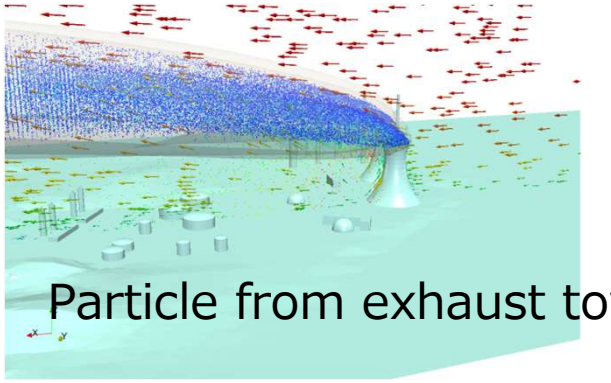
- Terrain data and building data are prepared, and it is read with a dedicated tool. By specifying the wind direction, EAT will automatically create an analysis area.
- In addition to flow calculation, diffusion of chemical species released from the exhaust tower and setting of particle calculation can be set easily.



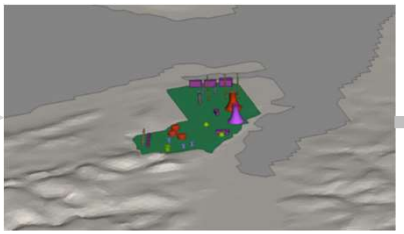
Terrain data



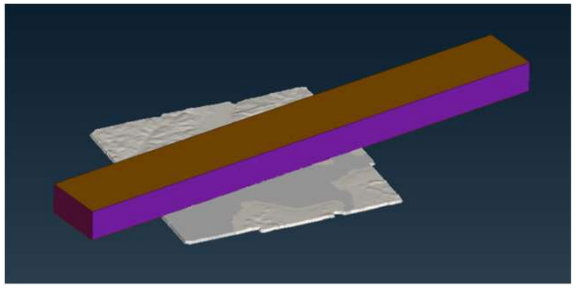
building data



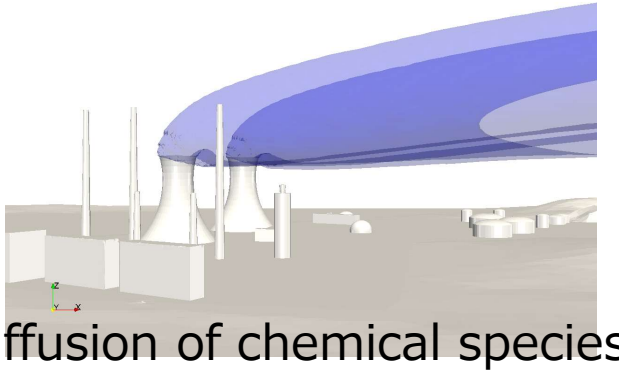
Particle from exhaust tower



Terrain ＋building



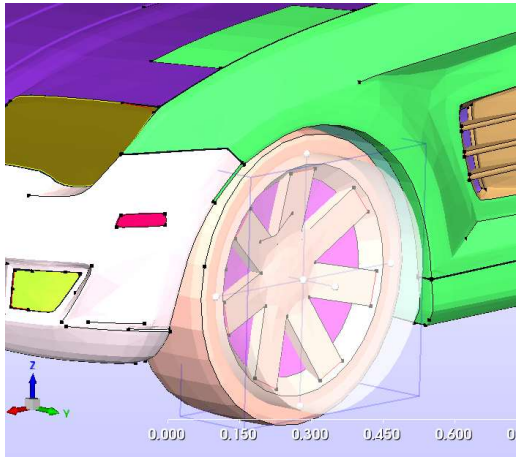
Terrain ＋building
＋ analysis domain



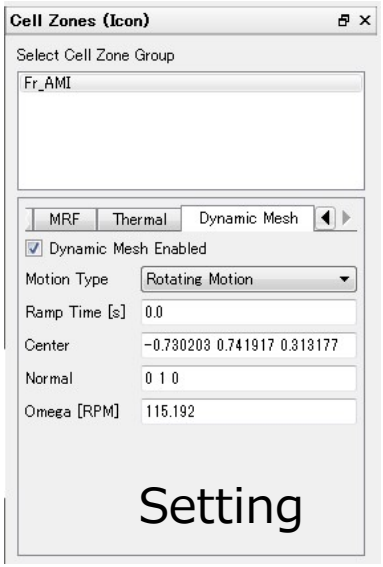
diffusion of chemical species

Analysis example using ennovaCFD ： Aero Dynamics with moving belt wind tunnel

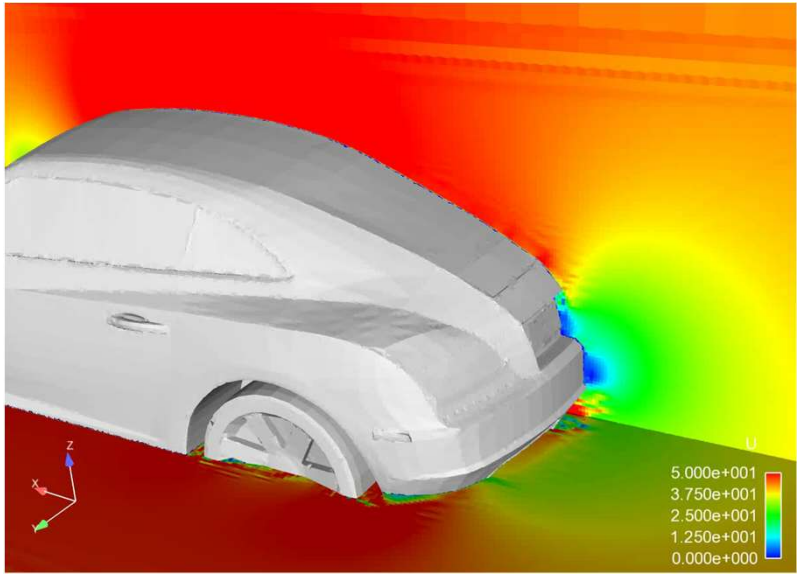
- Due to the amendment of the Fuel Efficiency Standards Law, demand for aerodynamic analysis corresponding to wind tunnel with moving belt is increasing.
- By considering the rotation of the tire with the sliding mesh, aerodynamic analysis corresponding to wind tunnel analysis with moving belt can be performed.



Creation of rotating domain



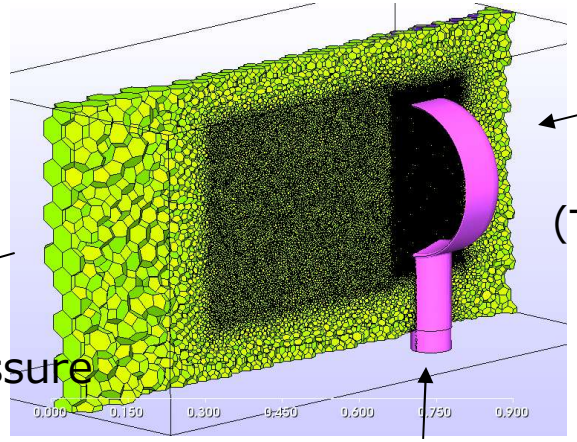
Setting



Velocity with tire sliding

Analysis example using ennovaCFD ： Air multiplier with macro function

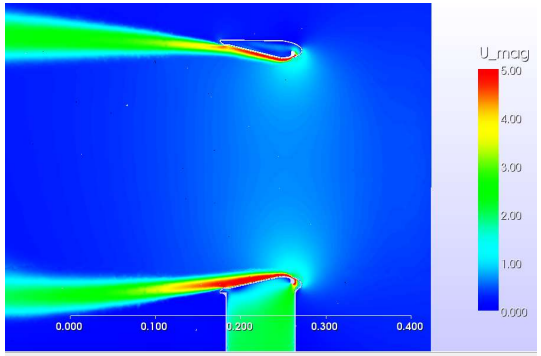
- The flow supplied from the inlet is discharged from the slit, and the flow rate is increased by involving the surrounding air. In the catalog, the flow rate at the outlet reaches about 15 times the inlet flow rate.



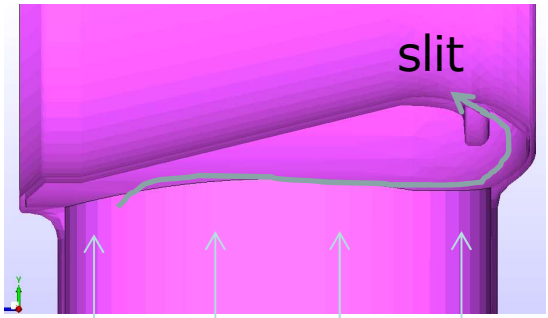
Suction (Total Pressure fixed)

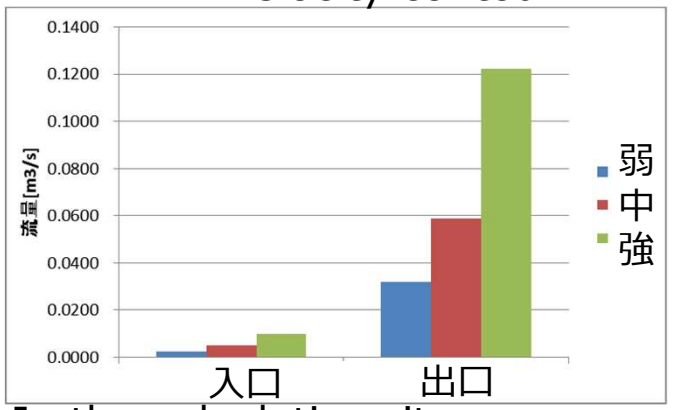
Outlet (Total pressure fixed)

Inlet（flow rate fixed)



Velocity contour

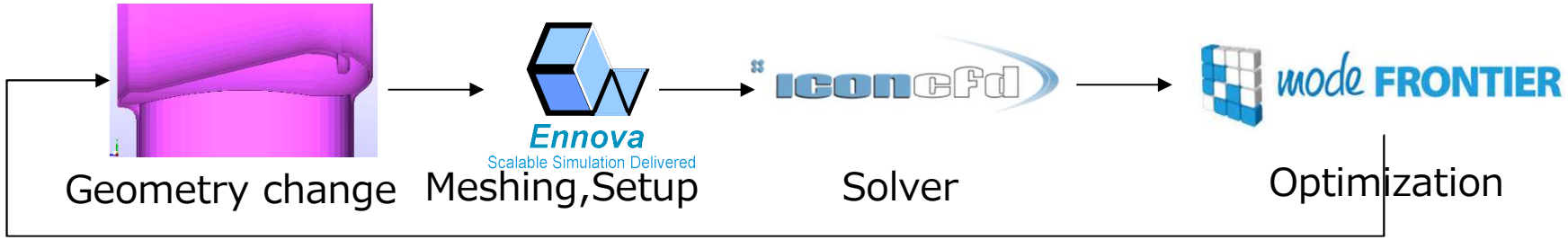




In the calculation, it was confirmed that the outlet flow rate increased about 12 times

Analysis example using ennovaCFD : Air multiplier with macro function

- Since enabling batch execution of ennova CFD from V1.7, it is also possible to parametric shape optimization by coupling with modeFrontier.
  - Cost function: maximize outlet flow rate, minimize pressure loss
  - Parameter: Slit shape (curvature, slit width, etc.)



- Macro function and batch execution (v1.7 release)
  - It is possible to output the history operated by the GUI to the macro file (.esf file).
- You can execute batch by using macro file.
  - % ennova - batch macro file name

ennovaCFD as a general meshing tool

- From V1.7 it is possible to output mesh file created with ennova CFD in ANSYS Fluent format (. msh file).

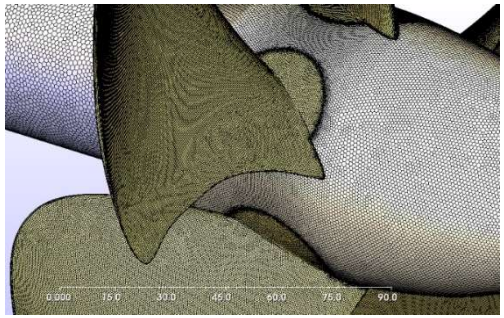
Ennova
Scalable Simulation Delivered

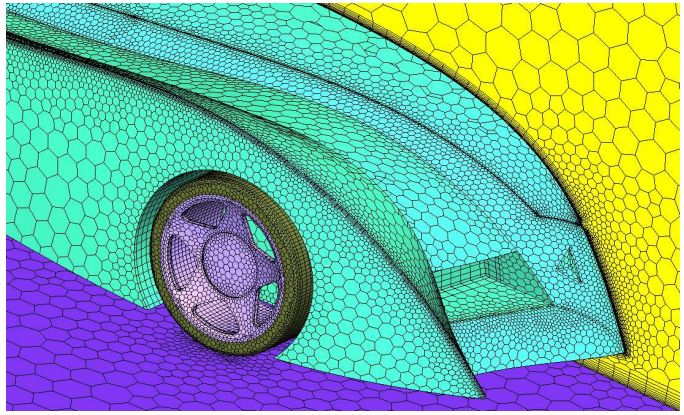
Meshing

iconCFD
Modularized Industrialized Customized

ANSYS

Solver





Next release

Ennova
Scalable Simulation Delivered

- V1.7 release (early next year)
  - Mesher, geometry correction tool Robustness improvement
  - Import of CAD (STEP, IGES, parasolid)
  - Output. msh file
  - WSL compatible
  - Macro function & batch execution

謝謝大家