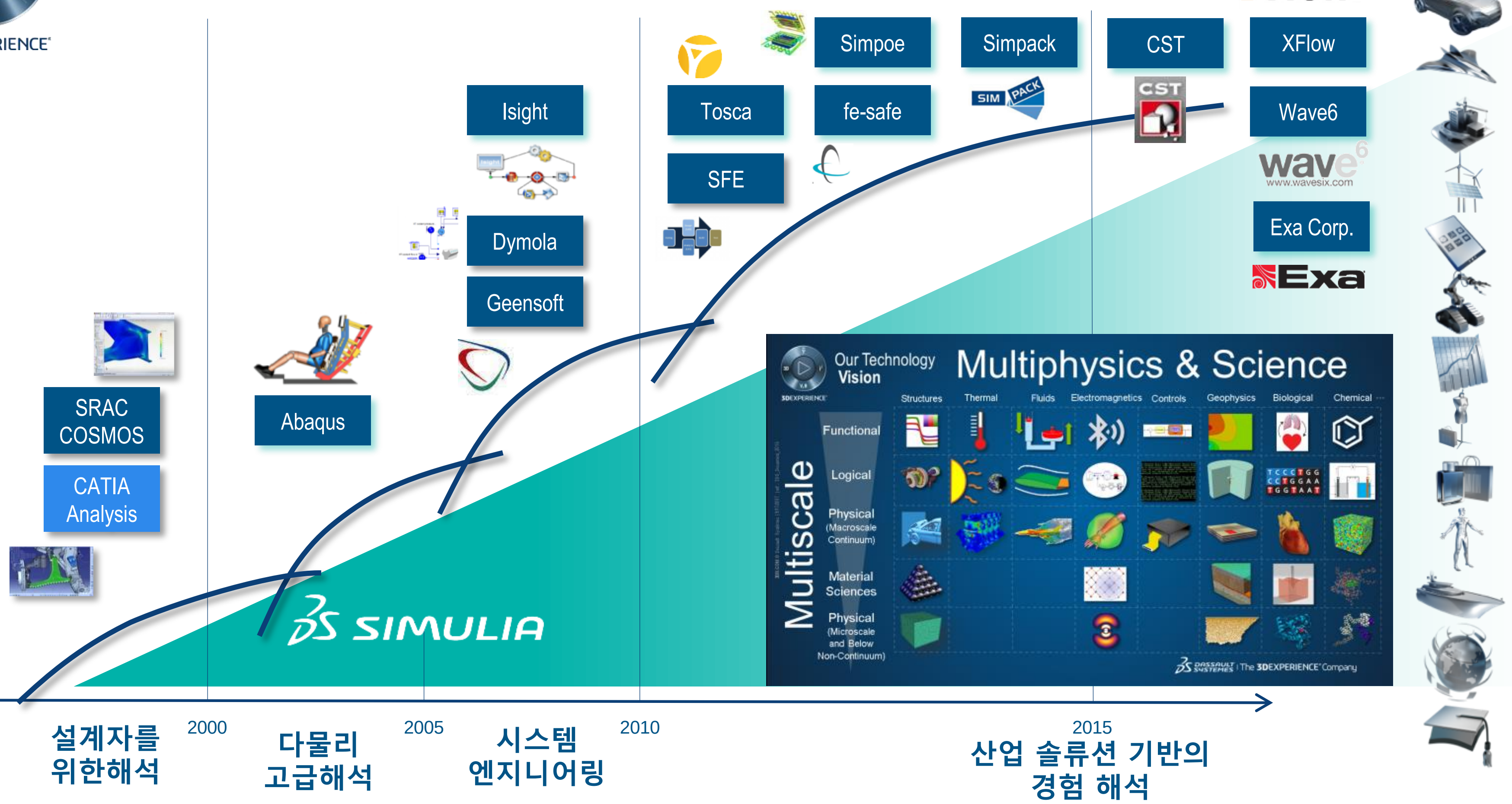
3DEXPERIENCE®

SIMULIA 포트폴리오

Dassault Systemes SIMULIA

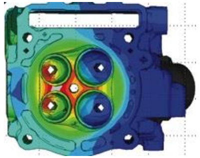
구승희
Seunghoi.ku@3ds.com

최고의 시뮬레이션을 위한 SIMULIA



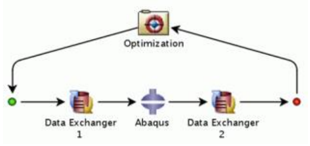
An Unrivaled Suite of Simulation Tools

Abaqus



유한 요소 해석
멀티스케일 시뮬레이션

Isight



프로세스 자동화 및
최적화(PIDO)

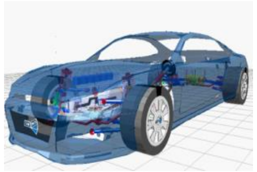
Tosca

비-파라메터
형상 최적화

fe-safe

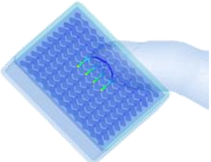
내구 및 피로
평가

Simpack



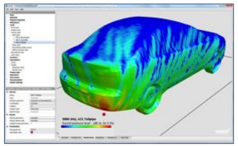
다물체 동역학

CST



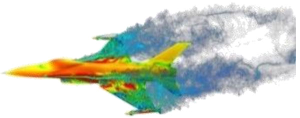
전기 전자
시뮬레이션

Wave6



진동-소음
시뮬레이션

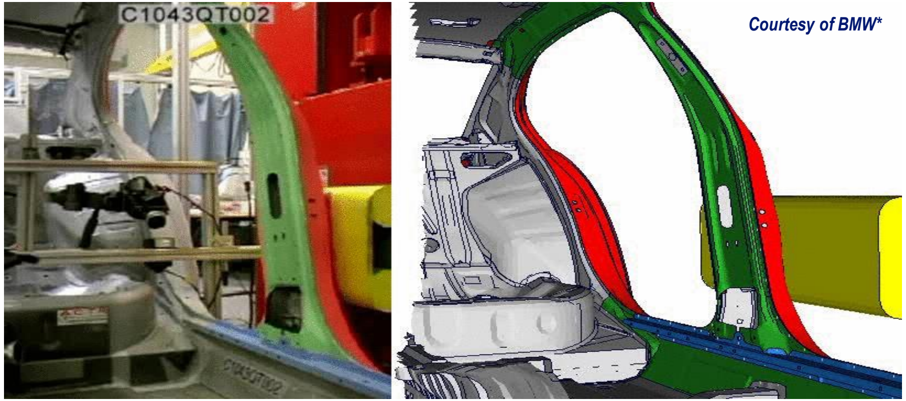
XFlow



래티스 볼츠만법
(무요소법)유동해석

Abaqus

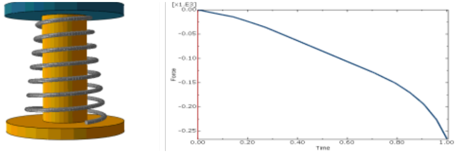
비선형 해석 솔루션



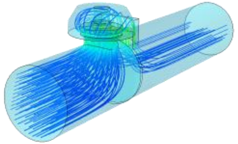
Leading companies take advantage of Abaqus Unified FEA to:

- Consolidate processes and tools
- Reduce costs and inefficiencies
- Decrease FEA toolset and training expenses
- Achieve greater efficiency in model generation
- Improve correlation between test and analysis results
- Facilitate data transfer between simulations
- Build a more flexible workforce with greater bandwidth for innovation

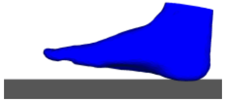
Why Abaqus?



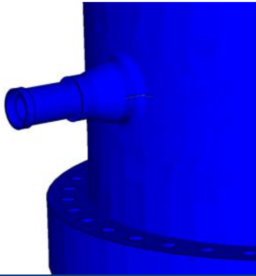
1. **비선형**: 접촉 및 대형 어셈블리분야에서 신뢰도 높은 결과 제공
2. **통합해석 환경**: 구조, 열 분야에서의 Implicit 와 Explicit 및 CFD(~2016 version), EM등의 다물리(Multi-Physics) 분야에 추가 비용 없이 사용 가능



3. **고성능 컴퓨팅**: HPC, Multi-GPU 지원
4. **자동화 해석**: 사용하기 쉬운 전후처리기인 Abaqus/CAE를 이용하고 Python을 통한 GUI 자동화를 통해 프로세스 구축
5. **포괄적인 문제 정의**: 다른 S/W가 수행하지 못하는 까다로운 문제(서브루팅을 사용한 다양한 재질 및 FE 모델 정의)를 구현 가능
6. **파괴역학**: 고급 손상 및 파괴 모델 정의

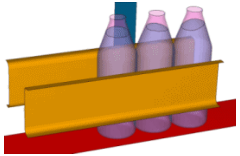


7. **CAE 통합**: CATIA, SOLIDWORKS 외의 다양한 CAE Tool과 Direct, Indirect 통합
8. **범용성**: 내구(fe-safe), 다물체동역학(SIMPACK), 최적화(Isight, TOSCA)등과 연계

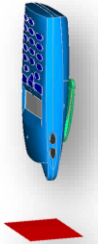


산업별 적용 분야

Consumer Packaged Goods
플라스틱과 유리 성형
컨베이어 시스템
컨테이너 낙하
압력/열 해석
병 밀봉 해석
접착제

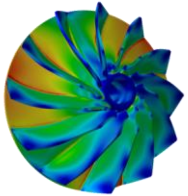


High Tech
납땜 열하중
낙하 해석
진동 해석
반도체
회로
휴대장치
컴퓨터와 주변기기

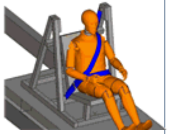


Life Sciences
피부 모델링
수술 장비
스텐트
약물 이송
골격
의료 포장

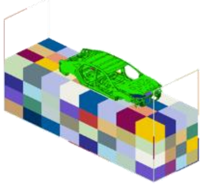
Aerospace & Defense
항법장치
Landing Gear
항공기 구조
항공기 엔진
복합재
방산 시스템
우주선 시스템



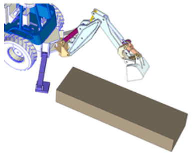
Automotive & Transportation



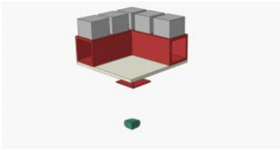
샤시 & 차체
타이어
내장재/충돌
브레이크
파워트레인
전장



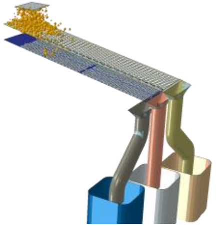
Industrial Equipment
비선형/열 해석
반복 하중
다물체 동역학
토양-구조 해석



Energy
굴착 파이프라인 wave load
파이프/압력 용기
열 해석
폭발/충격/낙하

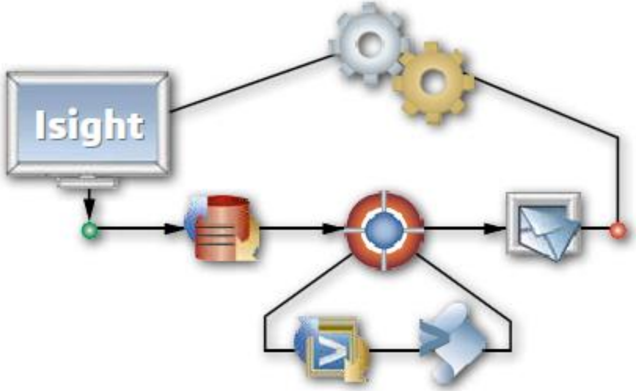


Architecture & Construction
내진/내열 해석
콘크리트 구조
침하/파괴



Isight

설계 탐색과 최적화를 자동적으로 수행

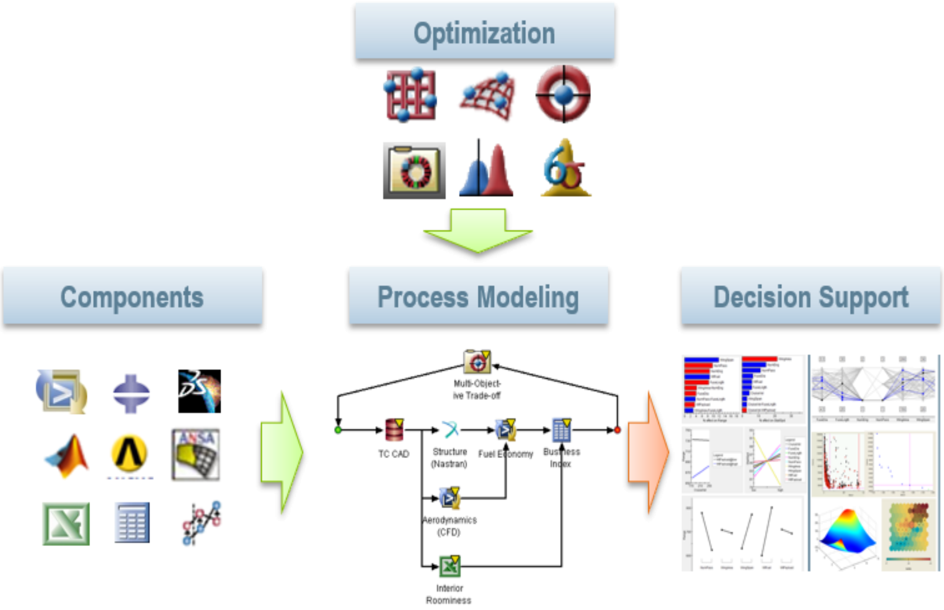


Isight makes your job easier:

- Easily automate simulation process flow
- Leverage advanced techniques such as design of experiments (DOE), design for Six Sigma
- Optimize your designs for cost, weight, materials and more
- Engage your hardware and computing resources at optimum levels
- Integrate seamlessly with your enterprise Web application servers and databases
- Shorten design and delivery cycles

Isight 프로세스 통합과 설계 최적화 (PIDO)

- 손쉽게 다른 해석 툴을 통합
- 해석 프로세스 플로우를 자동화
- 전체 매개 변수의 공간 탐색
- 고급 기술을 이용한 설계 최적화
- 효율 개선
- 제품 설계 가속화
- 수작업에 의한 오류 감소
- 더 많은 대안 분석 검토



Tosca

구조 설계와 유동 흐름 시스템의 최적화

Optimized product performance

Images courtesy of Adam Opel AG.

The benefits of using Tosca Structure and/or Tosca Fluid are many:

- Accelerate conceptual design and reduce time-to-market
- Support ready-to-manufacture product design
- Save weight and ensure the highest result quality for reliable components
- Avoid error-prone, time-consuming model simplification
- Apply realistic simulation and handle nonlinearities directly within the optimization
- Define optimization tasks interactively in intuitive graphic user interfaces
- Create fluid-flow devices with reduced pressure drop and improved flow uniformity

Tosca 구조 설계와 유동 흐름 시스템의 최적화

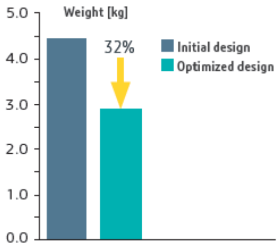
혁신적인 설계

제품 개발 가속

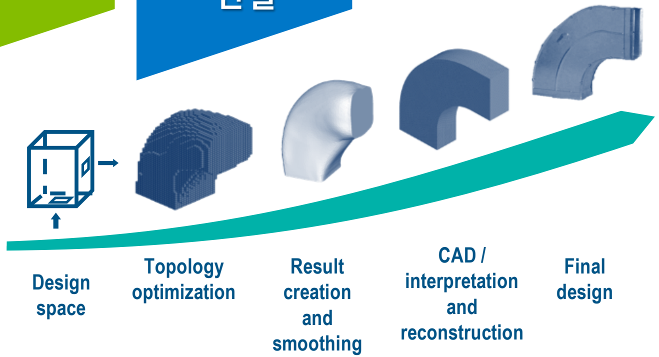
비선형을 고려한 현실적인 최적 결과

설계 최적화를 위한 완전 설계 자유

선도적인 FEA/CFD 솔버를 이용한 완전 연결



Courtesy of GF Automotive

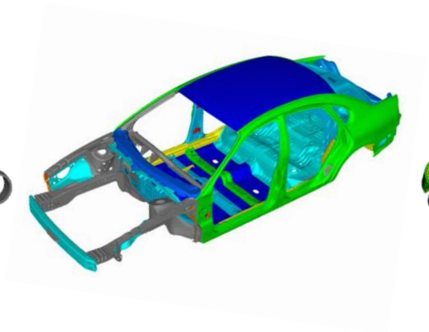


Tosca 최적화 모듈

Tosca Structure Topology

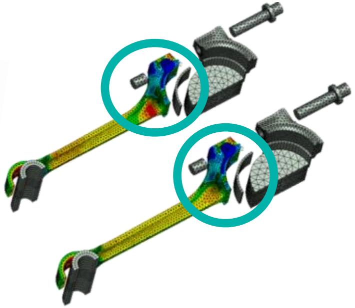
최대 강성/최소 무게를 고려한 설계

Tosca Structure Sizing



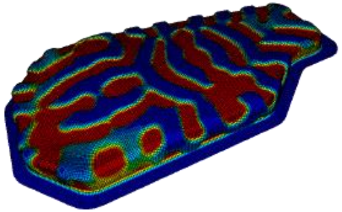
Sheet 두께 최적화를 통한 질량 감소

Tosca Structure Shape



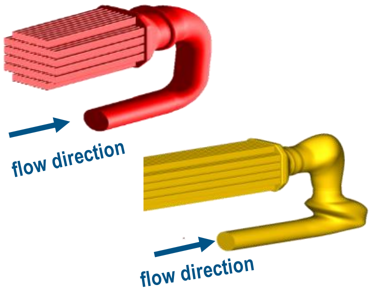
국부 응력 감소와 내구성 증가

Tosca Structure Bead



박판 구조의 강성/고유 주파수 증가

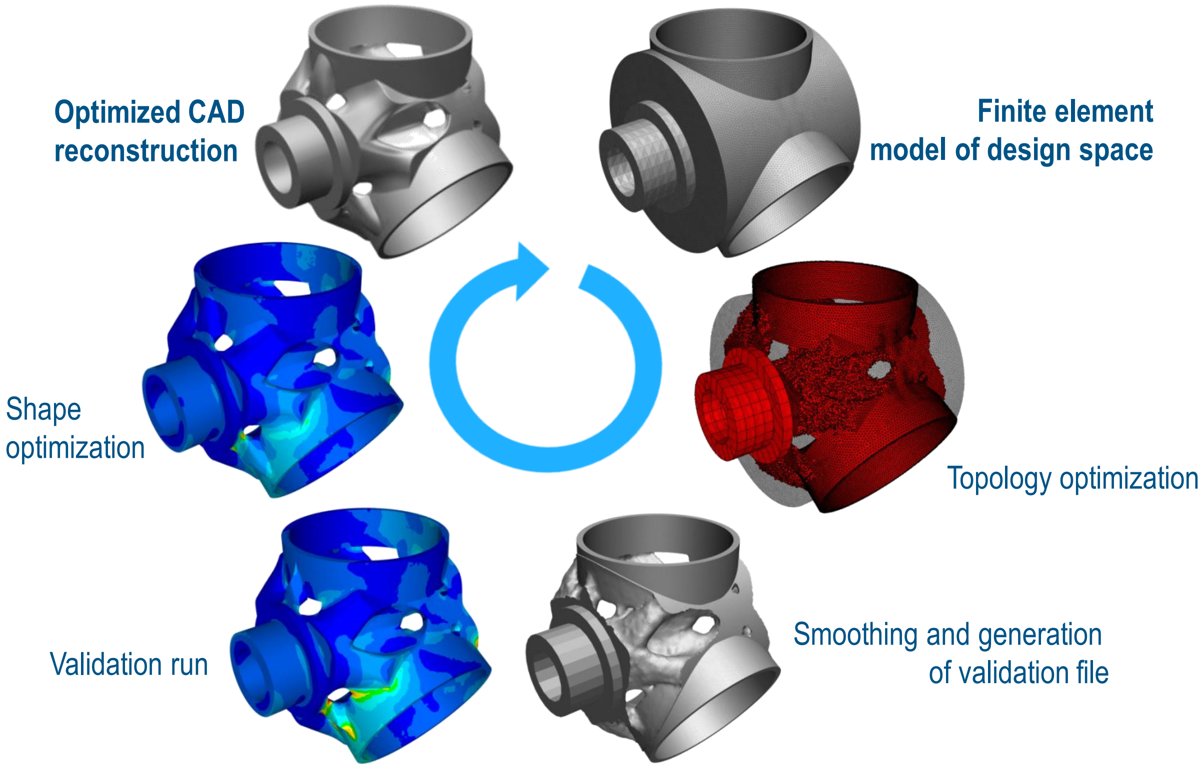
Tosca Fluid Topology



압력 저하를 줄이기 위한 내부 유동 위상 최적화

Tosca 응용 분야

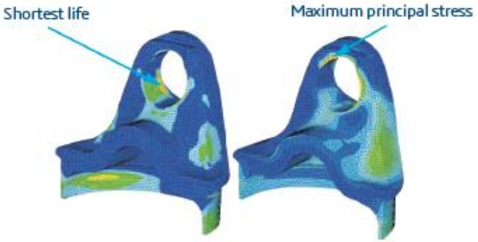
- ▶ 위상 최적화
  - ▷ 중량 절감
  - ▷ 강성 및 동적 하중 고려
  - ▷ 제작 제약 조건 포함
  - ▷ 다양한 인자 반영
    - · 변위
    - · 하중
    - · 공유 진동수



fe-safe

유한요소 모델을 위한 내구 해석

Cracks may not occur at the locations of maximum stress



Images courtesy of Dana Automotive Systems Group, LLC.

Critical plane multiaxial stress-life and strain life methods

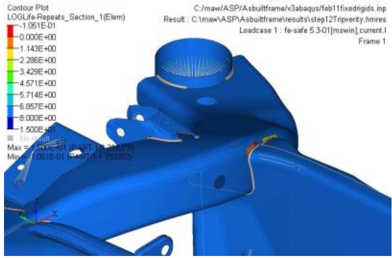
Image courtesy of Raufoss Technology.

fe-safe provides many benefits to users:

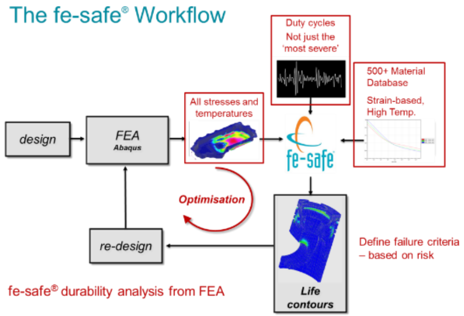
- Accurate analysis of structural welds, seam welds and spot welds
- Vibration fatigue evaluation of damage that identifies which parts of the duty cycle contribute the most fatigue damage
- Results reading from forming or assembly processes to estimate residual stresses for rapid sensitivity analysis
- A mesh-insensitive structural stress method predicts failure locations and calculates fatigue life for welded joints and structures
- A material database providing a comprehensive library of fatigue properties for commonly used materials

fe-safe 물리적 평가를 기반의 피로 내구 해석

- ▶ 초도품을 제작하여 시험을 하는 경우
  - ▷ 시간이 많이 소요되며
  - ▷ 프로젝트 시간 규모는 예측할 수 없고
  - ▷ 모든 조건을 설명 할 수 없으며
  - ▷ 고비용이 소요됩니다



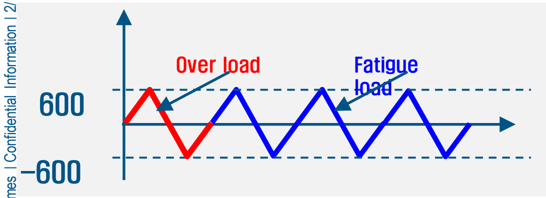
- ▶ fe-safe를 내구 해석의 장점은
  - ▷ 피로 핫스팟 및 피로 수명의 정확한 식별이 가능하며
  - ▷ 제품 리콜 및 보증 비용 절감하여
  - ▷ 프로토 타입 테스트 시간 단축되어 설계의 향상됩니다

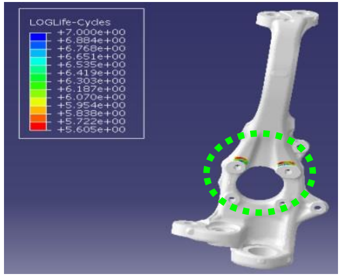


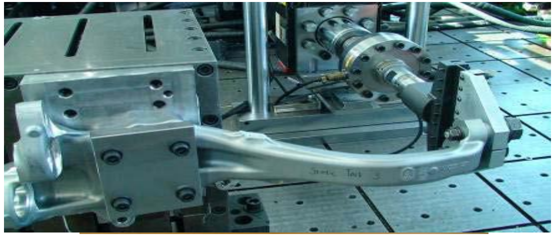
fe-safe 응용 사례

Testimonial: Hyundai Motor Company

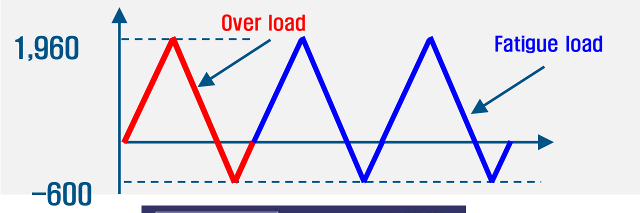
< only low level fatigue loading >

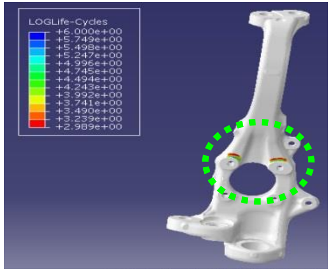






< only high level fatigue loading >





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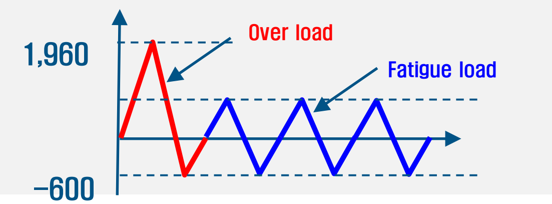
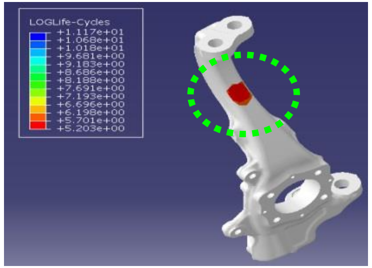
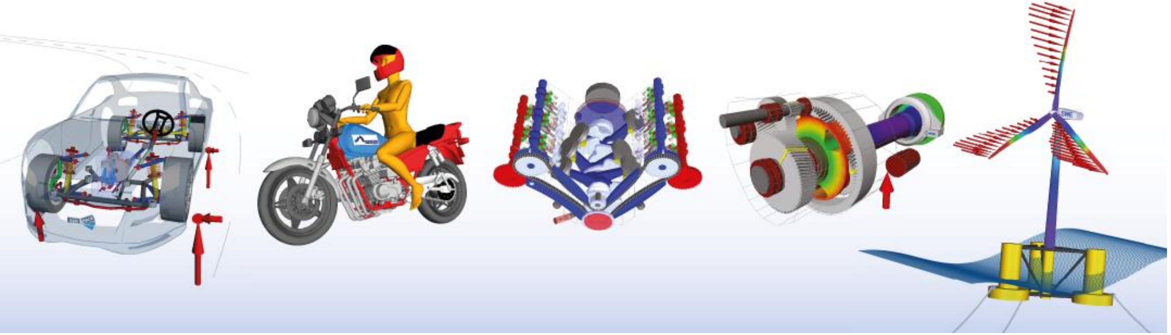




SIMPACK

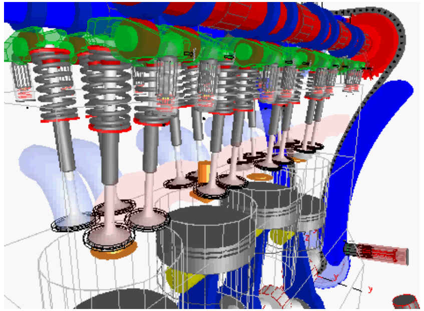
선도적인 다물체 시뮬레이션 기술



Leading Multi-Body Simulation (MBS) Software for the dynamic analysis of any mechanical or mechatronic system.

- Simulation and virtual testing
- Extreme non-linear system behavior
- Analyses up into the acoustic range
- Stress, strain and durability
- Batch jobs
- Automatic report generation
- Expert and deployment mode

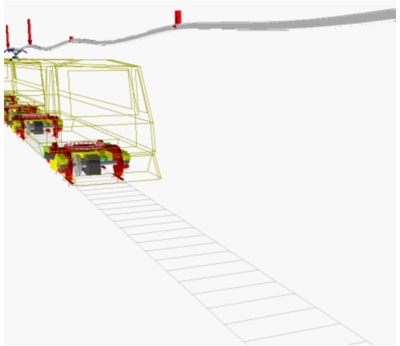
SIMPACK

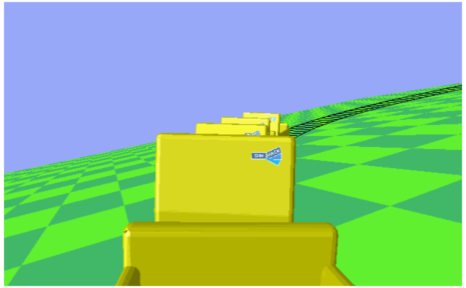


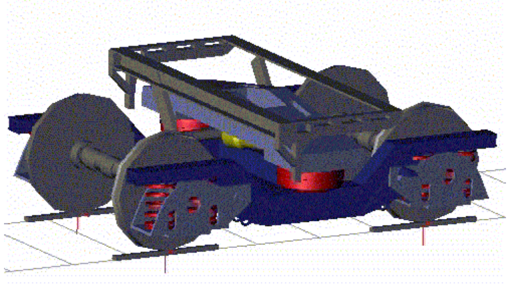
- Mechanical System 의 동적 거동 해석에 사용되는 범용 S/W
  - 다용도의 3D & 2D (Topology diagram) 모델 에디터
  - 빠르고 정확하며 안정적이고 신뢰성 높은 Solver
- 기능의 특장점
  - 빠르고 강인한 Solver - 상대좌표계 적용 및 멀티코어 Parallel 연산 수행
  - 유연체 (Flexible body) 통합 해석 - Craig-Bampton Modal Reduction 적용
  - EHD (Elasto-hydrodynamic) 베어링 모듈 - 엔진 저널베어링 모델링 가능
  - 다양한 Gear Pair Element 제공 - Spur, Helical, Ring, Bevel, Rack & Pinion 등
  - 뛰어난 실시간 (Real-time) 시뮬레이션 능력 - 빠른 Solver 로 인해 모델 단순화 불필요
  - 뛰어난 고주파 영역 해석 능력 - Numerical Damping 제로 구현으로 음향 영역까지도 해석 가능

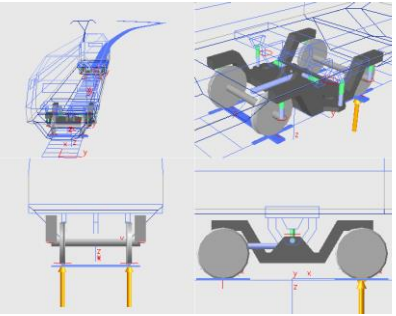
SIMPACK 응용 분야

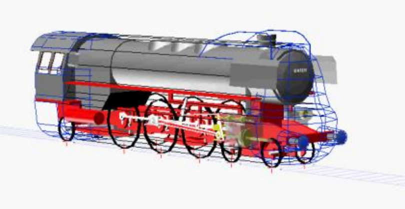
- ▶ Worldwide No.1 for Rail Simulation
  - ▷ 휠 & 레일 간 Contact 시뮬레이션
  - ▷ 탈선 및 Contact 부 마모 해석
  - ▷ 승차감 해석
  - ▷ 레일 교차 및 철길 건널목 시뮬레이션
  - ▷ 팬터그래프 & 전차선 인터페이스
  - ▷ 횡풍 (옆바람) 해석 등





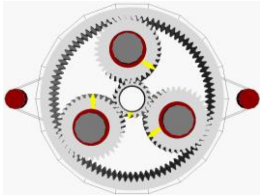
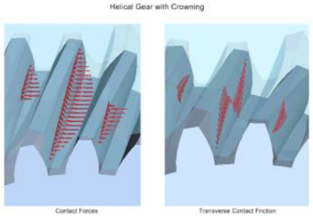




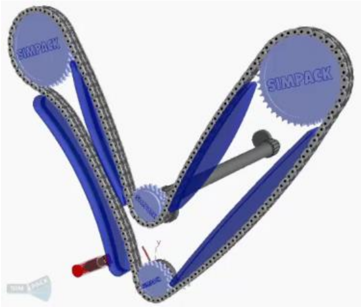


SIMPACK 응용 분야

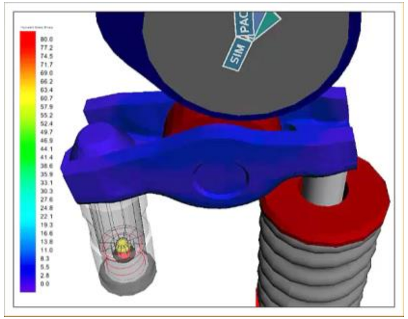
- ▶ 차량 엔진 해석
  - ▷ 엔진 단품 레벨에서부터 Complete Engine 에까지 Full Line-up 구성
  - ▷ EHD 저널베어링, Valve Train, Crank Train, 체인, Vibration 등

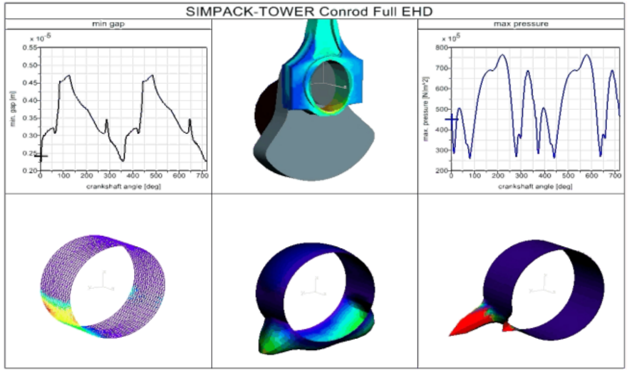
Gear contact



Chain guides



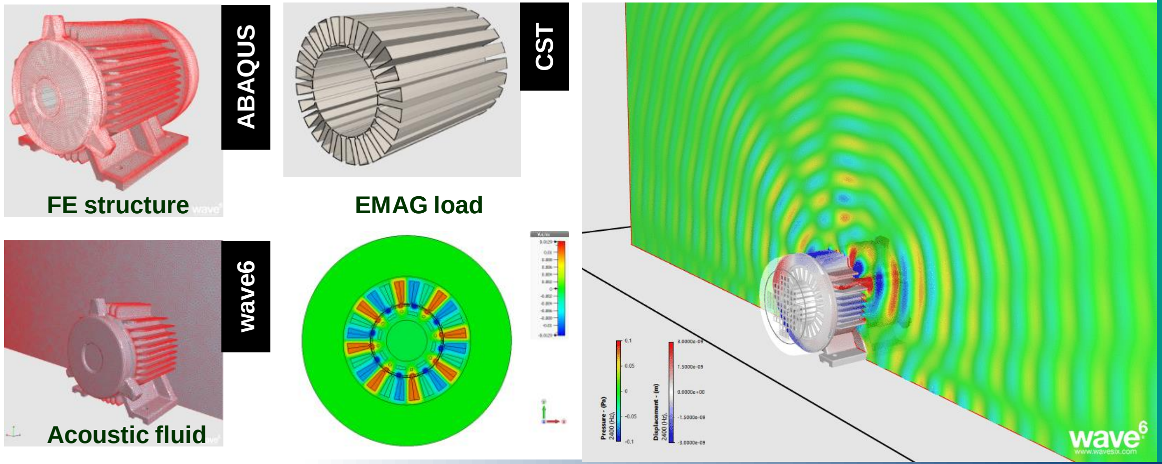
Valve train components



Hydrodynamic bearing

Wave6

차세대 진동 소음 및 공력 진동 소음 시뮬레이션



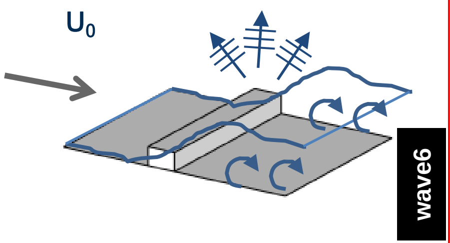
Next generation of vibro-acoustic solution

- Statistical Energy Analysis
- Acoustic Boundary Elements
- Acoustic Finite Elements
- Structural Finite Elements

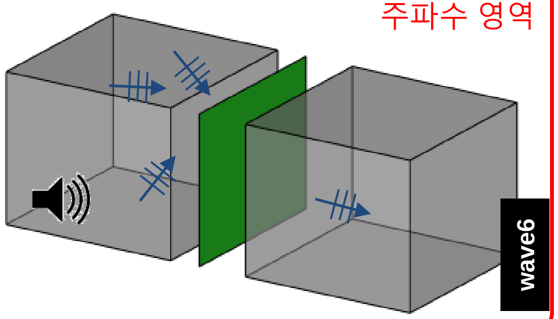
진동 소음 영역

항공 음향학
(Aero-Acoustics)
강체 구조물에
외부의 유동소음
표준화된 원거리
음향상사식 사용

주파수 영역



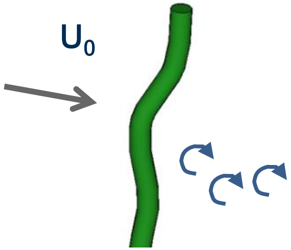
주파수 영역



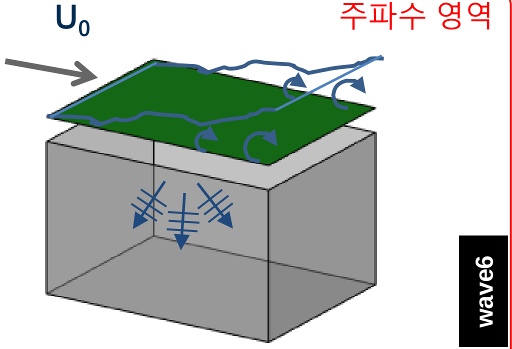
진동음향
(Vibro-Acoustics)
소음 및 진동 전달
(항공 및 구조물 전송
경로를 통한 구조,
유체 및 탄성 탄성
물질의 파 전파)

유체-구조 상호작용
(Fluid-Structure-Interaction)
유체에 의한 구조물의
큰 변형 (흔들림 및
안정성)에 사용

시간영역



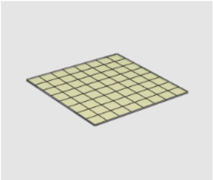
주파수 영역



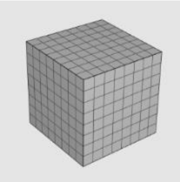
항공 진동음향학
(Aero-Vibro-Acoustics)
구조 내부의 바람소리
변동하는 표면
압력으로인한 음파
전달

Wave6 : 광범위한 주파수 범위에서 소음 및 진동 (및 흐름 유도 소음 및 진동) 해석

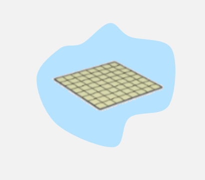
저대역 주파수 (결정적 알고리즘)



유한요소(FE)
구조

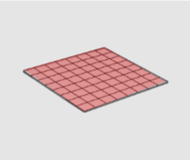


유한요소(FE)
음향



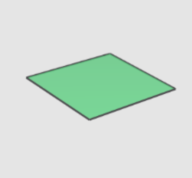
경계요소법
(BEM) 무한 음향
유체

중간대역 주파수(혼합)

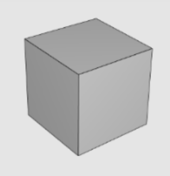


음향탄성법
(PEM)

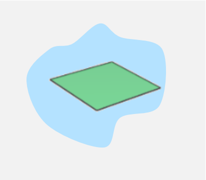
고대역 주파수(통계적 알고리즘)



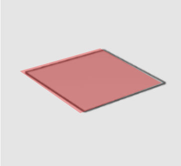
통계적
에너지 분석
(SEA)
구조



통계적
에너지 분석
(SEA)
공동



통계적
에너지 분석
(SEA)
무한음향유체



음향탄성법
소음 제거법

새롭고 빠른 BEM

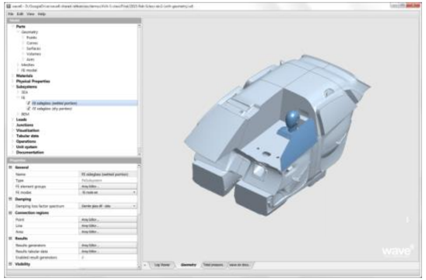
- 워크스테이션에서 표면의 백만개 절점을 갖는 유한요소법(FE) / 경계요소법(BEM)
- 완전연성 해석 (2-way coupling)

새롭게 일반화 된 SEA법

- 보다 정확한 통계적 에너지분석(SEA)
- CAD 또는 FE로부터 빠른 SEA 모델 구축

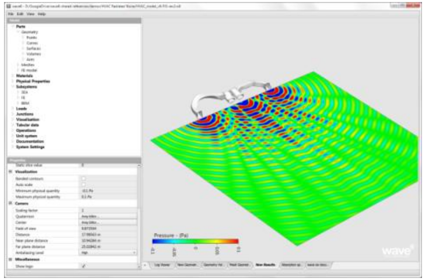
Wave6 : 응용분야

공력구조음향 (FE+BEM+SEA+CFD)



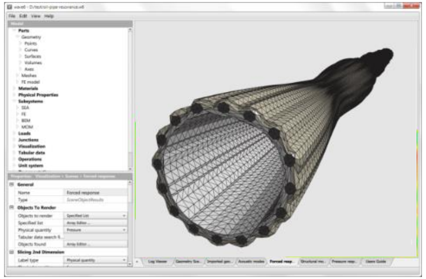
사이드미러 내부 바람소리

소음해석 (FE + BEM)



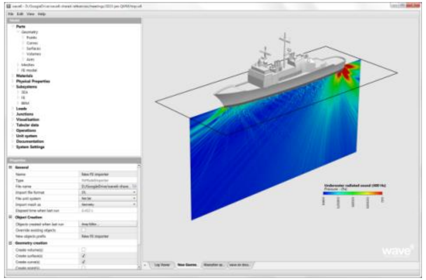
공기조화 장치와 머플러의 셀 노이즈

소음해석 (SEA)



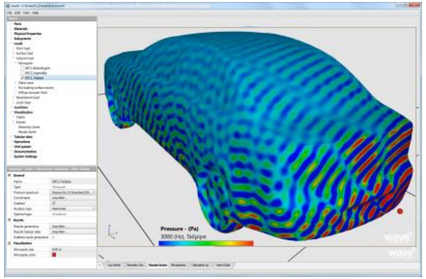
덕트 내부의 압력 파동

소음해석 (FE + BEM + CFD)



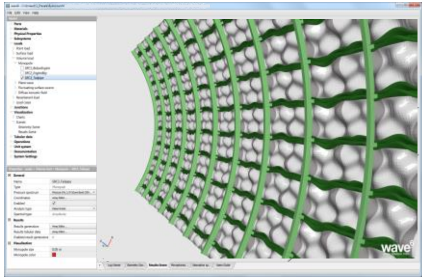
수중음향 (설치 효과)

소음해석 (BEM)



자동차 주변의 소리 회절
(3kHz에서 배기관 노이즈 소스 회절)

소음해석 (SEA)



항공기/발사체 내부 소음

XFlow

LBM(Lattice Boltzmann Method)을 사용하는 무요소법 CFD S/W

Next generation CFD software system that uses a proprietary state-of-the-art Lattice Boltzmann technology.

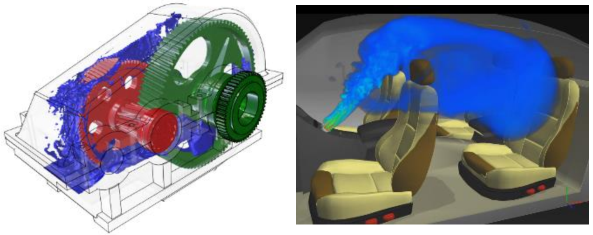
- Lattice Boltzmann technology
- Simplified CFD workflow minimizes the presence of algorithmic parameters and avoids the traditionally time consuming meshing process
- Adaptive scale refinement
- Turbulence modeling with High fidelity WMLES (Wall-Modeled Large Eddy Simulation)
- Advanced analysis capabilities

Xflow 특장점

1. **사용의 용이성**: 자동 격자 생성 및 적응 형 세분화를 통해 일반적인 CFD 워크 플로우의 전처리 단계에서 시간과 노력을 줄이면서도 사용자 입력을 최소화
2. **높은 정밀도**: 벽 모델링 된 LES (Large Eddy Simulation) 방법은 복잡한 유동 물리에 대한 고해상도 통찰력을 제공하는 난류 스케일의 대부분을 효율적으로 해결
3. **Solver**: CFD 포트폴리오를 확장하는 높은 충실도의 전산 유체 역학 (CFD) 애플리케이션을 위한 Lattice-Boltzmann 기술 기반 솔버를 제공. Transient (unsteady state)해석 시 RANS 모델 사용하는 기존 CFD s/w 대비 계산 속도 3배~10배 이상 빠름
4. **Multi-Physics 기능**:유체-구조 연성해석(FSI), 공력 소음 해석 등 기본 모듈로 포함
5. **병렬처리 기능**: 고성능 컴퓨팅 (HPC)의 성능을 활용하기 위해 완벽하게 병렬화되어 실제 테스트를 줄이거 나 바꾸기 위해 현실적인 CFD 시뮬레이션 실행을 가속화
6. **뛰어난 그래픽 처리**: 고급 렌더링 기능은 현실적인 시각화 기능을 제공하여 흐름 및 열 성능에 대한 심층적 인 통찰력을 제공

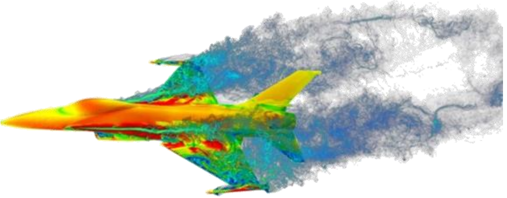
Xflow 응용분야

자동차 산업



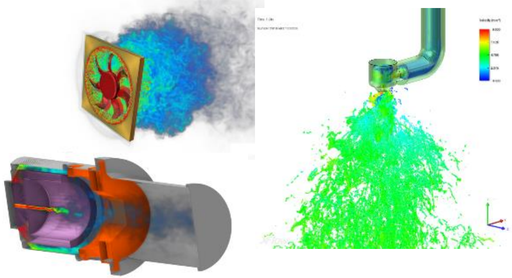
공역학, 파워트레인, HVAC

항공 우주



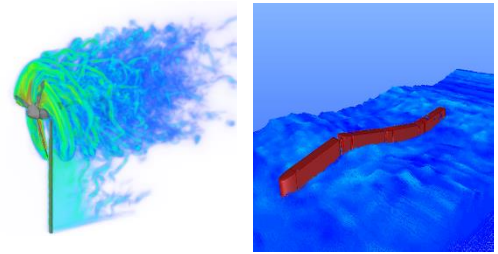
공력

하이테크 산업



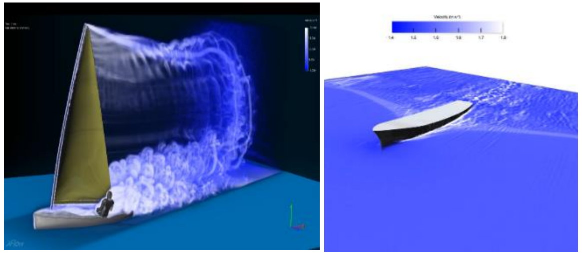
팬, 밸브, 펌프, 노즐

에너지



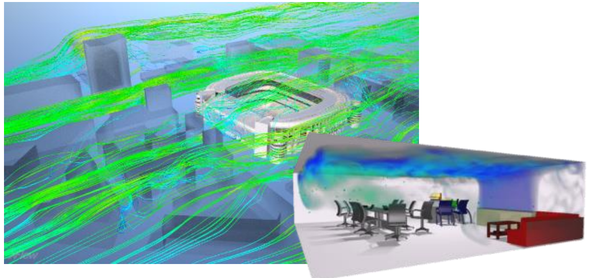
풍력, 수력, 태양

선박



항해

도시공학

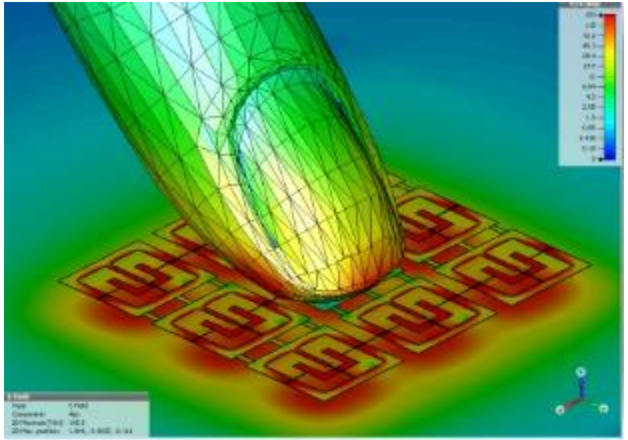


빌딩 주변의 유체 흐름

CST

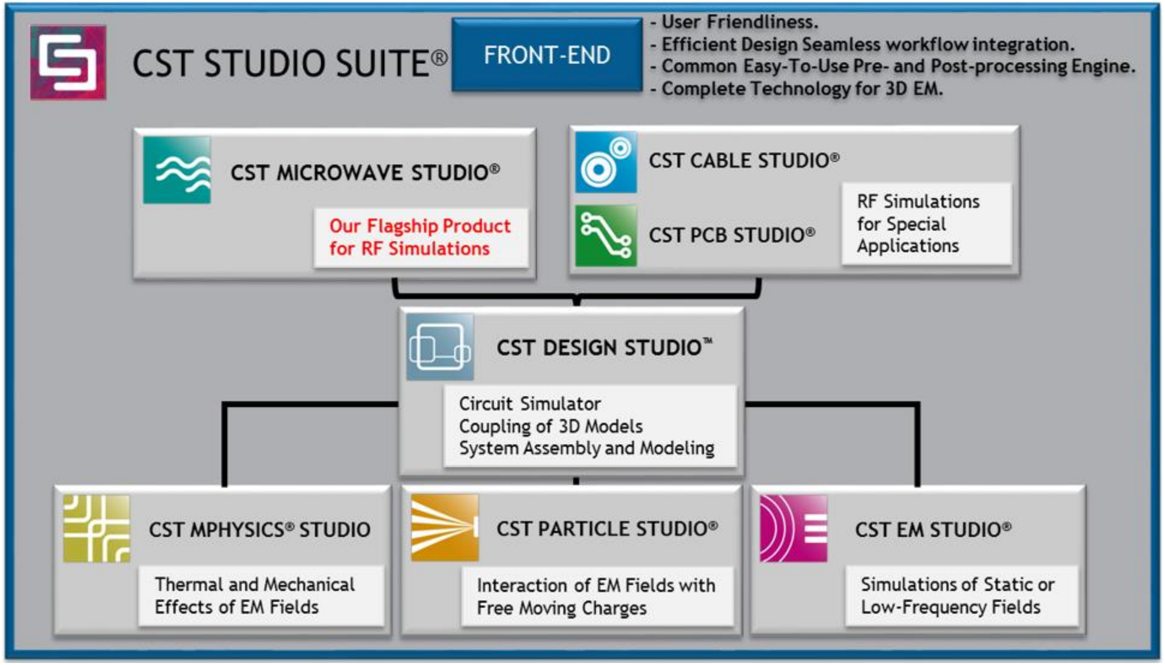
Electromagnetic Simulation

- User friendliness
- Efficient design seamless workflow integration
- Common easy-to-use pre & post processing engine
- Complete technology for 3D EM



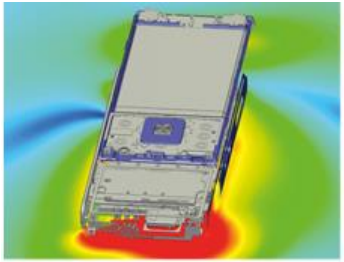
CST

CST's Product Portfolio

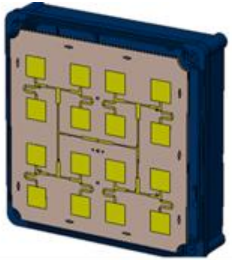


CST

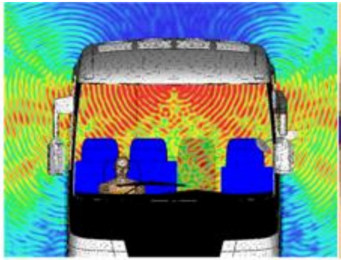
CST Application



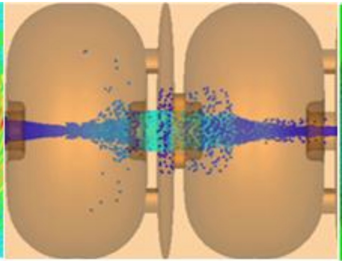
Individual antennas



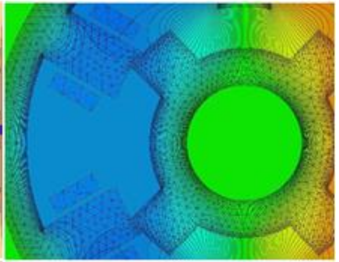
Antenna arrays



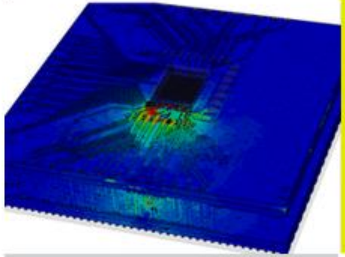
Installed antenna performance



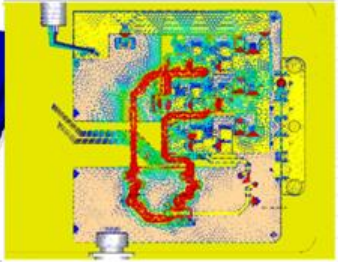
Accelerator Devices



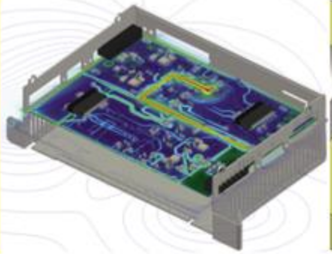
Electrical Machine



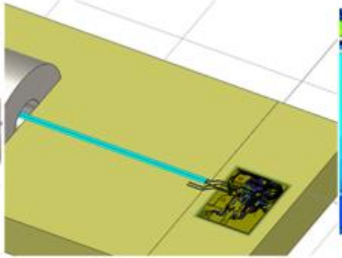
Package



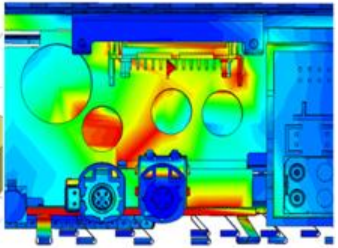
Conducted Emission



Radiated Emission

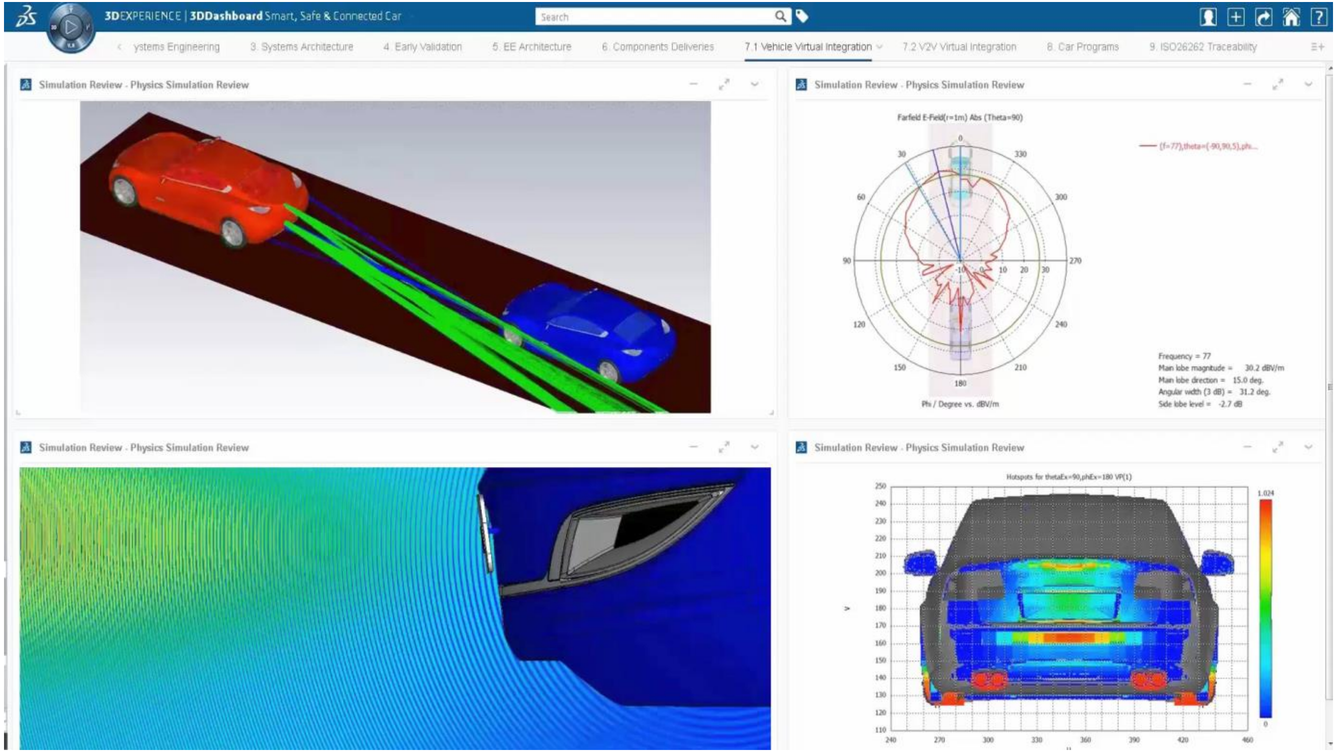


Conducted Immunity



Radiated Immunity

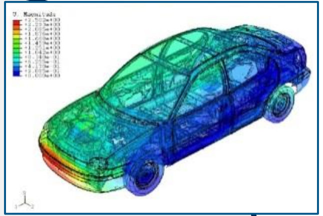
CST



Collision detection / Autonomous vehicle

Wave6

Simpack
multibody dynamics
accurate modeling of high frequency content of powertrain sources

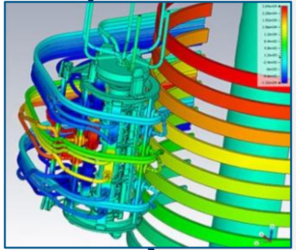


Abaqus
Explicit and Implicit Finite Elements
Best-in-class solvers and materials

SOURCES

PATHS

CST
electromagnetics
accurate modeling of emag sources in electric machines/vehicles



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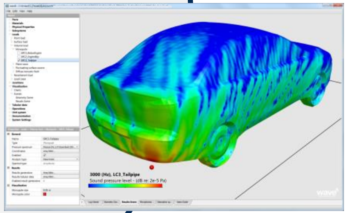
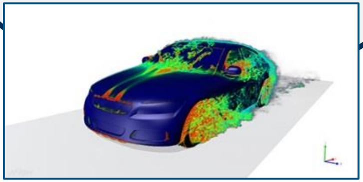


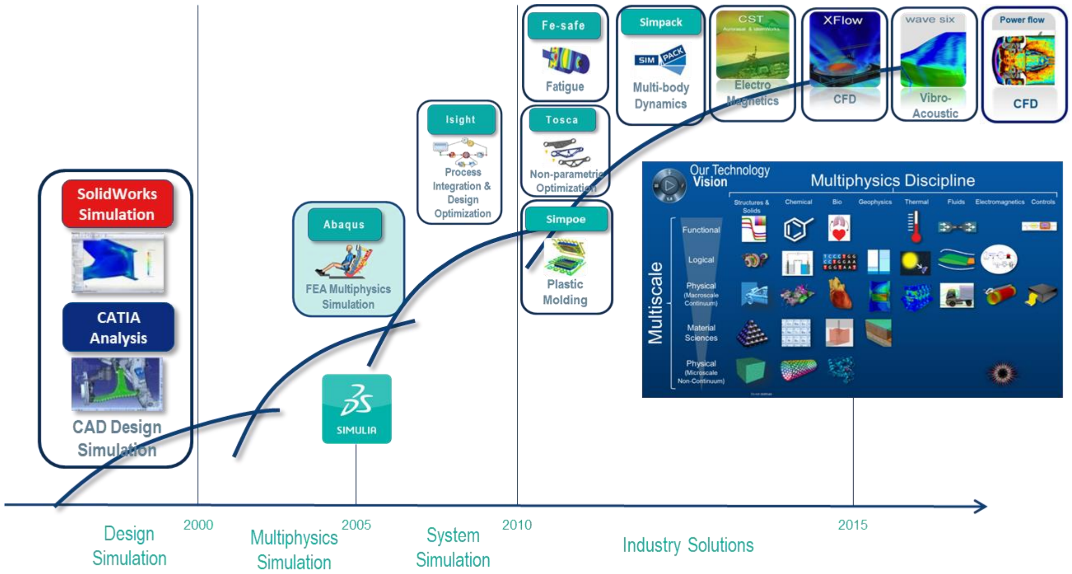
Wave6
vibro-acoustics and flow noise
full spectrum analysis methods

XFlow
unsteady CFD
accurate and fast modeling of aerodynamic sources in flow noise



SIMULIA has best in class tools for modeling both the sources and the transmission of noise and vibration

3DEXPERIENCE Platform



3D
i^i
V+R
3DEXPERIENCE®

What is the 3DEXPERIENCE Platform?

A **Business Experience Platform** available On Premise and in public or private cloud

3DEXPERIENCE®

To enable our clients to create delightful **EXPERIENCES** for their ultimate customers or consumers

Collaboration

Productivity

Decision Support

Open

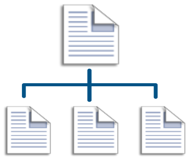
Single Source

On Cloud

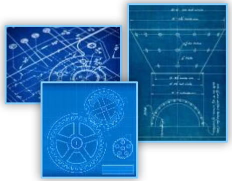
On Premise

Generational changes with **3D**EXPERIENCE

Modeling Products → **Creating Experiences**



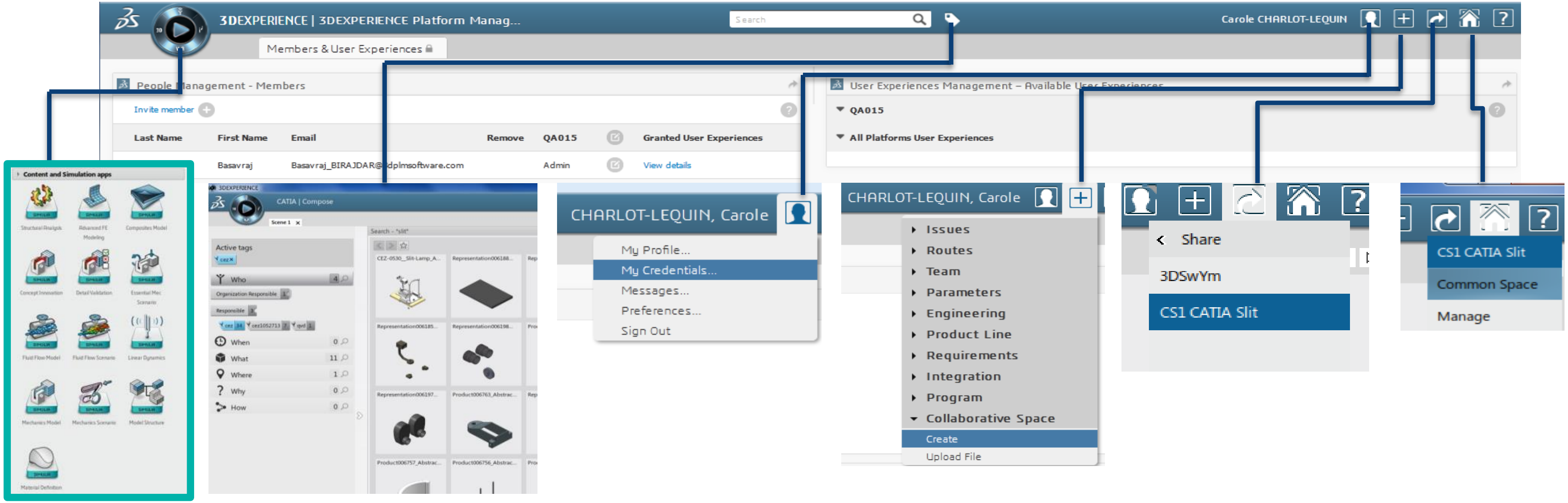
file-based → **data-driven** online global single instance innovation platform



static-designs → **model-based** combining multi-physics, behavior modeling, big data, social collaboration, intuitive decision support

3DEXPERIENCE Compass

Available for all 3DS applications from: CATIA, DELMIA, ENOVIA, and SIMULIA



My Apps | 3DSearch and 6WTag | Me Menu | New Menu | Share Menu | Home Menu

3DEXPERIENCE Portfolio Architecture

Industry Solution Experiences

Business Solution Level
Game Changer - Vision

Industry Process Experiences

Value proposition

Roles

Value proposition, Priced – Licensed
Customer Orderable Level

Apps

End-User Level
Icons on the desktop
User documentation

3DEXPERIENCE Business Platform