
ESI Group의 OpenFOAM 솔루션 및 적용 사례 소개

한국 ESI
이동국 과장

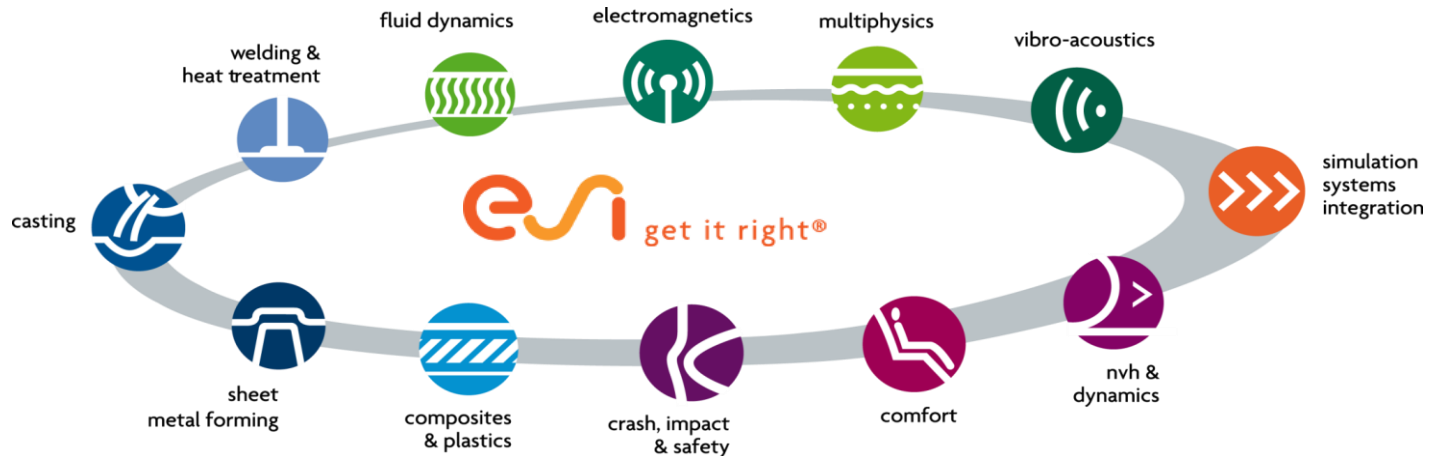
발표 내용 및 순서

- ESI Group 및 한국 ESI 소개
- ESI Group OpenFOAM 해석 사례
 - Aerodynamics
 - Underhood Cooling
 - Internal Flow
 - Aeroacoustics
 - OpenFOAM process build up
- ESI Group OpenFOAM Solutions
- Q&A

ESI Group 및 한국 ESI 소개

ESI Group

- 1973에 프랑스에서 설립되어 1985년 세계 최초로 자동차 충돌 해석 개발/수행
- 2016년 현재 전 세계 40여개국에 지사를 두고 전 산업 분야의 Virtual Prototyping (CAE) 솔루션 제공 중



한국 ESI

- 1995년 ESI France와 한국 ESTech 공동출자 법인 설립
- 서울 가양동 소재
- 상시직원 35명



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ESI OpenFOAM 솔루션

ESI Group의 OpenFOAM® Solution

1

- "Synergy" between ESI Group and OpenCFD Ltd

2

- Powerful User Interface for OpenFOAM, "Visual-CFD"

3

- OpenFOAM extension by using "Visual-Process(SDK)"

4

- OpenFOAM Cloud Solution, "ESI CLOUD"

1. OpenCFD in ESI Group

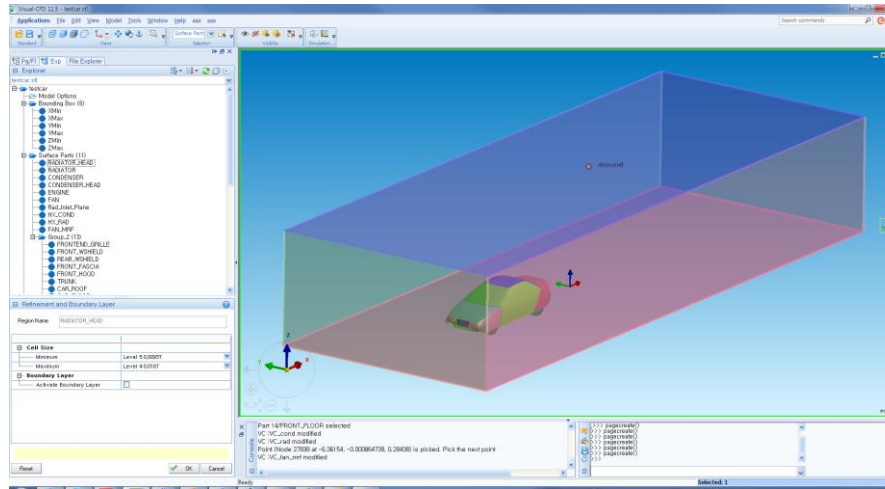
ESI Group과 OpenCFD사의 시너지

- Development Projects
 - OpenFOAM 코드 개발 (OpenFOAM 3.0+)
- Technical Support
 - 설치, 기술지원, 시스템 환경 지원
- Industrial Consulting
 - 특정 분야의 솔루션 제공
- Community Projects
 - 버그 수정, 기능 개발, 기능 통합 등
- Trainings
 - ESI Global Office와 연계되는 다양한 교육 제공
 - Basic(Foundation) / Advance / Industrial Solution
- Documentations
 - 고객 특화 매뉴얼 제공

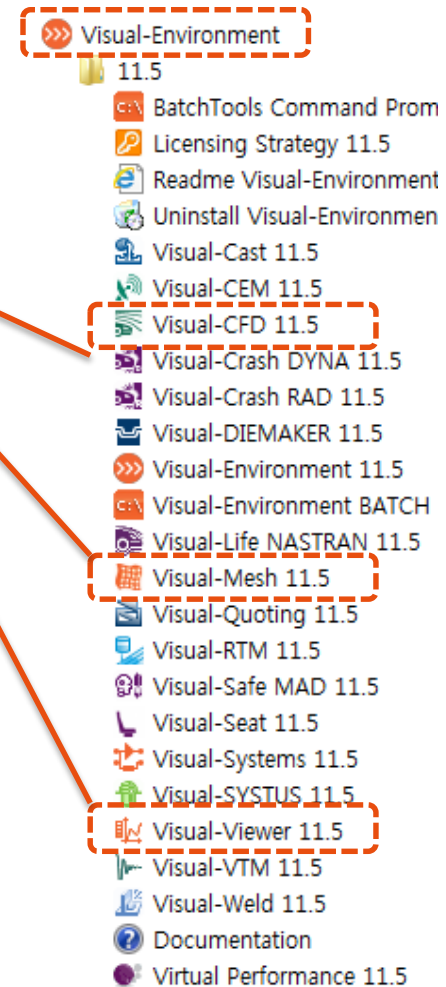
Aerodynamics
Aeroacoustics
Engines
Powertrains
Turbomachinery
Hydrodynamics
Fluid-Structure Interaction
Multiphase Flows
Combustion and explosions
Solid Mechanics
High Performance Computing

2. Visual-CFD

Visual Environment® 내의 OpenFOAM 인터페이스



- ESI 솔루션 통합 플랫폼 (Interface)
- GUI 작업만으로 OpenFOAM 전 해석 과정 수행
- 클러스터로의 Job Submission 기능
- 다양한 기능의 Pre / Post Processing
- 직관적인 UI 구성 및 편의성
- 검증된 User Interface
- 완전한 매크로 기능 및 Python 스크립트 지원
- GUI 각 기능 및 구성 사용자 설정 가능
- ESI의 다양한 솔루션과의 직접적인 연계 가능



2. Visual-CFD

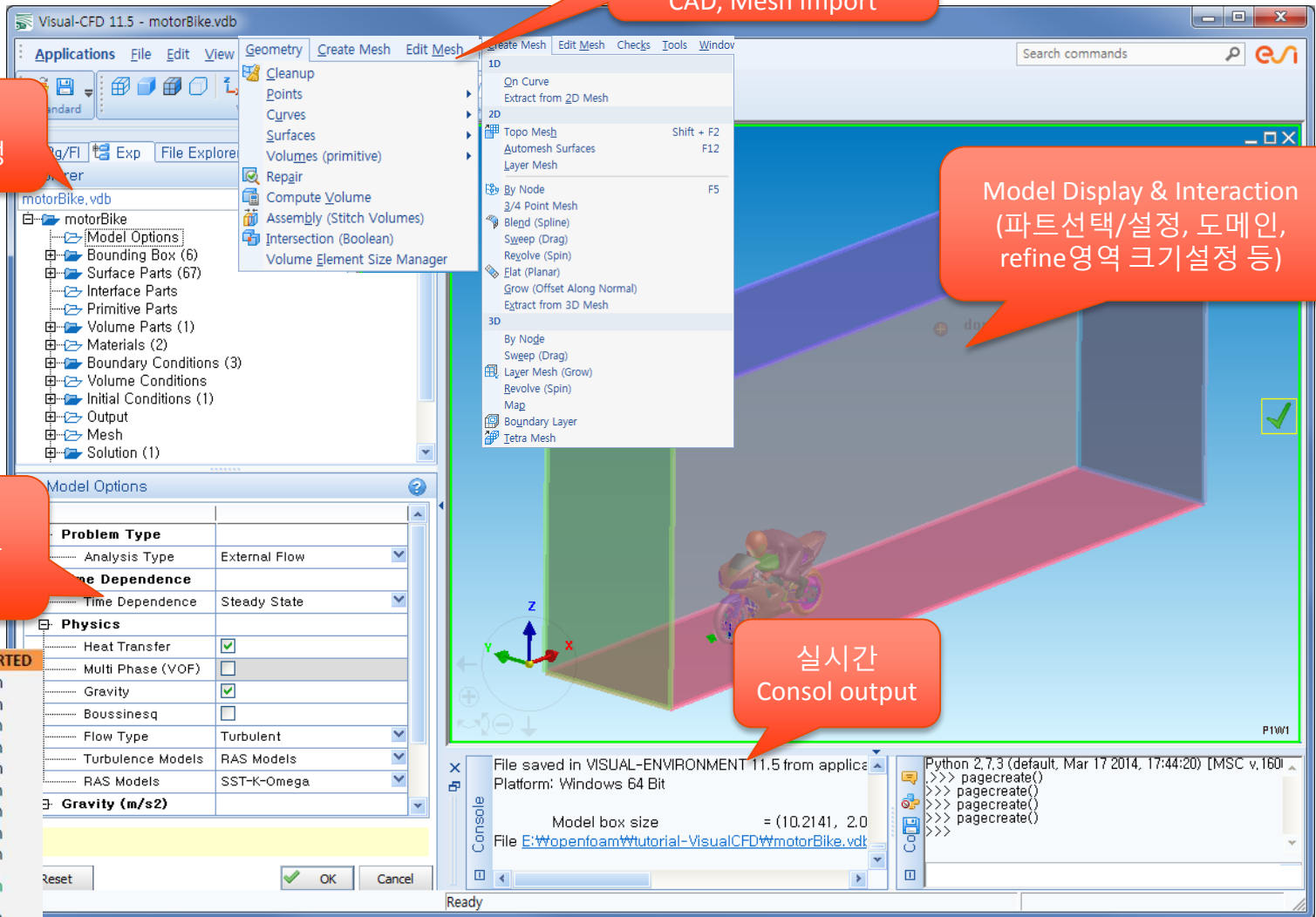
Geometry 생성/수정
표면격자 생성/수정
CAD, Mesh Import

Top-Down 방식의
직관적인 모델 설정

Model Display & Interaction
(파트선택/설정, 도메인,
refine 영역 크기설정 등)

OpenFOAM 모든
변수/기능을 GUI를
통하여 설정

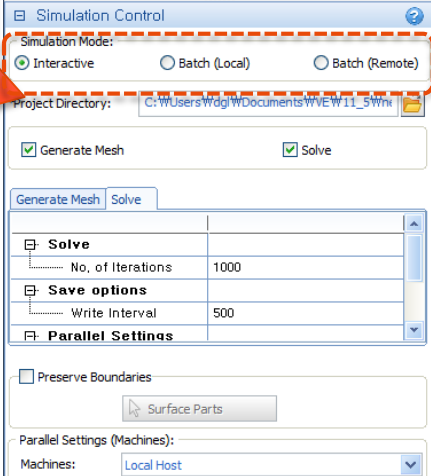
- LIST OF OpenFOAM® SOLVERS SUPPORTED**
- simpleFoam
 - pimpleFoam
 - rhoSimpleFoam
 - rhoPimpleFoam
 - buoyantSimpleFoam
 - buoyantPimpleFoam
 - buoyantBoussinesqSimpleFoam
 - buoyantBoussinesqPimpleFoam
 - interFoam
 - interDyMFoam
 - pimpleDyMFoam
 - chtMultiRegionSimpleFoam
 - chtMultiRegionFoam
- These cover most of the widely used



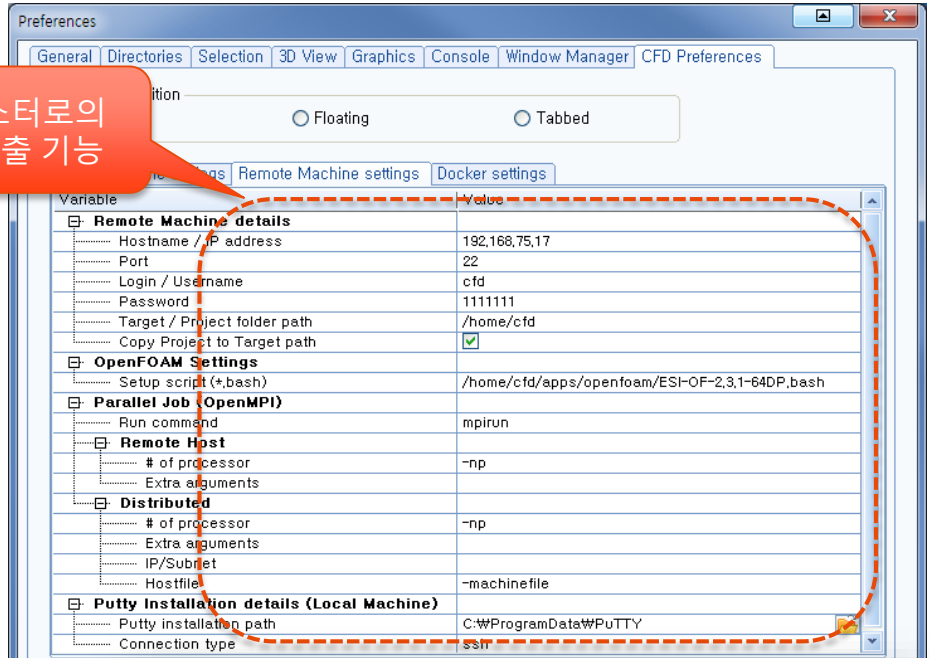
실시간
Consol output

2. Visual-CFD

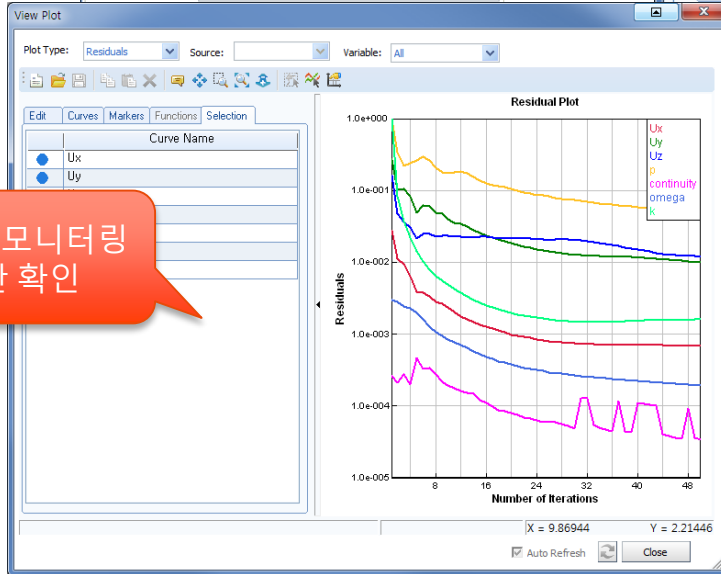
다양한 OpenFOAM
솔버 실행 방식



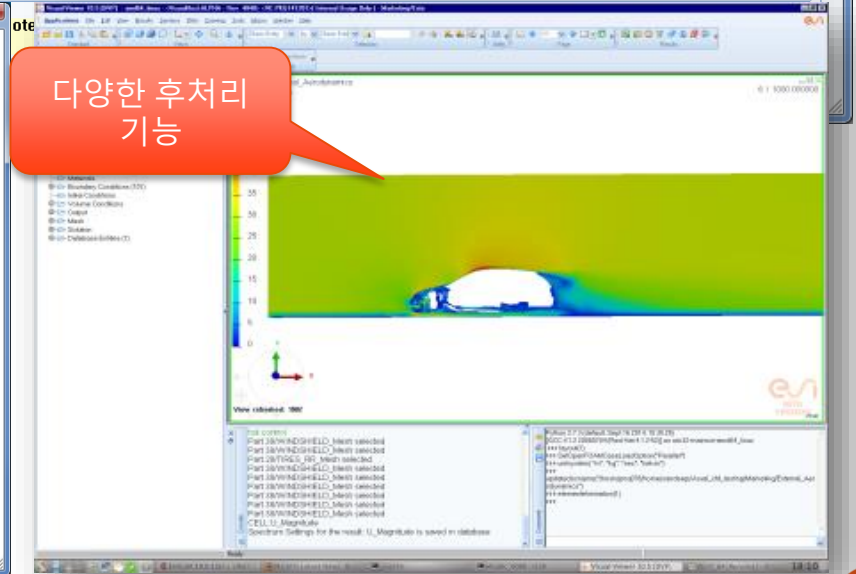
클러스터로의
Job 제출 기능



수렴변수 및 모니터링
값 실시간 확인



다양한 후처리
기능



2. Visual-CFD

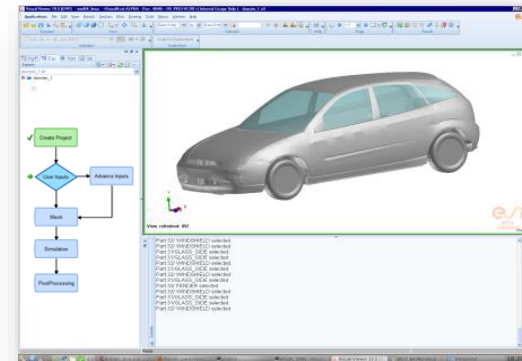
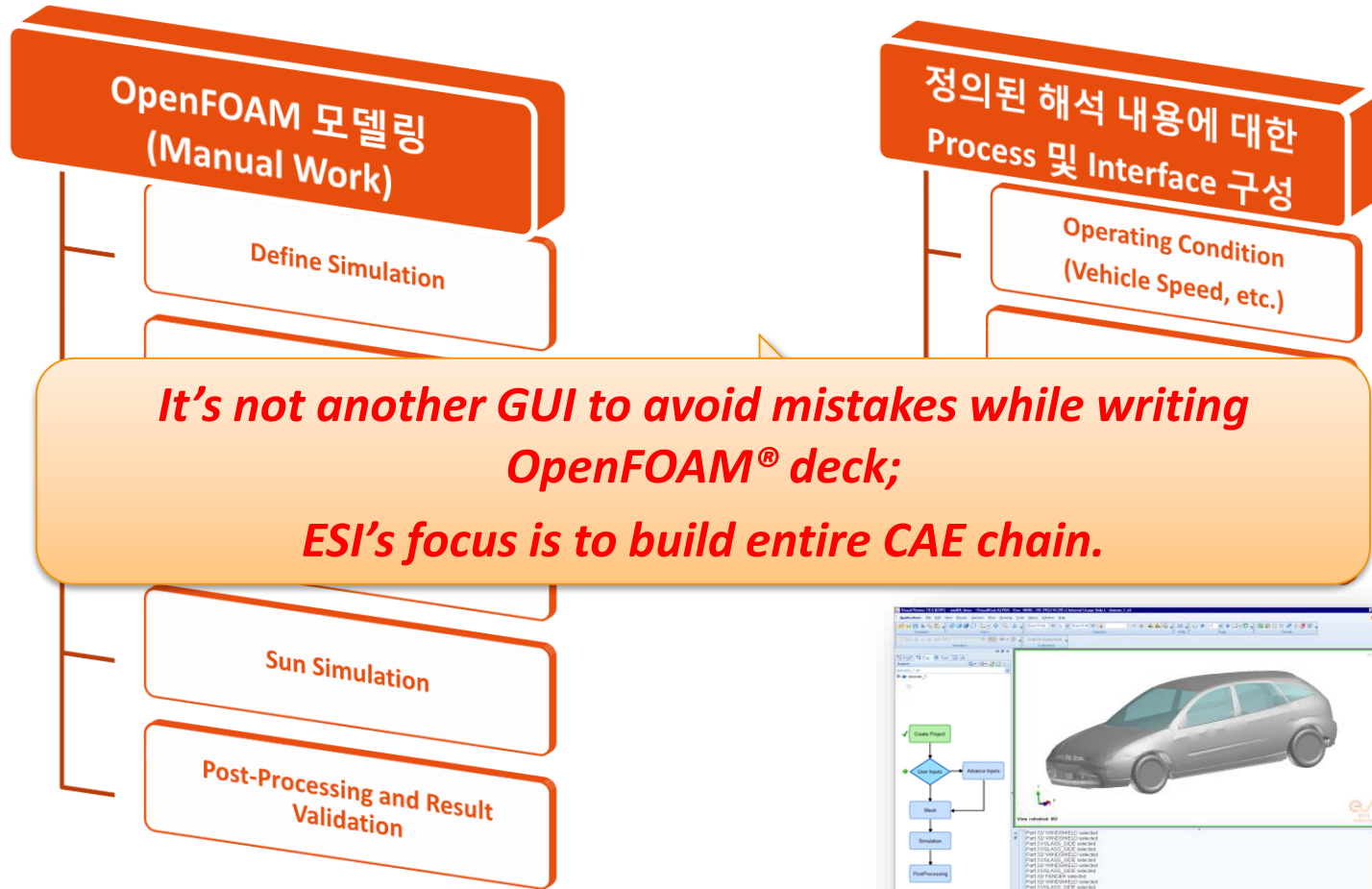
모든 작업의 Macro 자동 기록 및 기록된 Macro 실행

OpenFOAM 해석 폴더/파일 자동 생성

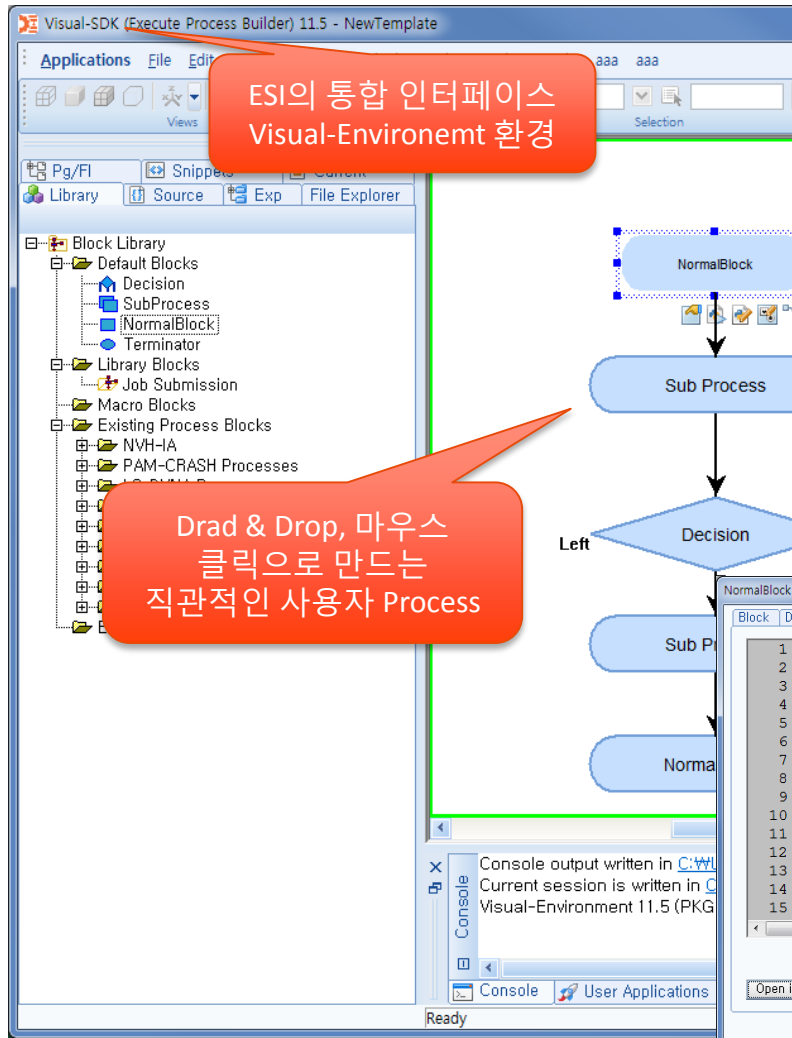
OpenFOAM의 폴더/파일 구조 및 변수값 직접 확인/편집 가능

3. Visual-Process (SDK)

Visual Environment[®] 내의 Process 자동화 Builder

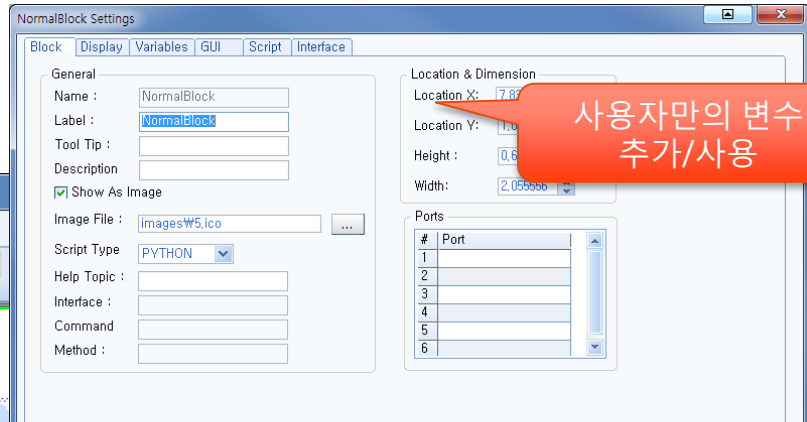


3. Visual-Process (SDK)

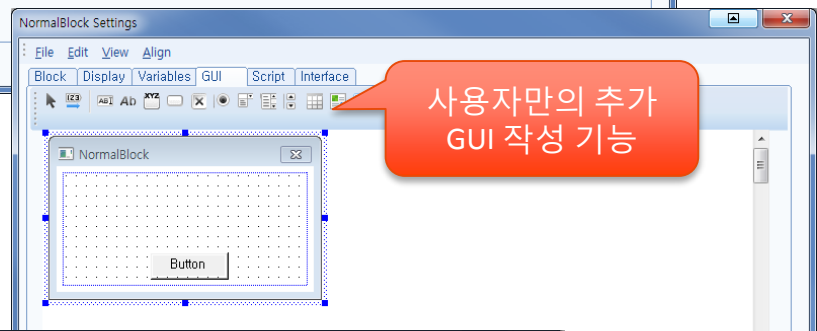


ESI의 통합 인터페이스
Visual-Environment 환경

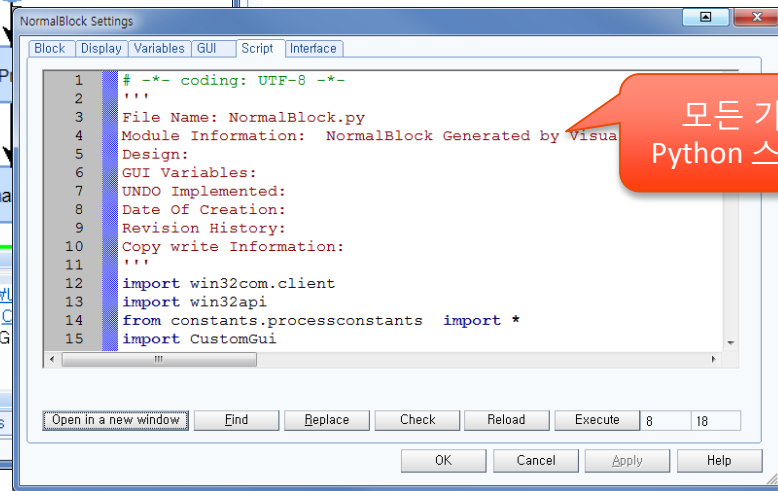
Drag & Drop, 마우스
클릭으로 만드는
직관적인 사용자 Process



사용자만의 변수
추가/사용



사용자만의 추가
GUI 작성 기능



모든 기능에 대한
Python 스크립트 지원

3. Visual-Process (SDK)

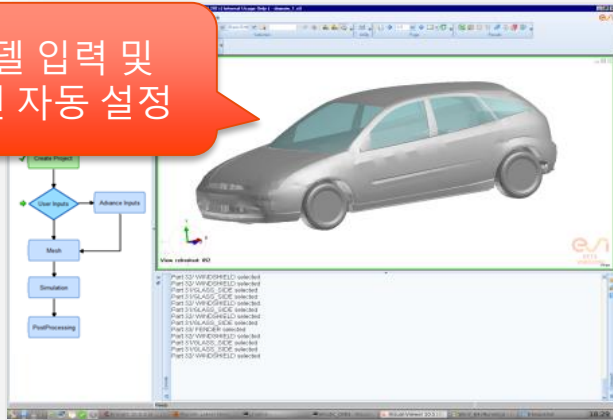
Visual-Process를 이용한 OpenFOAM 해석 자동화 사례

The screenshot displays the Visual-Process Executive 10.0 interface. On the left, a workflow diagram titled 'Marine' shows a sequence of steps: 'Create Project' (indicated by a green arrow), 'User Inputs', 'Advance Inputs', 'Mesh', 'Simulation', and 'PostProcessing'. A red callout bubble labeled '사용자 정의 Process' (User-defined Process) points to this diagram. The central 3D view shows a ship model with a coordinate system. A red callout bubble labeled '해석 모델 입력창' (Analysis Model Input Window) points to a 'Create Project' dialog box overlaid on the model. This dialog includes fields for 'Enter Case name' (test_case), 'Working Directory' (C:\Users\esipune\visua...), and 'Select Geometry File' (Browse). On the right, a 'Specific User Inputs' panel is shown, containing various parameters for the simulation, such as 'Ship speed' (3.0 m/s), 'Pitch Angle' (2.0 deg), 'Yaw Angle' (0.0 deg), 'Water Level' (0.45 times max height of ship), and 'Mesh Settings' (Surface Size on Ship body: Coarse to Fine). A red callout bubble labeled '해석 조건 입력창' (Analysis Conditions Input Window) points to this panel. The bottom console window shows the following text: 'Reading STL data in ASCII format..', 'Reading solid hull_bottom', 'Reading solid hull_top', 'Reading solid hull_back', 'MODEL STATISTICS', 'Nodes = 58033', '2D Elements = 116062', 'Tria = 116062', 'Parts = 3', 'Model box size = (6.27559, 0.858505, 0.572322) Diagonal length =', and 'File C:\Users\esipune\FILES\DTC_in_m.stl loaded'. A message at the bottom of the console says 'Please update your graphic card to benefit from our optimized rendering'.

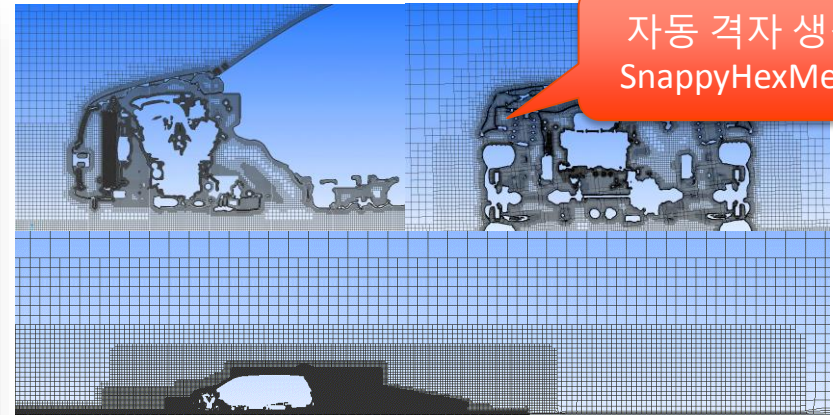
3. Visual-Process (SDK)

Visual-Process를 이용한 OpenFOAM 해석 자동화 사례

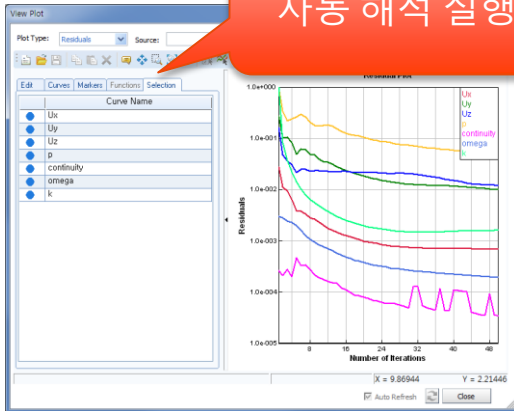
해석 모델 입력 및
해석 조건 자동 설정



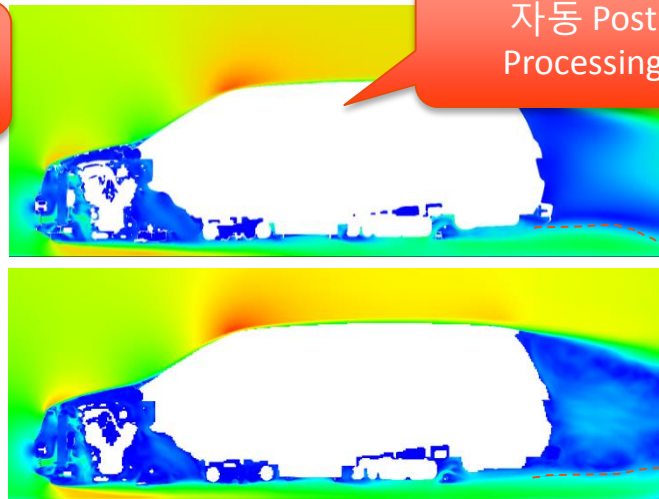
자동 격자 생성
SnappyHexMesh



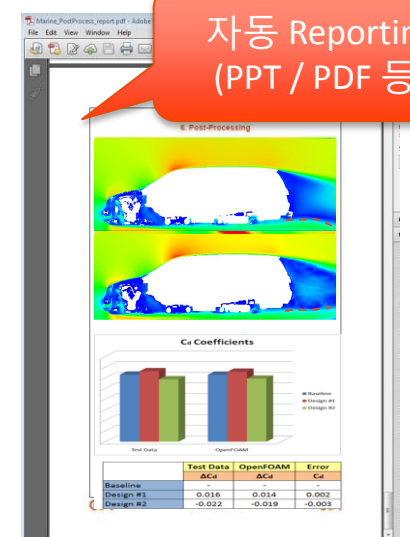
자동 해석 실행



자동 Post
Processing



자동 Reporting
(PPT / PDF 등)



4. OpenFOAM Cloud Solution



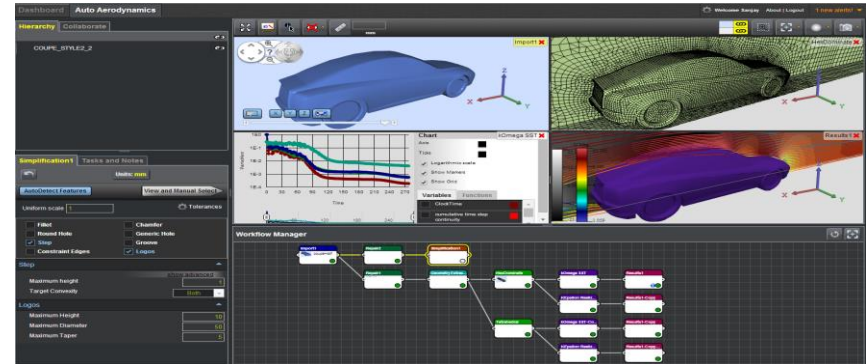
4. OpenFOAM Cloud Solution

ESI Could Solution

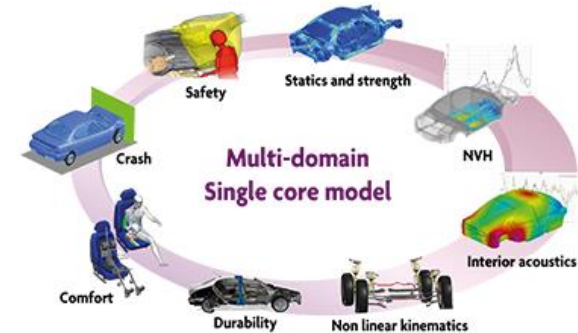


cloud.esi-group.com

- ESI Total Solution through Web Brouser
- HPC Platform Accessibility
- Application
 - ▶ CFD (OpenFOAM)
 - ▶ Virtual Performance (Pam-Crash)
 - ▶ Data Analytics (MineSET)
- Framework



- Model Preparation
 - CAD Import, Geometry repair, Meshing, Solver, Results processing
 - Highly scalable
- Client & Server Side rendering
 - 3D remote visualisation of large data-sets
 - Parallel rendering
 - Simultaneous viewing of animations
- Collaboration
 - Real-time sharing



4. OpenFOAM Cloud Solution

Account Plan



Free

SUBSCRIPTION FEE

Free

CPU HOURS

Up to 50 core/hours

NUMBER OF USERS

One

NUMBER OF NEW SIMULATIONS

Up to 4 simulations

DISTRIBUTED PROCESSING

Up to 4 cores per job

NETWORK SPEED

STORAGE

Up to 4 GB

MODELING



REAL-TIME COLLABORATION



VISUALIZATION



Create Account



Professional

Starting at 1300 €

Up to 2000 core/hours

One

Unlimited

Up to 64 cores per job

Up to 10 Gbit/s

Unlimited



Contact us



Enterprise

Contact us

-

Unlimited

Unlimited

Unlimited

Up to 10 Gbit/s

Unlimited



Contact us



For more information, please contact ESI Korea
dong-guk.lee@esi-group.com