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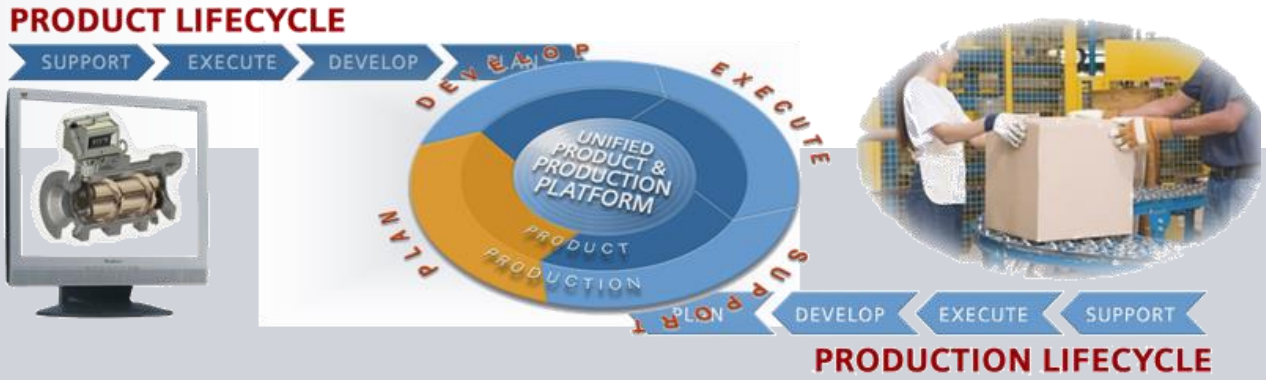
SIMCENTER

Thermal & Flow Analysis



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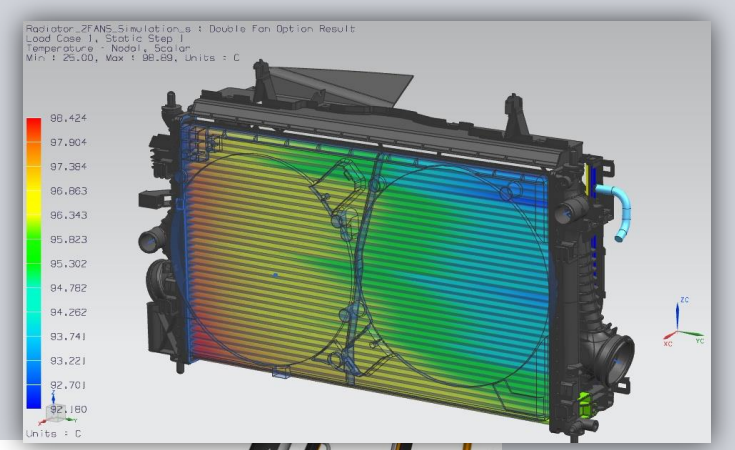
2 라디에이터 해석

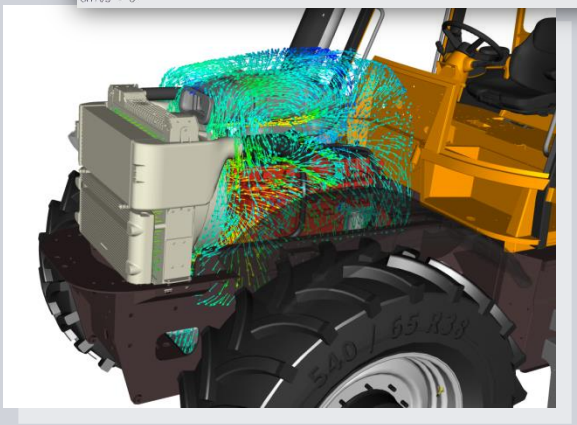
3 펌프 / 팬 CFD 해석

4 언더후드 냉각 해석

5 CAE 해석 자동화

6 기타 해석 사례





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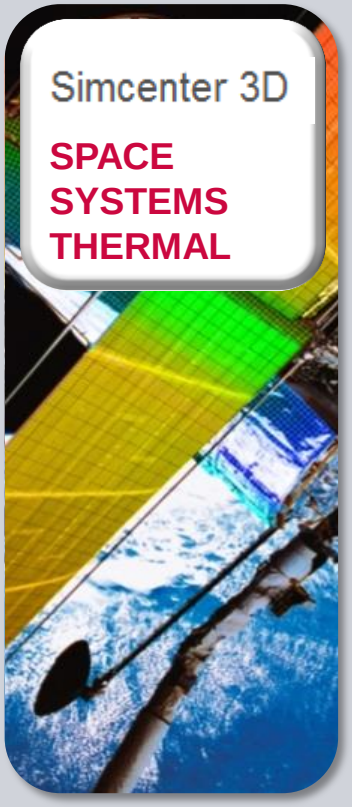
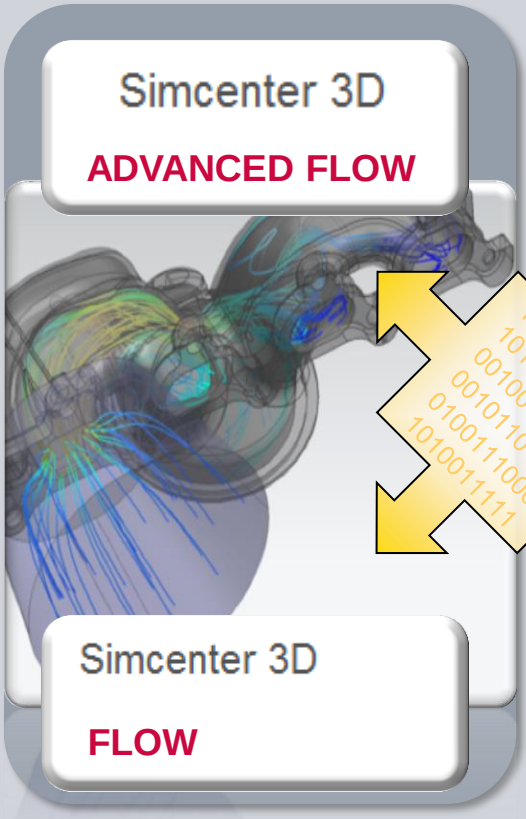
열, 유동 해석 – Multi Physics

산업군에 타겟팅 된 제품



일반적인 열유동 해석 제품



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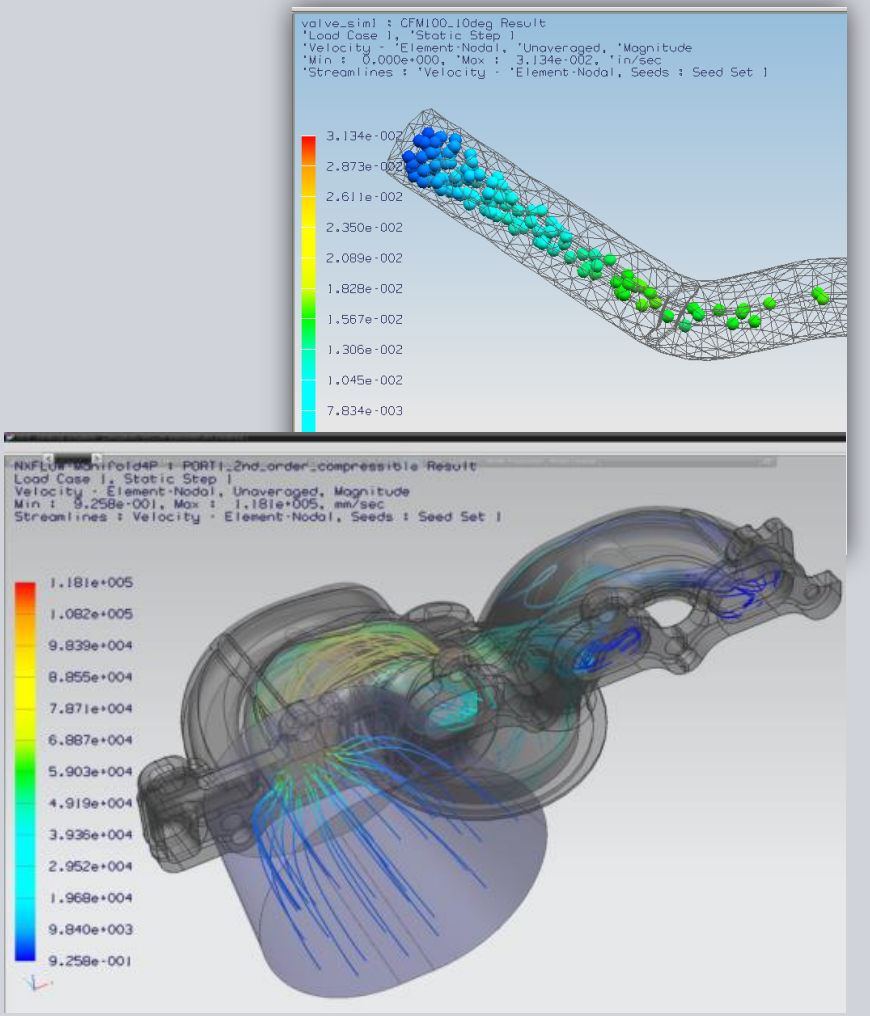
유동해석

- FEM 방식
- 정상상태 및 트랜전트 유동해석에 나비엔스토크 방정식 적용
- 압축성 및 비압축성 유동 모두 적용 가능
- 난류 및 층류 해석
- 어셈블리 안에서의 각 파트별 단절된 유동 메쉬를 자동 연결
- 국부 메쉬 세밀화 및 경계 메쉬 생성
- 주입구, 팬, 벤트, 스크린, 스피커울림판, 다공성 막 기능 제공
- 선형 및 비선형 경계조건



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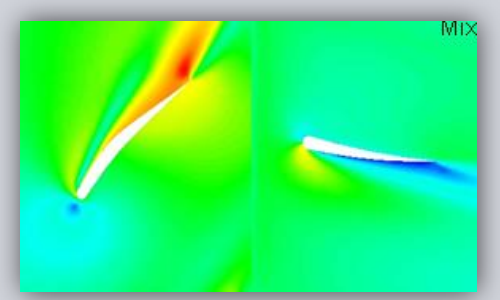
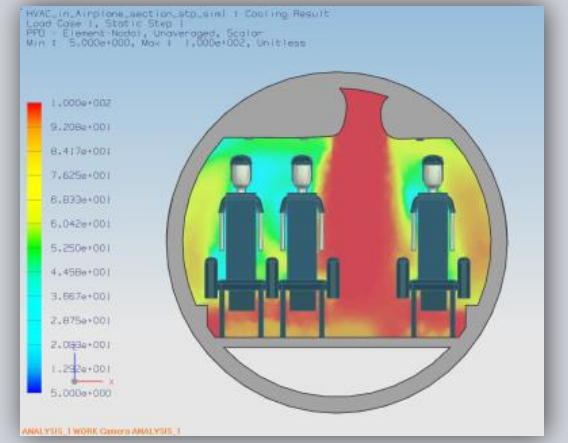
Advanced 유동해석

- SST, k-W 등 Advanced turbulence 모델 제공
- Moving & Multiple 회전 프레임 제공
- 축 대칭 또는 반복주기적인 경계조건 적용 가능
- 강체 운동과 연동 가능
- 초고속 압축성 유동
- Non-Newtonian 유동해석
- 입자해석
- 정수압 문제(including 1-D to 3-D fluid domains connections)
- 습도, 응고 문제 해석





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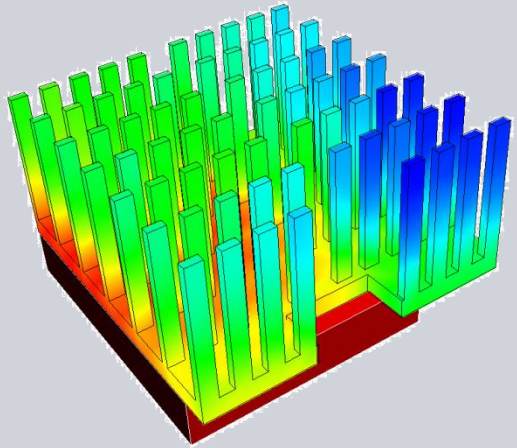
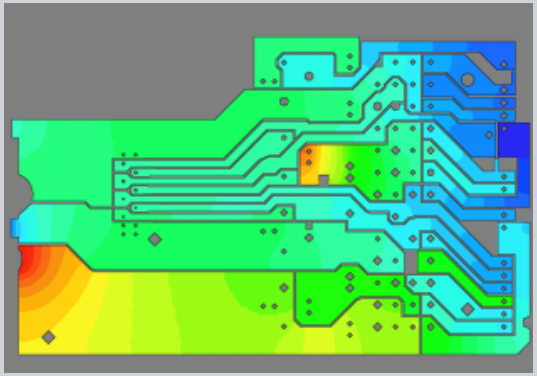
열해석

- FE-based 해석
- 정상상태 또는 트랜젼트 열전달
- 전도, 대류, 복사가 동시에 일어나는 문제 해석 가능
- 어셈블리 안에서의 각 파트별 단절된 유동 메쉬의 자동 연결
- SIMCENTER Flow와 커플링 가능
- 온도함수를 가지는 재질 지원
- 시간 및 공간에 따라 가변적인 경계조건 적용 가능





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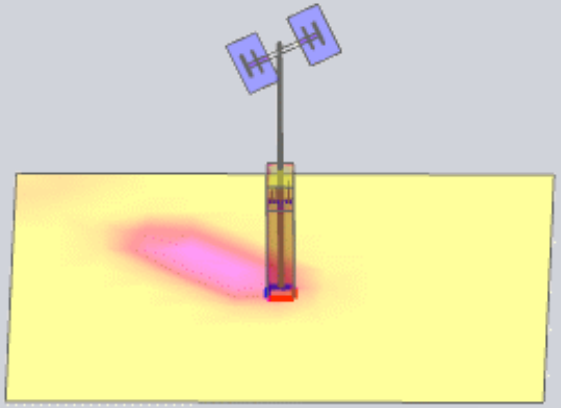
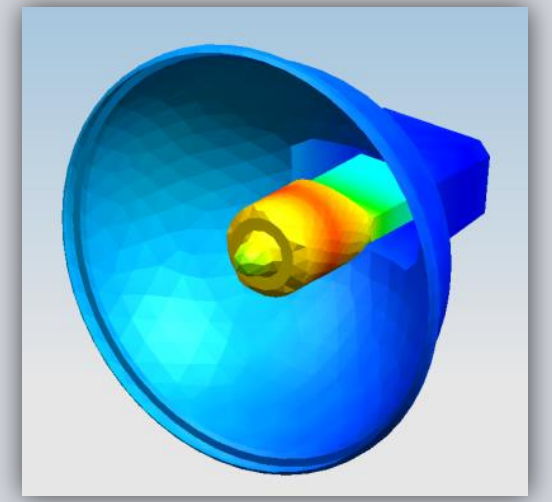
Advanced 열해석

- 능동 열원 제어
- Advanced 열광학 물성
- 몬테카를로 & advanced 복사 해석
- 태양열
- 복사 열 소스
- 열에 의한 침식 문제
- 대류 커플링
- 회전&병진 운동 지원
- 전기적 열원 제공 가능
- 정수압 덕트 네트웍
- 복합물질 또는 다중 레이어
- 오픈 아키텍쳐
- 멀티 CPU를 이용한 해석 가능(Parallel processing)





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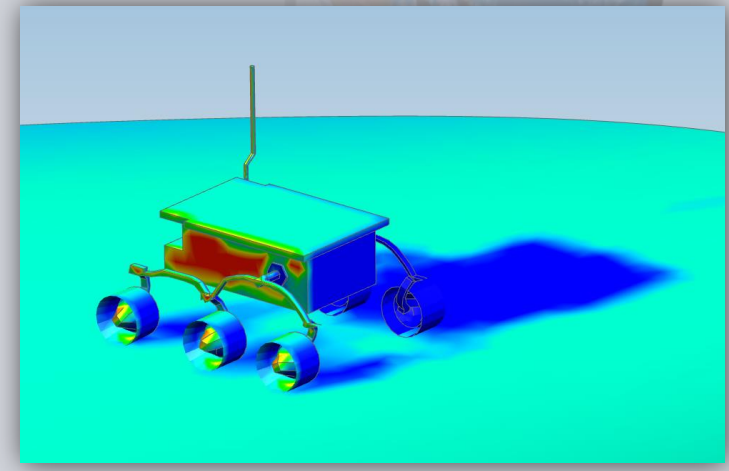
SIMCENTER 스페이스 시스템 열해석

- 인공위성 모델러
- 광선 트레이싱
- 몬테카를로 광선 트레이싱 이론 적용
- Parallel Processing
- 열광학 물성지원
- 트랜전트 회전, 무빙 메쉬, 강체 운동,
- 다층 쉘
- 갭사이즈 공차에 기초한 표면 컨택 지원
- 대류,복사 컨택



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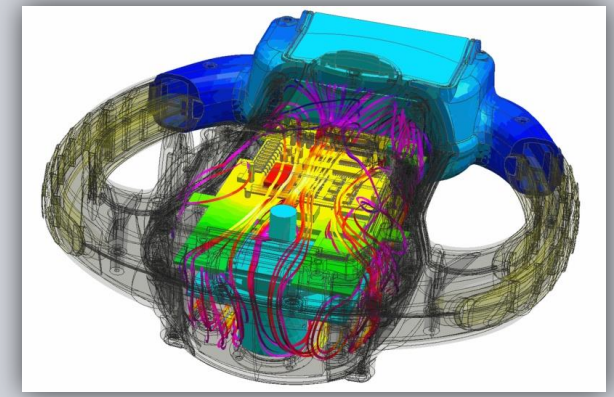
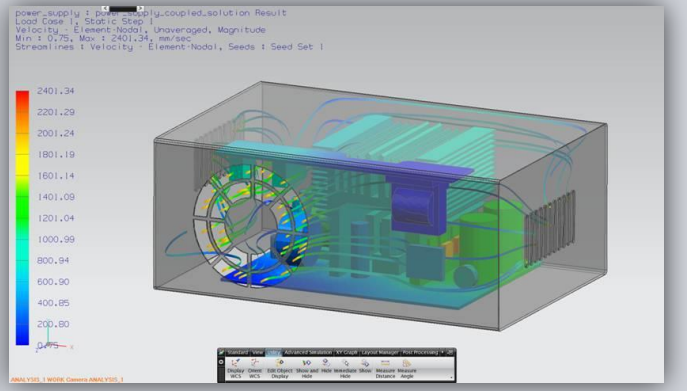
전자시스템 냉각 해석

- 전자장비의 열전달 및 유동 해석
- 열, 유동 커플 해석
  - 자연 대류 및 강제 대류(implicit or explicit)
  - 전도
  - 복사

- Specialized tools:
  - 팬 카타로그
  - 히터와 팬의 온도조절장치 및 능동 컨트롤러
  - 펠티어 효과(열전현상)에 의한 쿨러 기능
  - 전기열(Joule heating)
  - 태양열
  - 덕트 네트웍
  - SIMCENTER PCB Exchange (ECAD/SIMCENTER 연결 데이터 호환)





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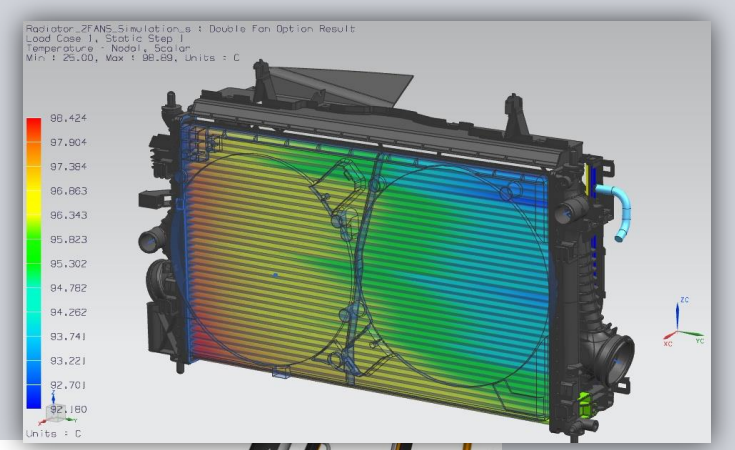

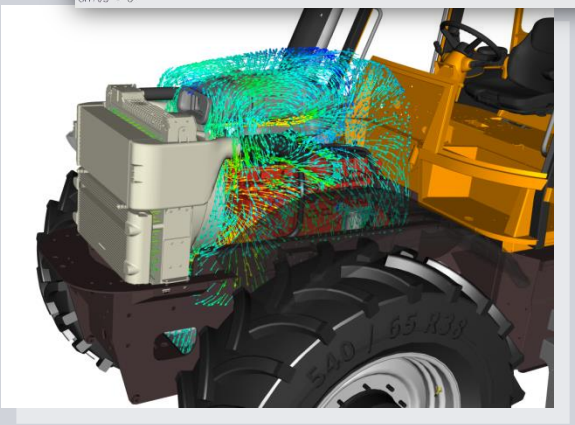

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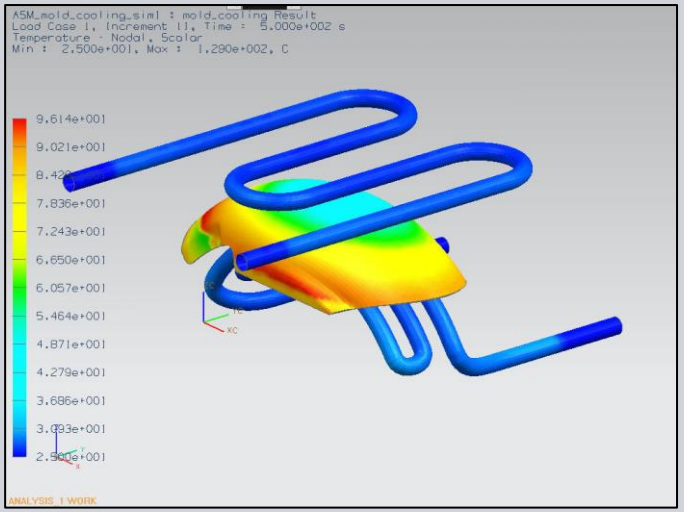
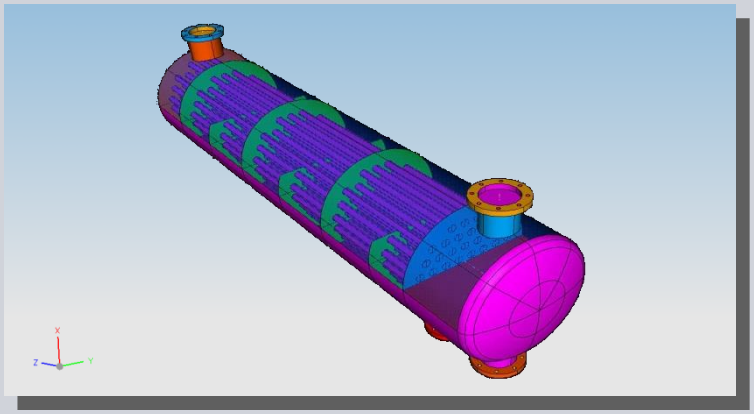
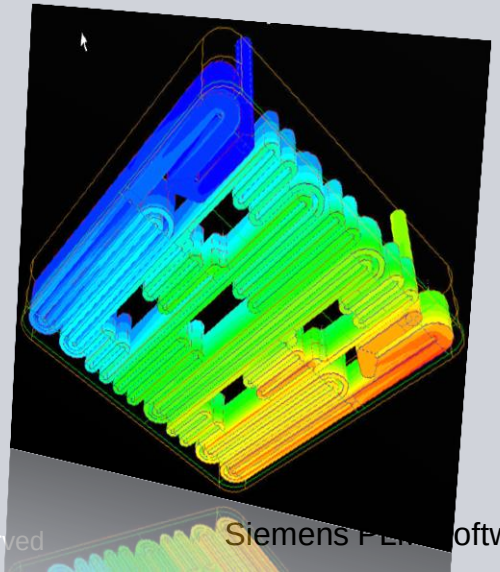
정수압 네트웍 열해석 모델

- 1D fluid 네트웍 모델링 기능 제공
- “열대류 커플링”에 의해 유체로부터 덕트로의 열전달 기능 제공
- 1D 덕트 네트웍과 3D CFD 구역의 커플링 기능 제공







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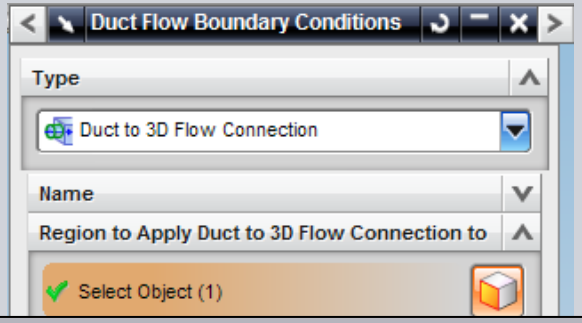
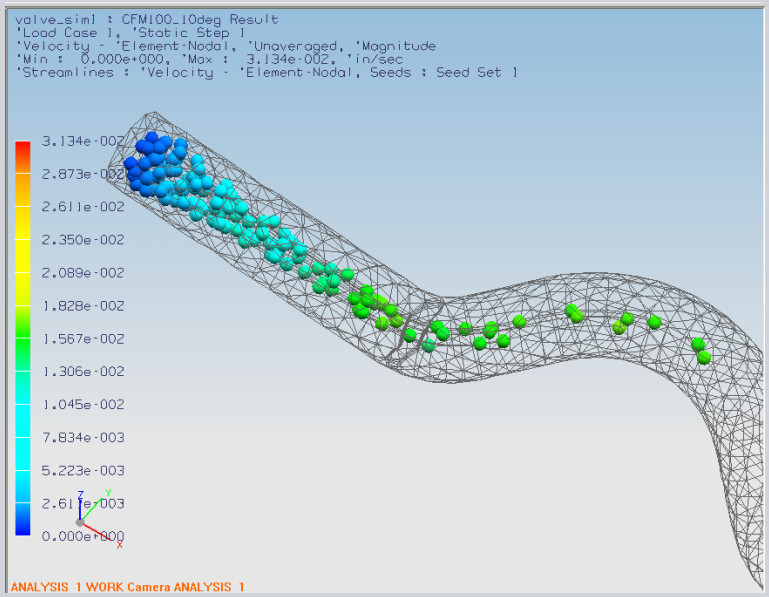
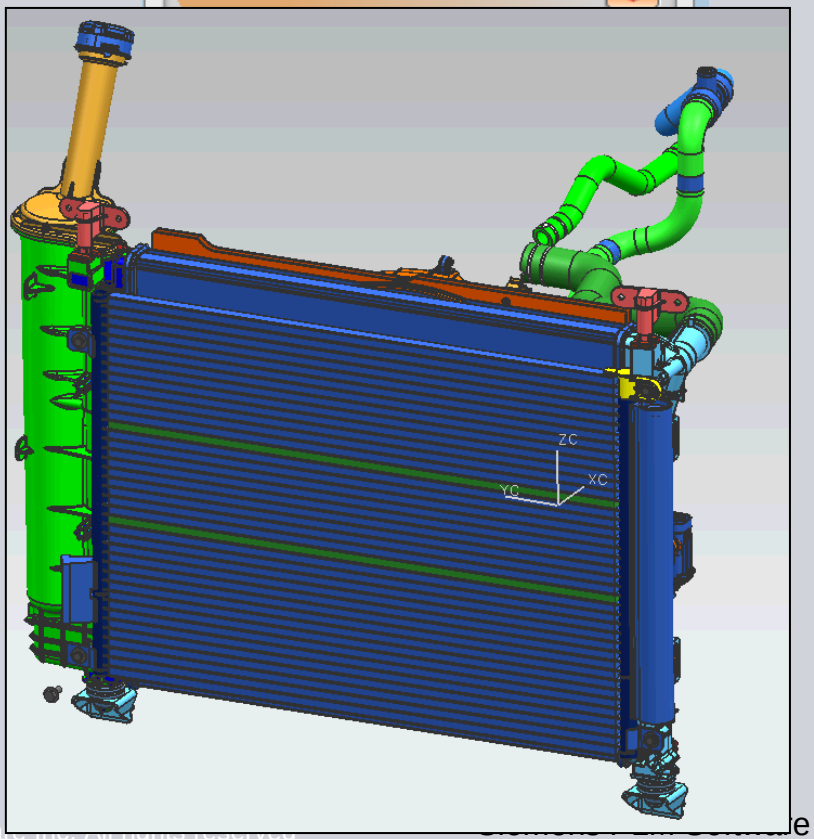
1차원 정수압 유동과 3차원 유동 연결

- 1차원 덕트 네트웍과 3차원 유동 도메인 연결







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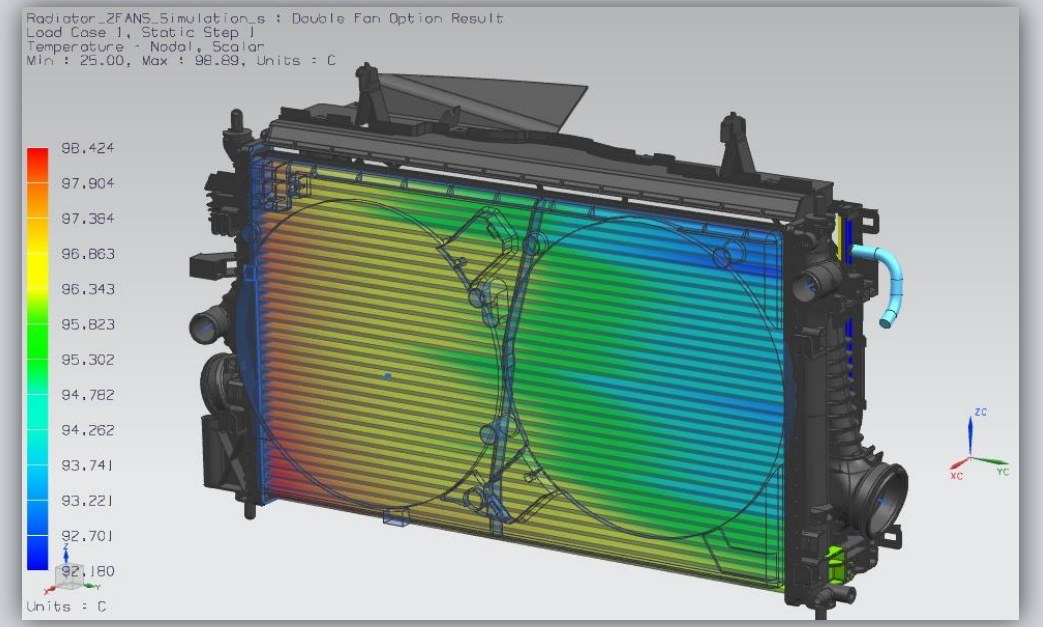
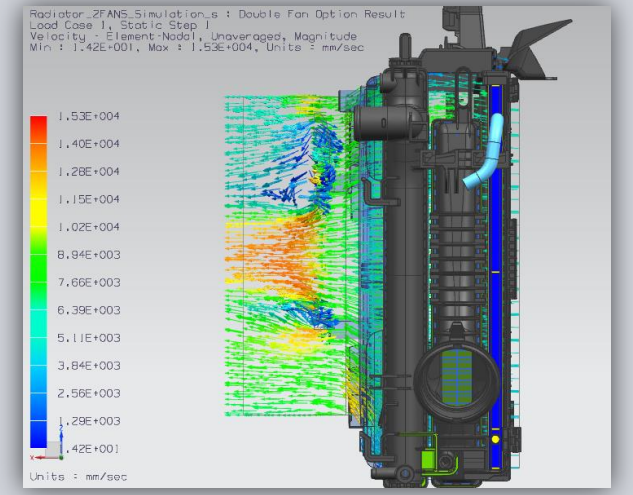
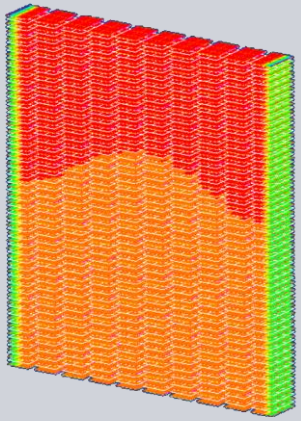
라디에이터 열 해석







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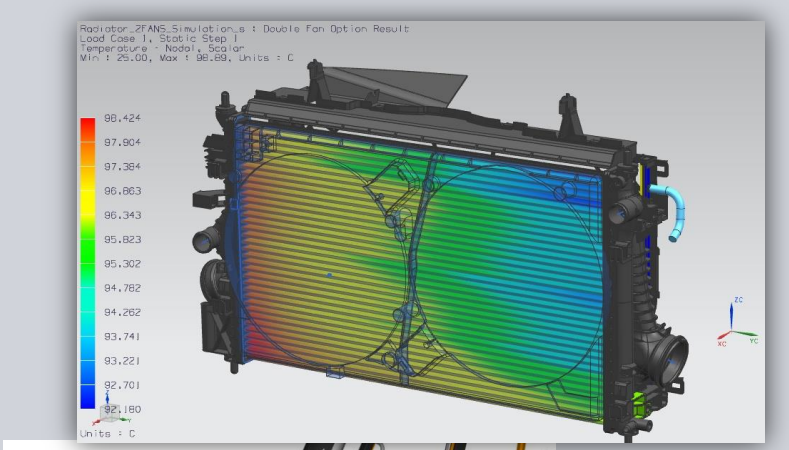
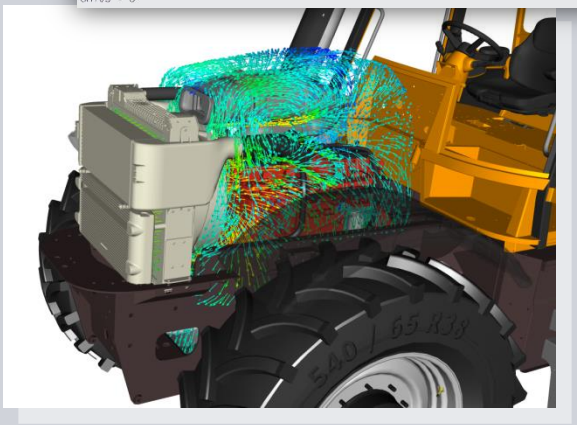
5 CAE 해석 자동화

6 기타 해석 사례





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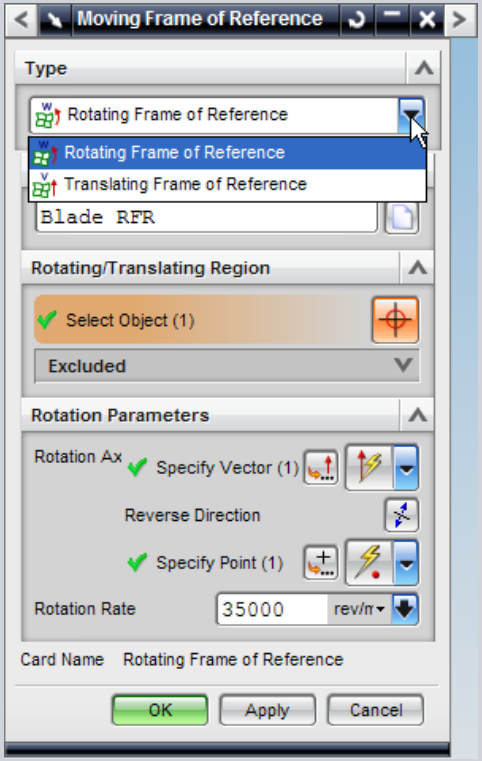
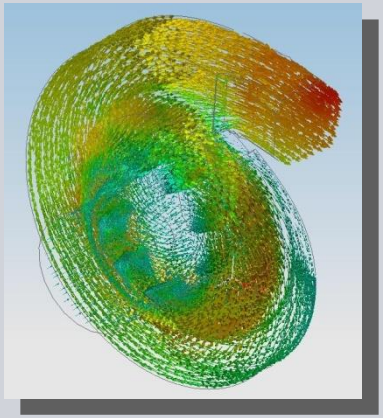
무빙 프레임 기능 제공

다중 회전 프레임(RFR and MRFR)

- RPM과 회전축 정의
- 코리올리 효과 고려
- If specified on “solids”
  - 유체/ 고체 인터페이스에서 전단력 고려함





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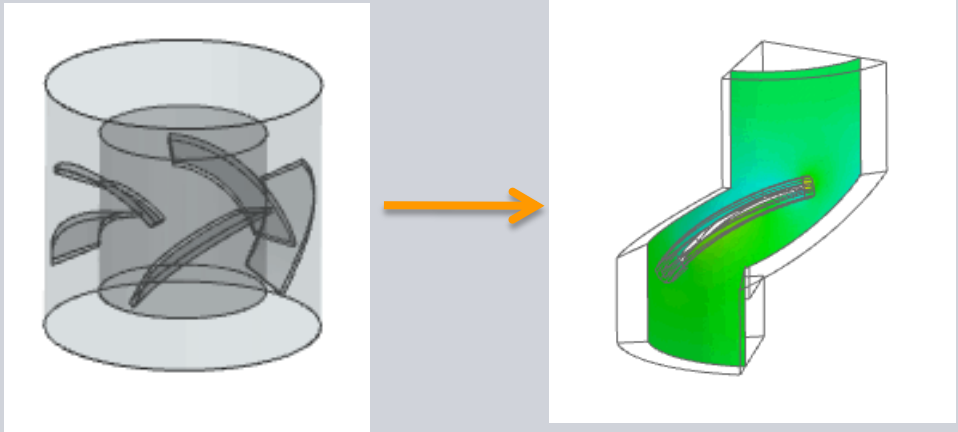
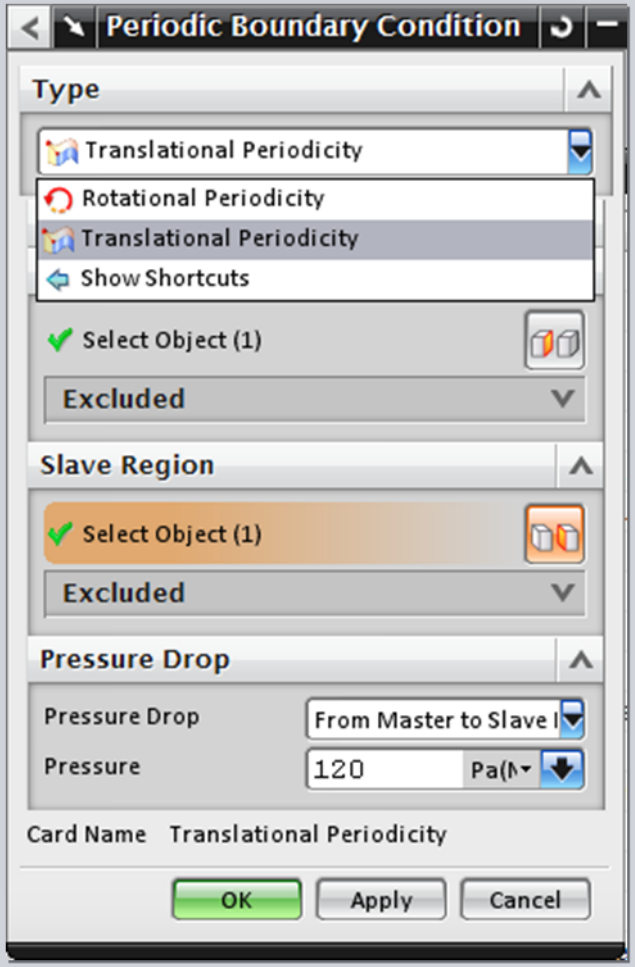
경계조건의 주기적 변화 고려 가능

- Requires surface mesh dependency
- 종속 절점을 독립 절점 유동 값에 온도, 압력, 속도값을 연동시킬 수 있음
- Type
  - 회전
  - 병진





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팬/ 펌프 곡선 구현

- 팬 블레이드 형상 구현

  팬 동작 조건 입력

- FE model로 변환

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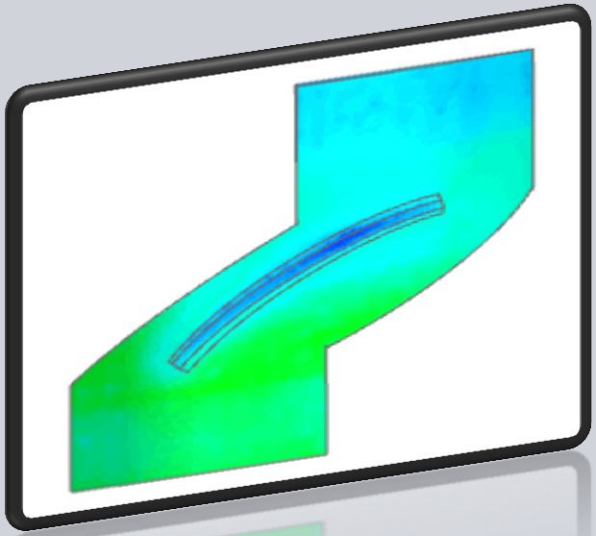
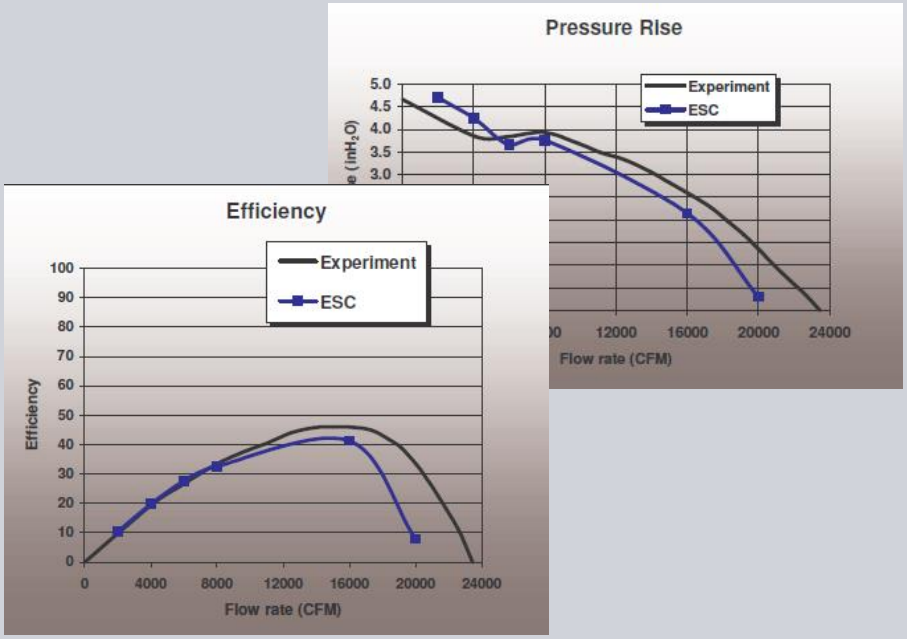
팬/ 펌프 곡선 구현

- 주기 반복적인 모델 구현
- 고정된 회전율 시뮬레이션
- Determined dP vs. CFM for 주어진 회전 비율





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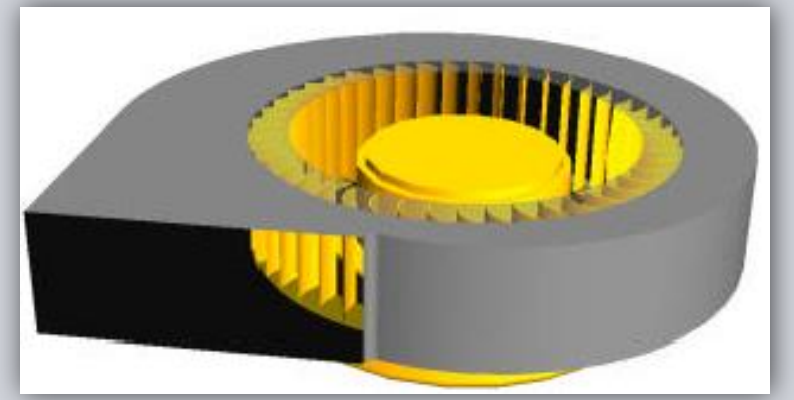
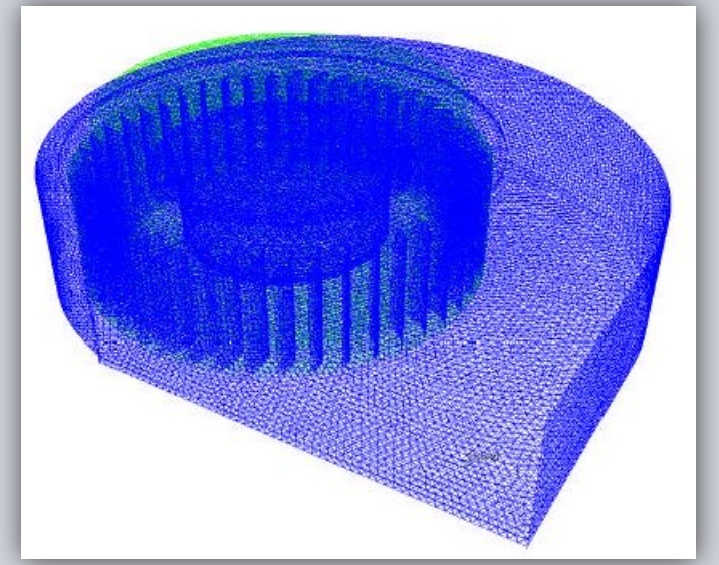
송풍기 해석 및 최적화

- 시스템 레벨 시뮬레이션
- 최적의 형상 도출





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송풍기 해석 및 최적화

- 3가지 형상에 대해 계산된 압력과 속도장

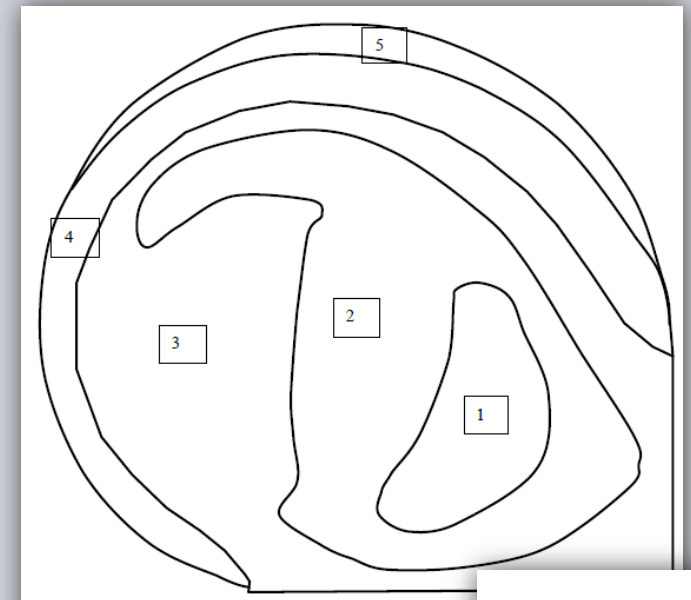
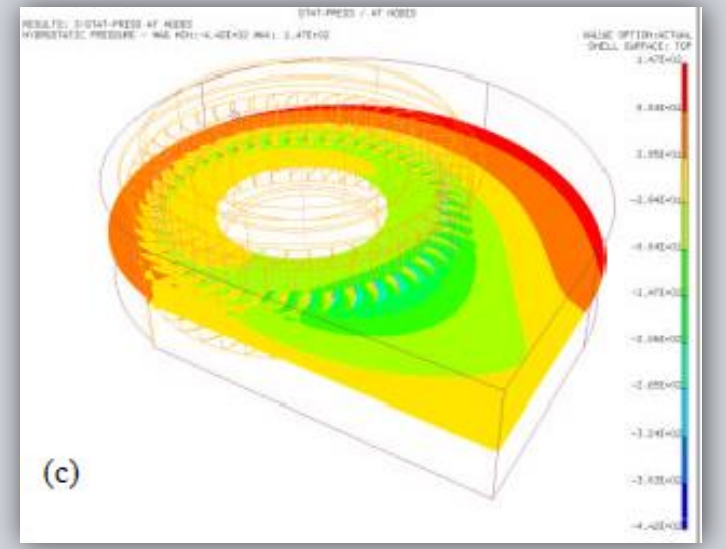
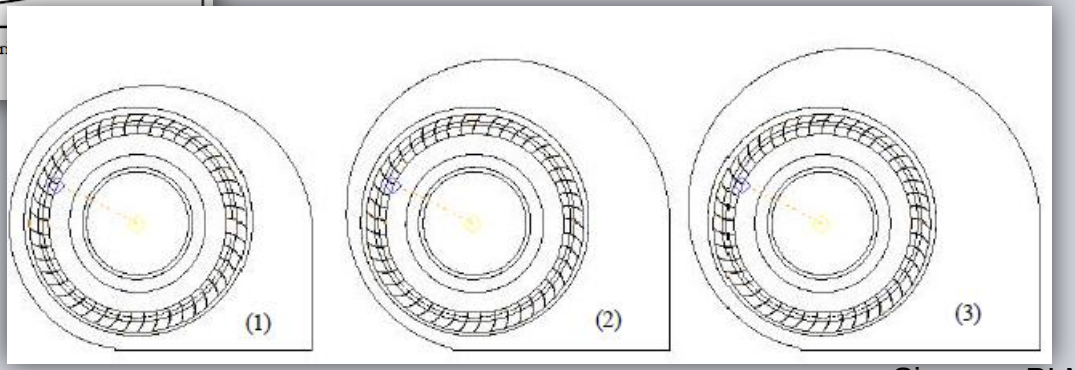


Figure 7: Flow Regime Map of A Blower In Terms of Isobar
numbered from 1 to 5 in order of increasing pressure level.





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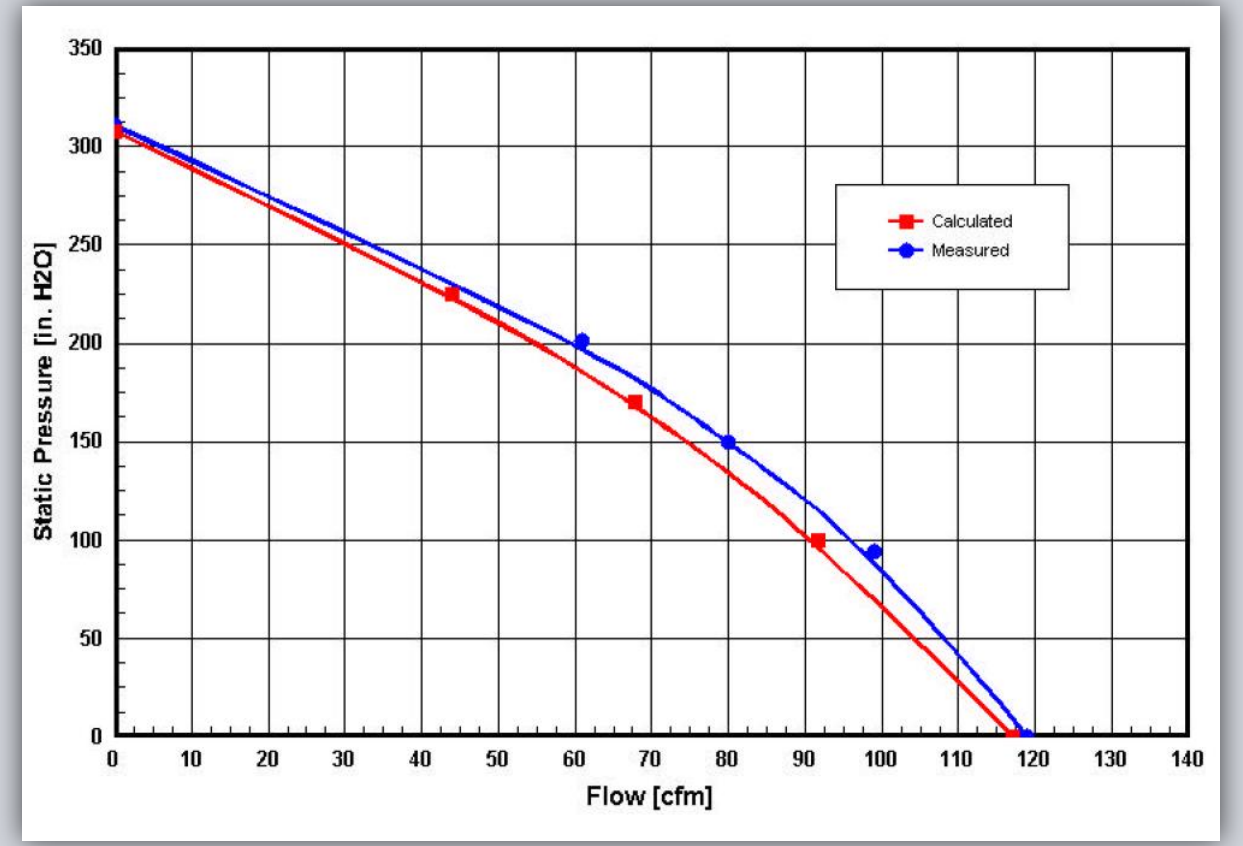
송풍기 해석 및 최적화

- 시험결과와 시뮬레이션 결과와의 비교 그래프



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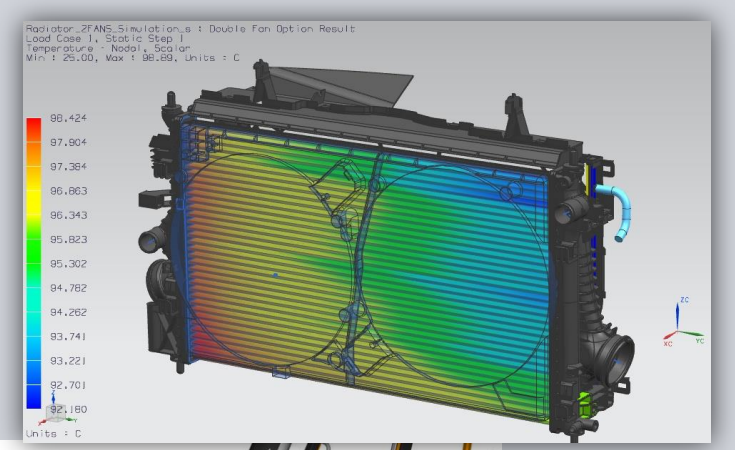
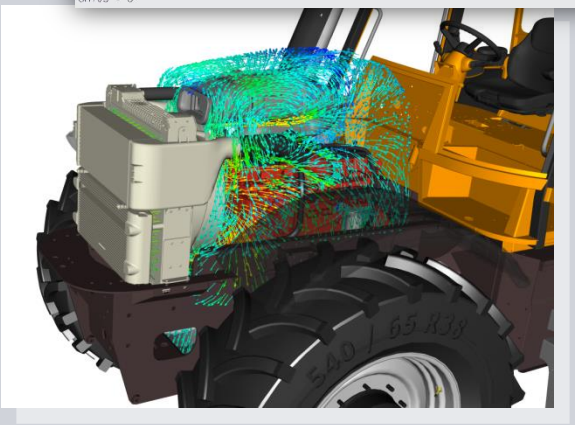
4 언더후드 냉각 해석

5 CAE 해석 자동화

6 기타 해석 사례





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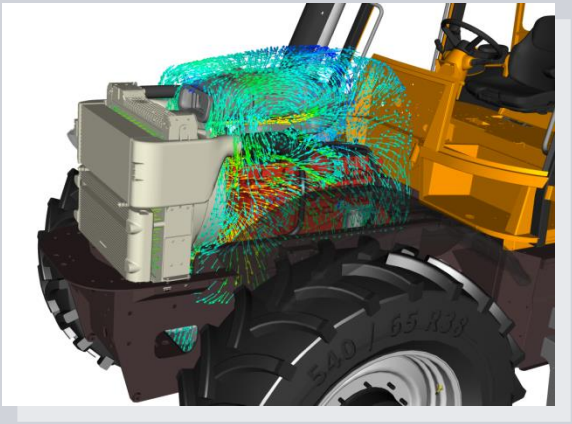
트랙터 언더후드 냉각



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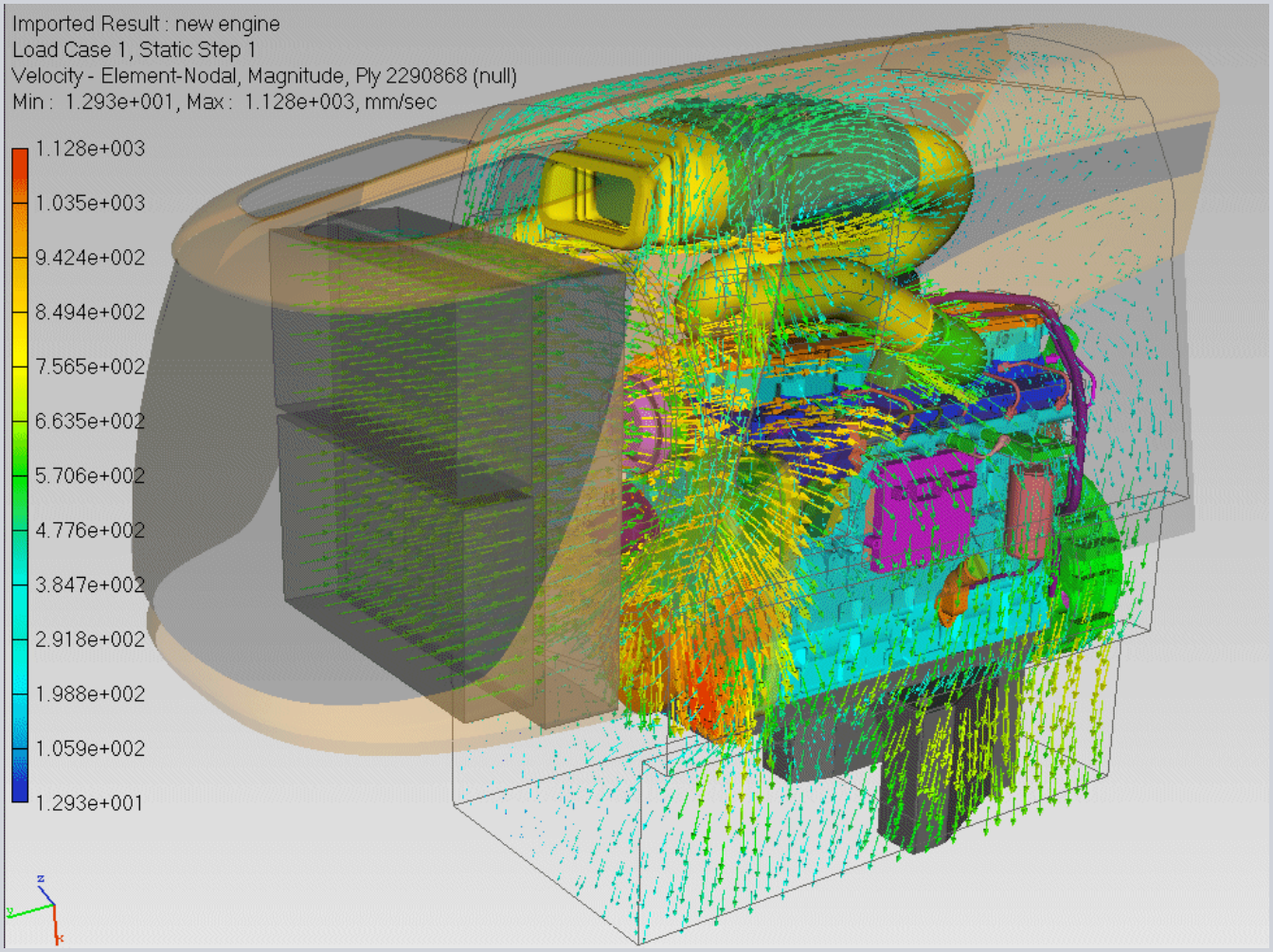
트랙터 언더후드 냉각



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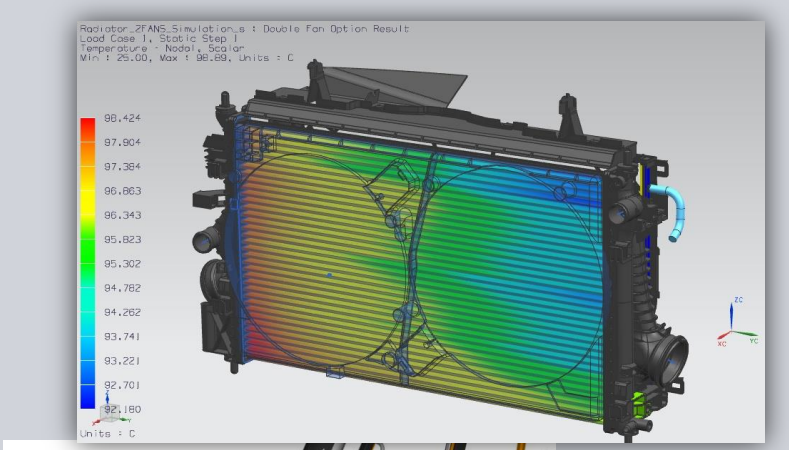
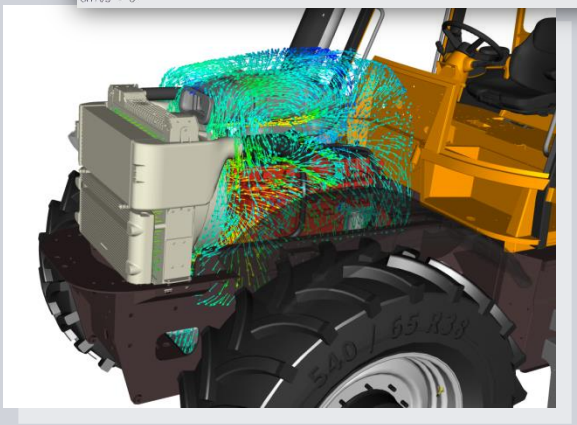
5 **CAE 해석 자동화**

6 기타 해석 사례





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Integrated Design & CAE Environment

Case Study: Automotive OEM

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Challenge:

설계자가 엔진 매니폴드 내 유동해석에 도전

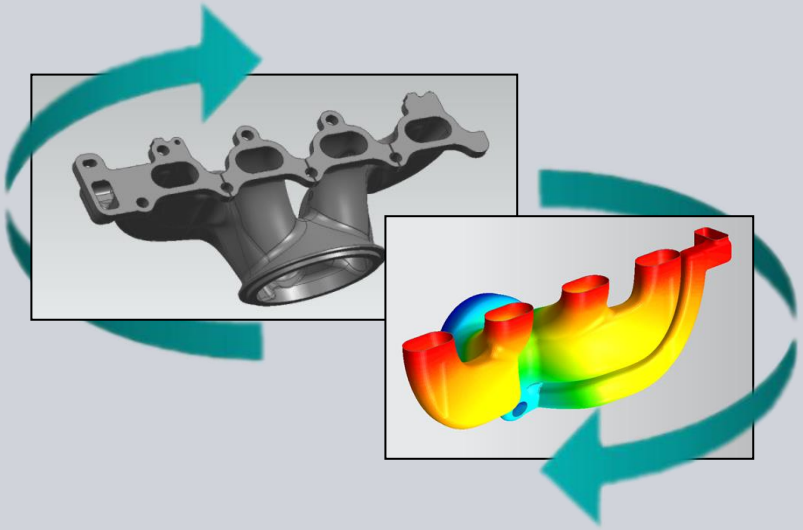
- Optimize a 10 day process requiring four CAE applications

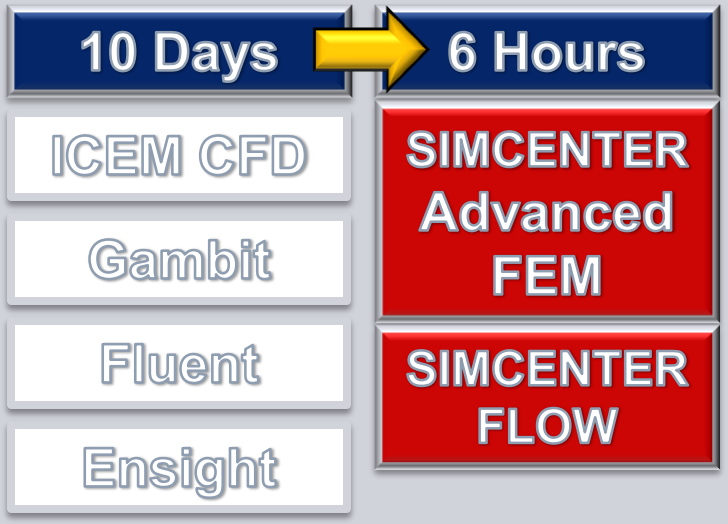
Solution:

- SIMCENTER Advanced FEM and SIMCENTER Flow으로 도전
- SIMCENTER Open을 이용한 자동화

Result:

- 통상 10일 걸리던 해석 프로세스를 6시간만에 가능하도록 함





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자동차 인테이크 매니폴드 **CFD** 해석

***Flow** 해석자동화를 위해 **SIMCENTER Open**을 이용*

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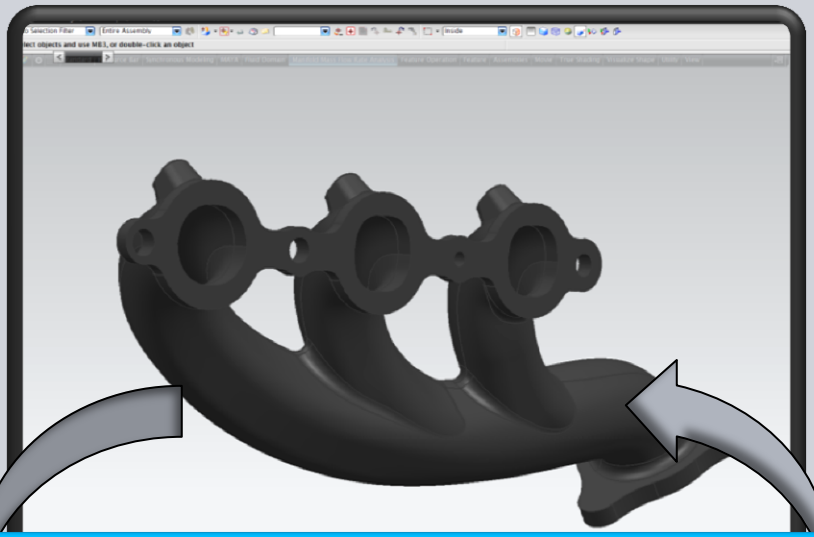
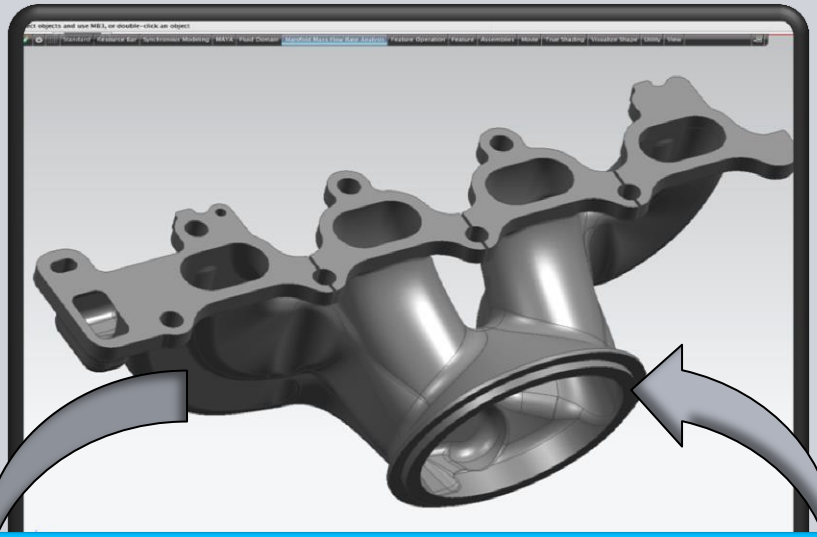
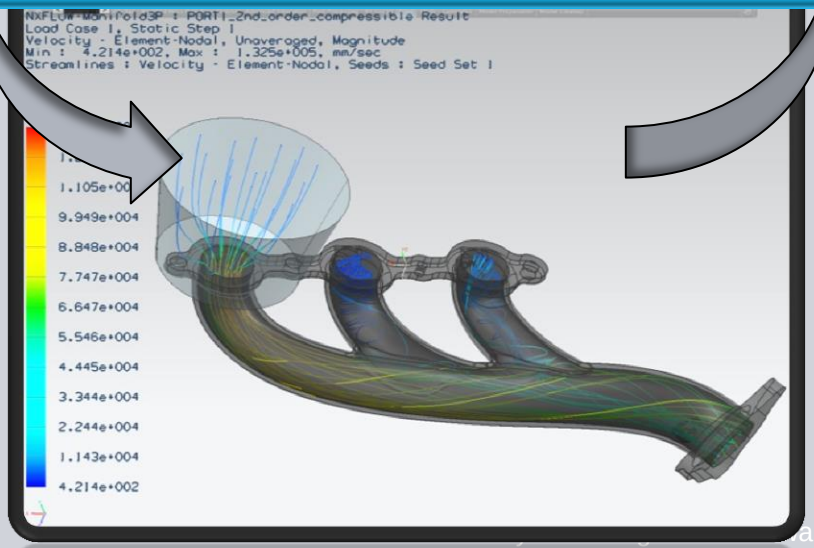
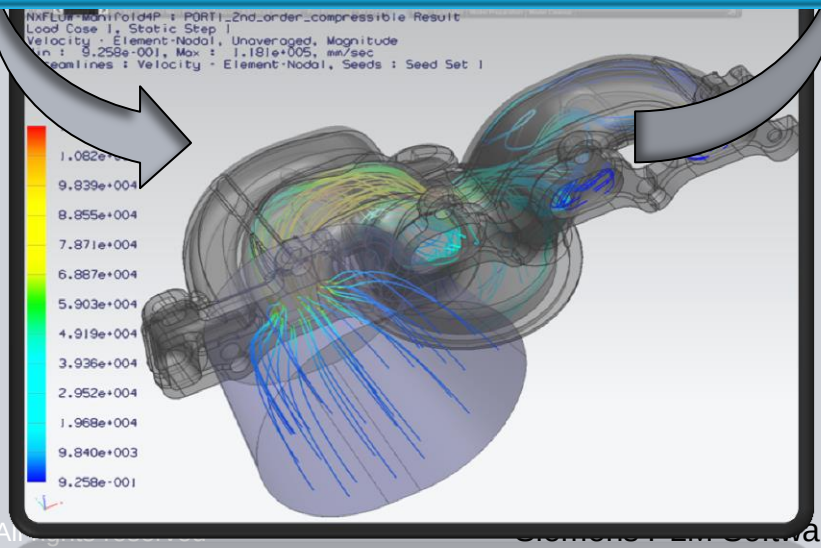




Same Process, Different Manifold Designs… Over and over again…





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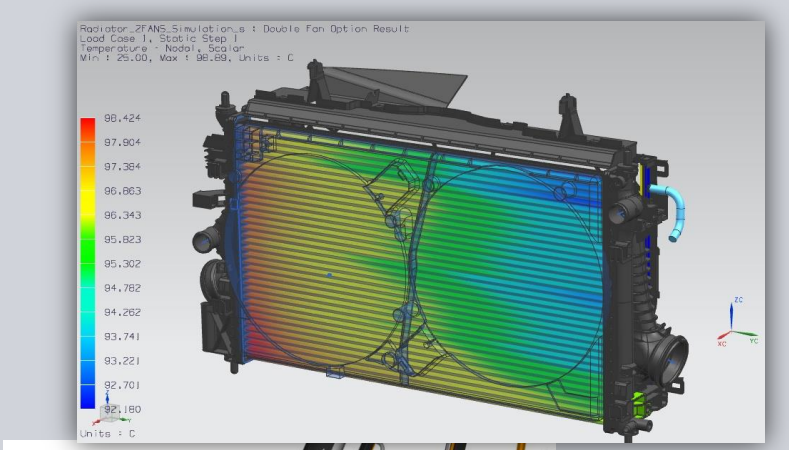

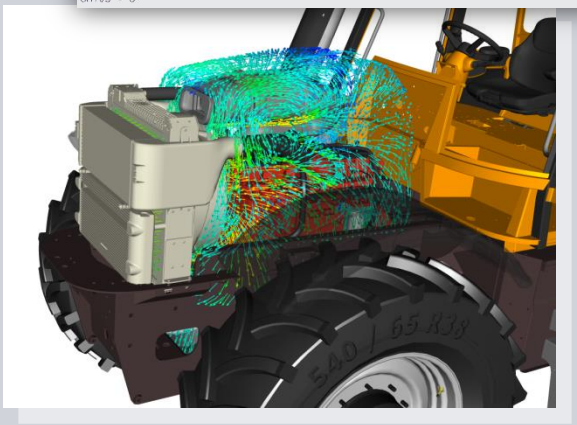

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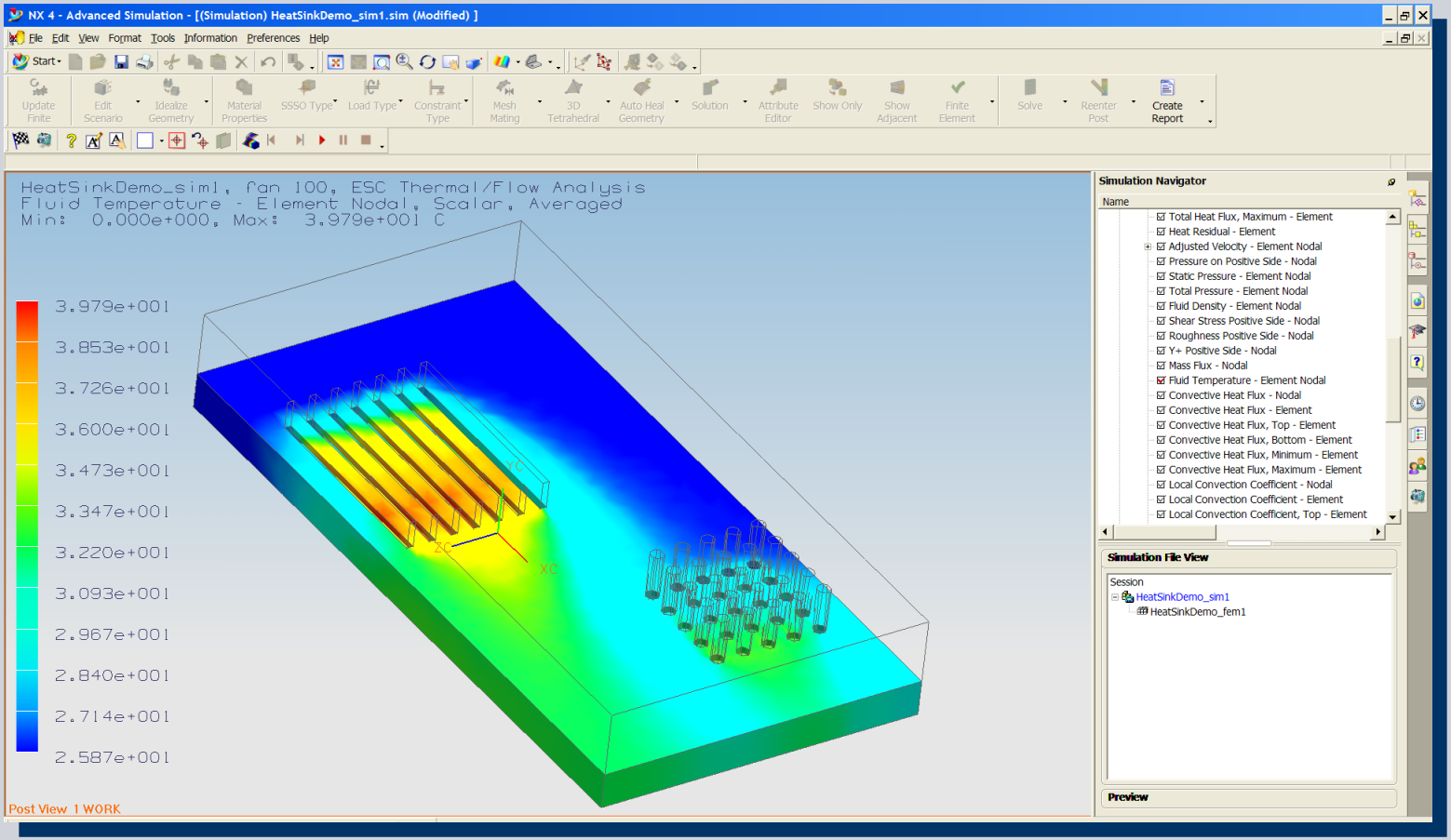
Heat Sinks Thermal



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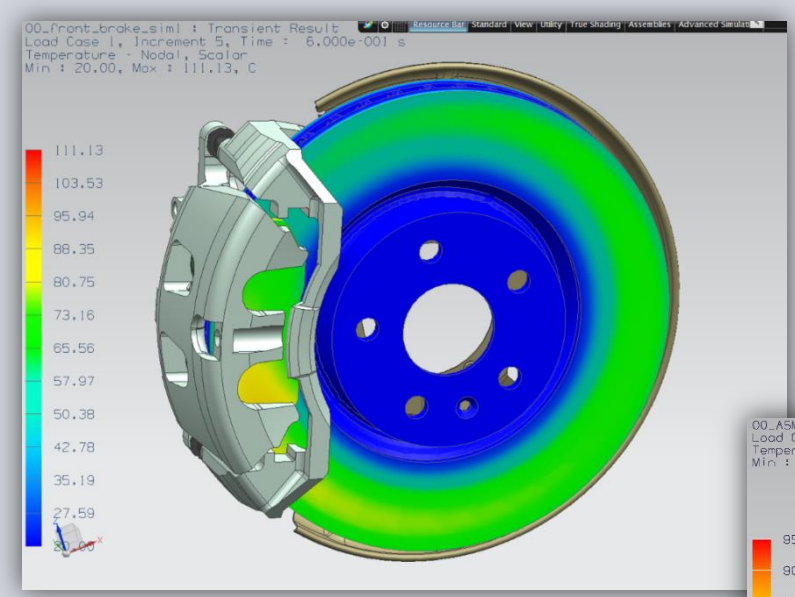
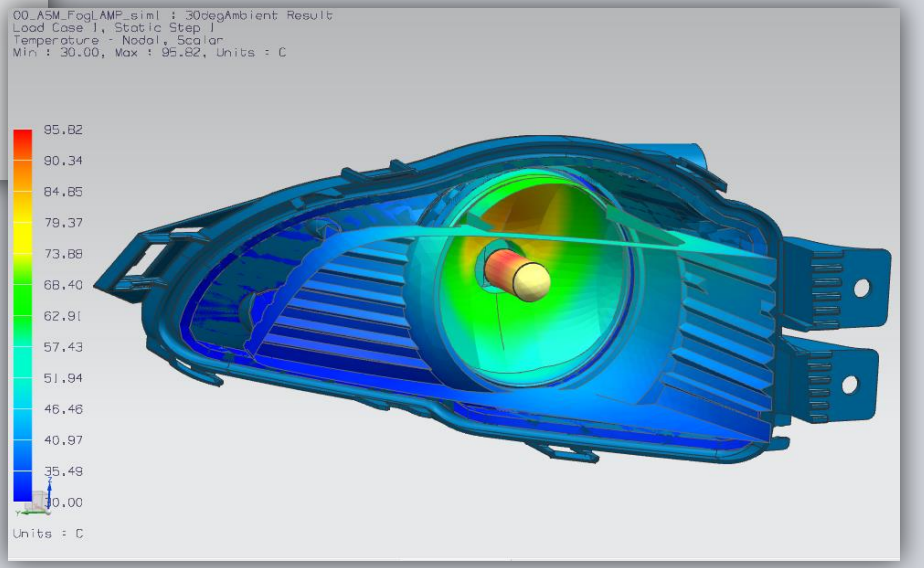
자동차 브레이크 열해석



자동차 램프 열해석



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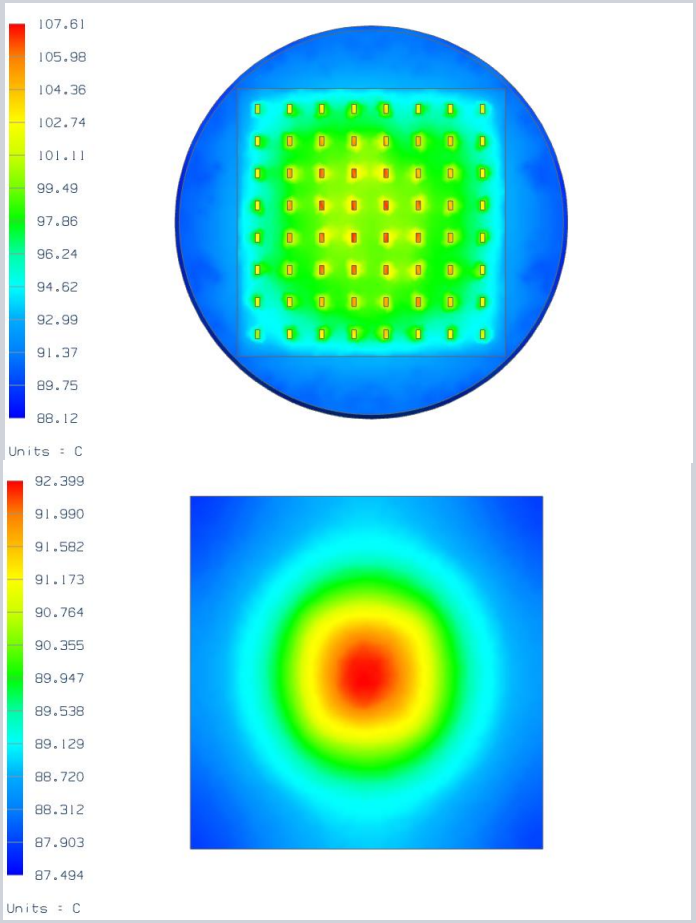
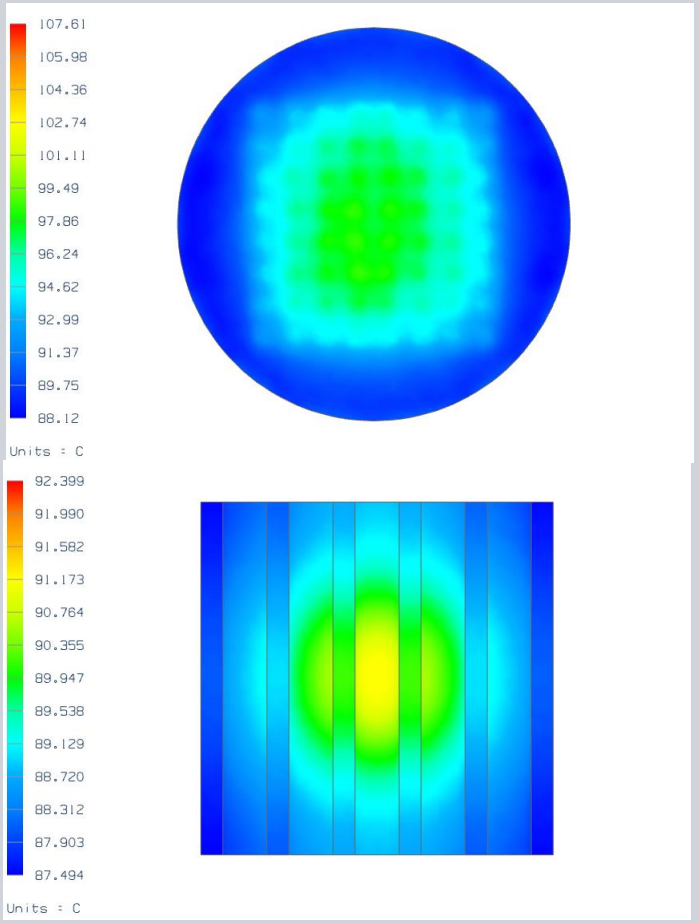
OLED Encap과 HS의 온도 분포





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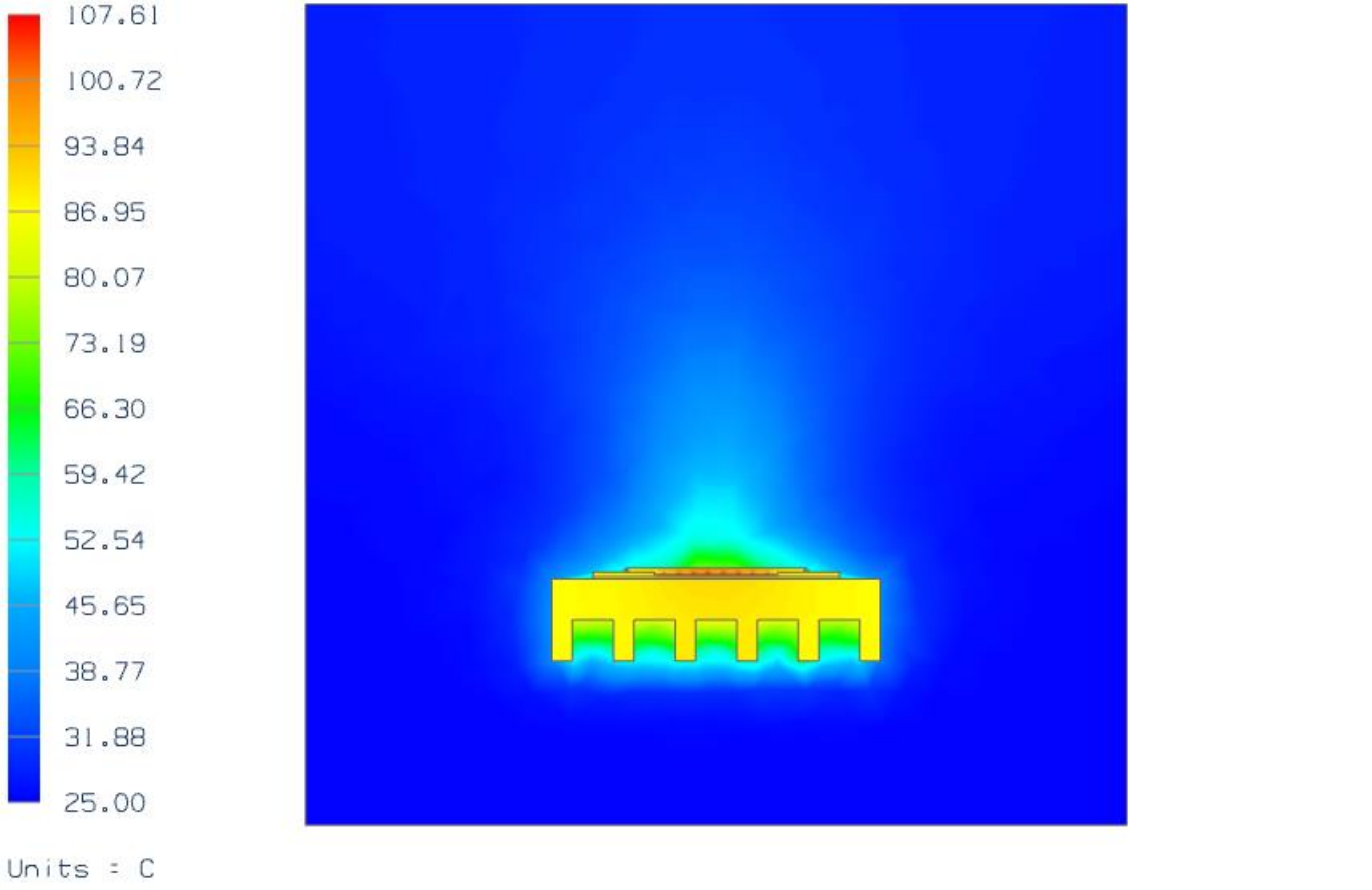

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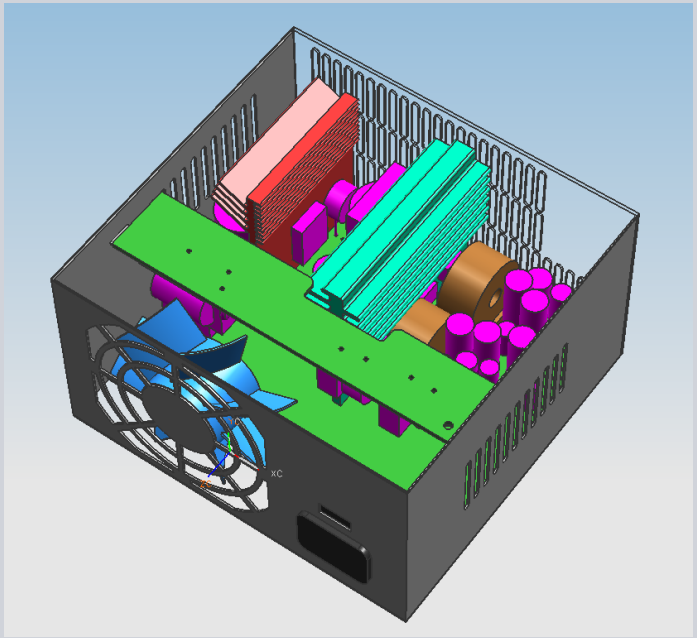
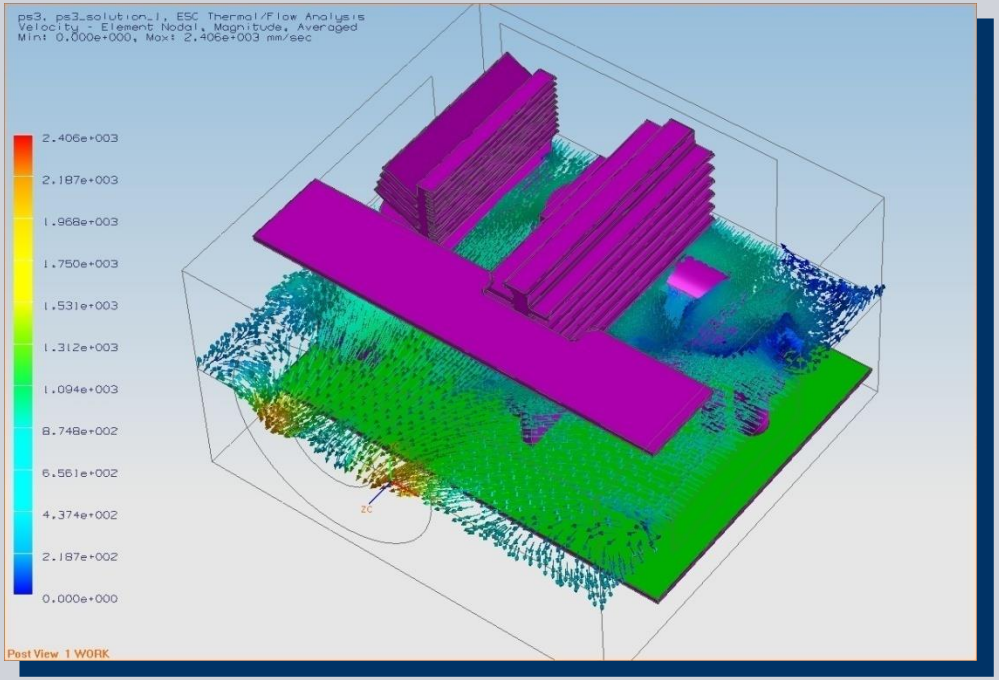
Power Supply 해석





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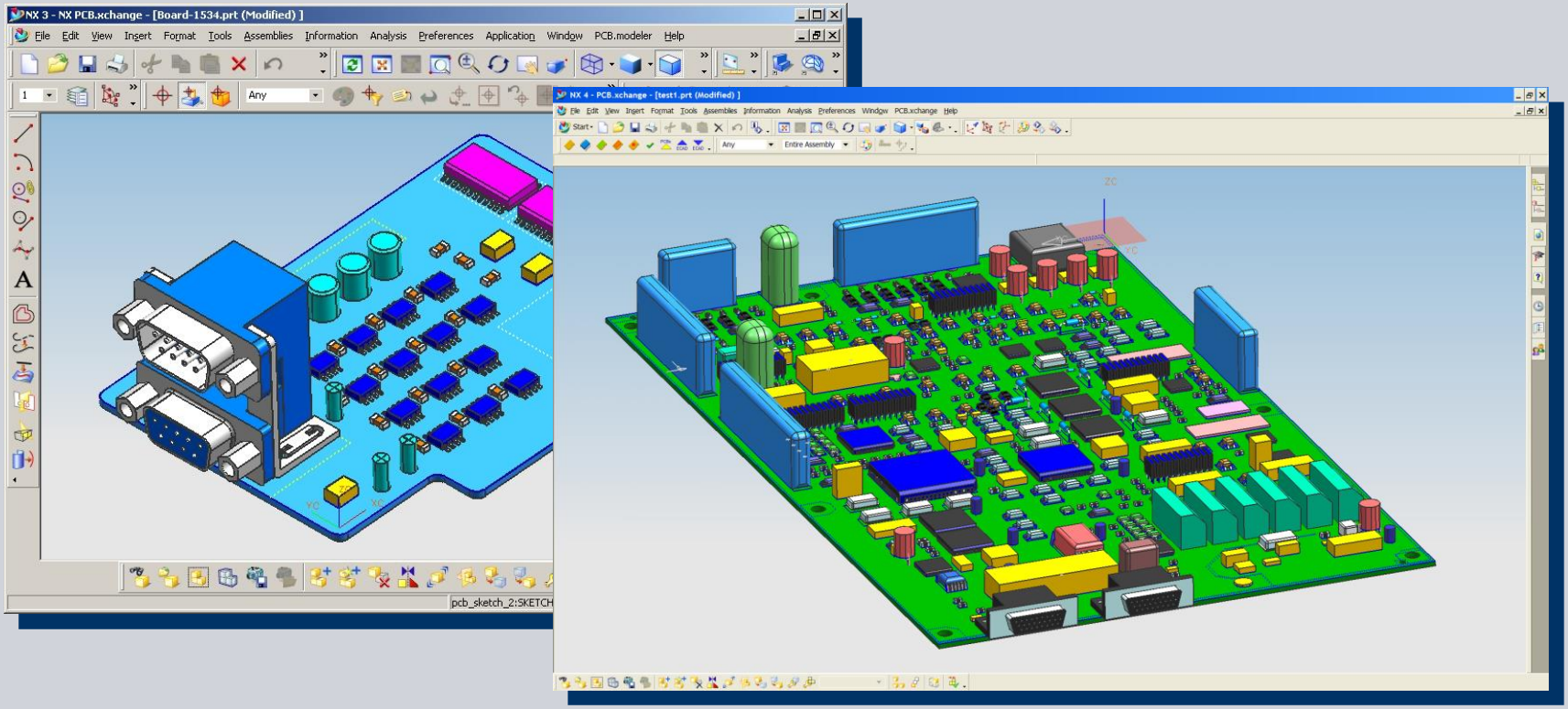
PCB 열유동 해석



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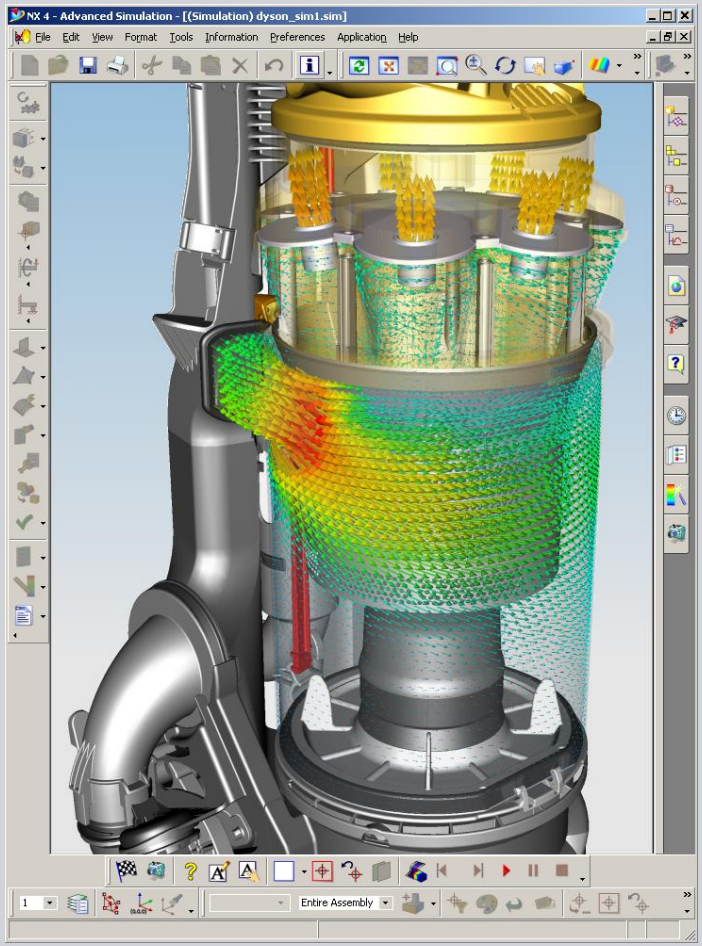
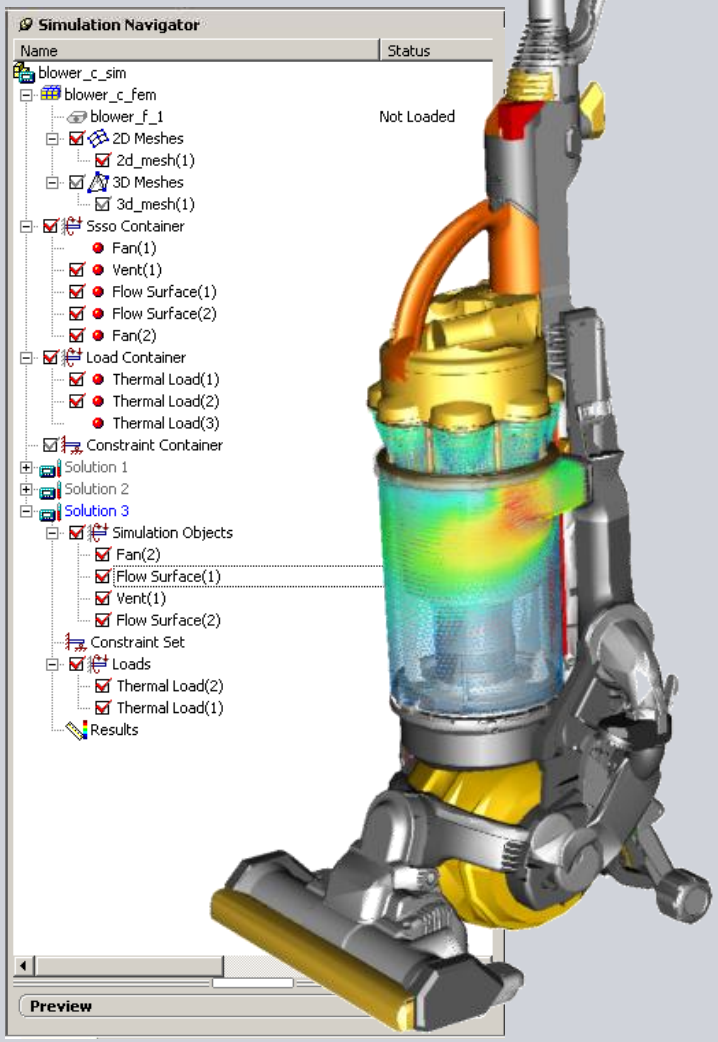
청소기





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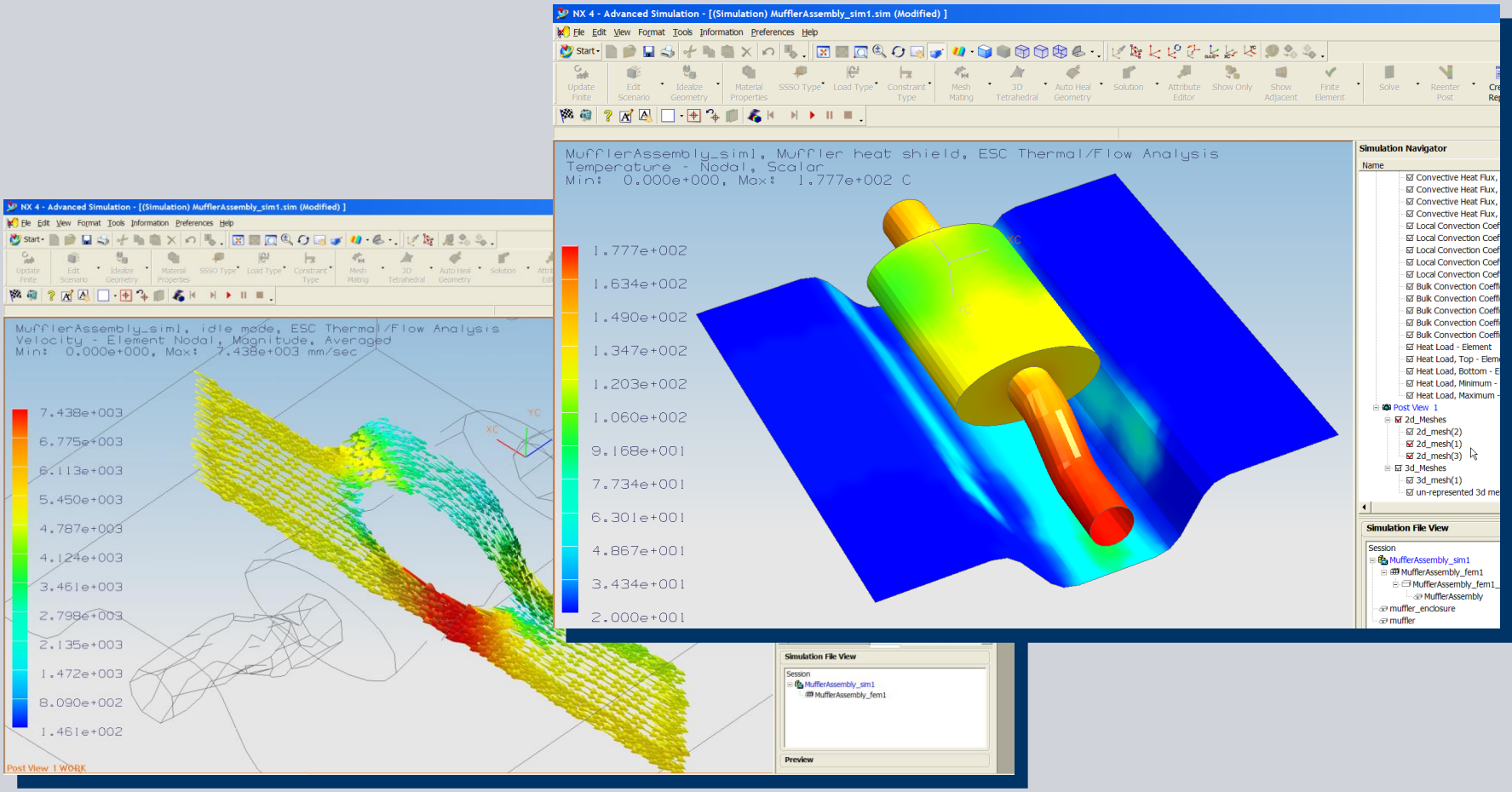

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