



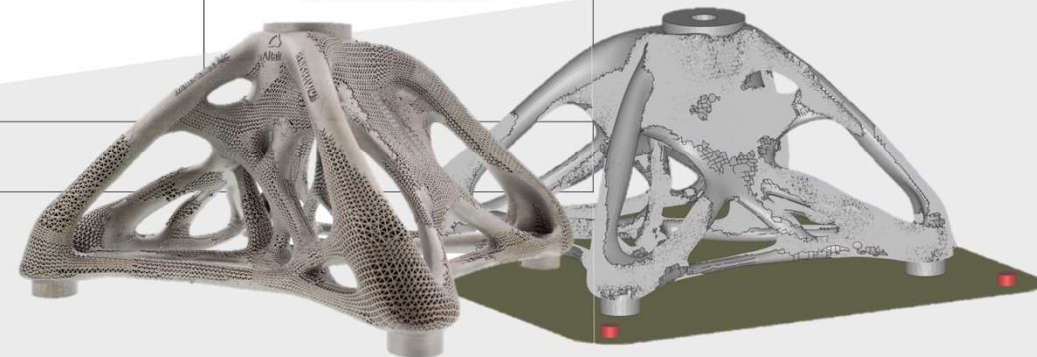
Additive Manufacturing 을 위한 공동 웨비나

Altair – Materialise

프로그램 진행안내

Agenda

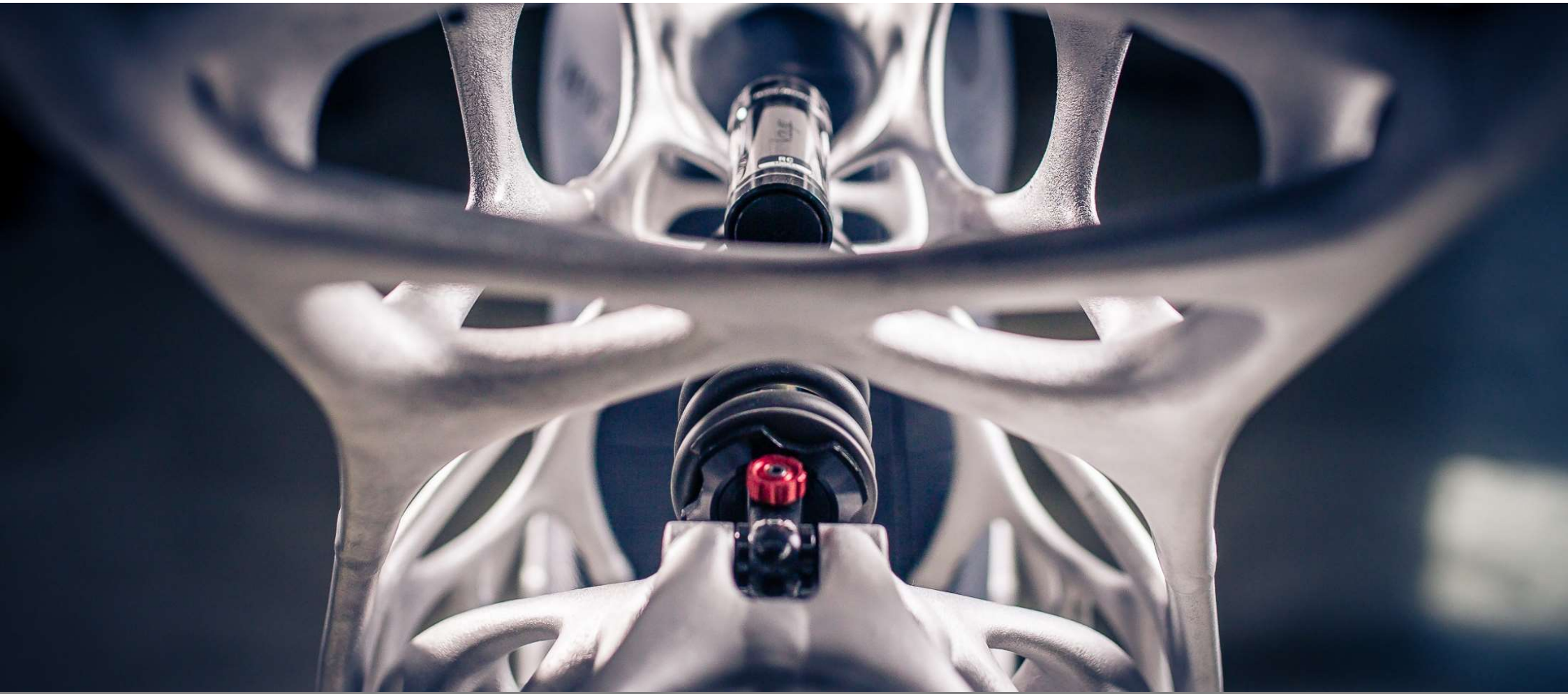
1. AM으로 부품 제작시 위상최적화를 위한 Altair OptiStruct & Inspire 활용 - OptiStruct_ & Inspire for AM - Spider Bracket Optimization Overview	Altair Korea
2. DfAM, 적층제조를 위한 디자인 : 빌드 성공률을 높이는 접근방안 - 위상최적화가 AM빌드에도 최적화 되어있는가? - Metal 프린팅을 위한 기본 요소 살펴보기	Materialise
3. Materialise 3-matic을 활용한 AM 디자인 최적화 시연 - STL 모델의 최적화 - 자유로운 래티스 컨트롤 - FEA 해석프로그램 연동을 위한 기능 - 빌드 준비를 위한 Data Size 관리	Materialise
4. Q&A	



Altair-Materialise 양사 소개



“3D 프린팅 소프트웨어 산업의 중추”



AM으로 부품 제작 시 위상최적화를 위한
ALTAIR OPTISTRUCT & INSPIRE 활용



AGENDA



- 1. Altair Solutions(OptiStruct & Inspire) for Additive Manufacturing**
- 2. Spider Bracket Optimization Overview**

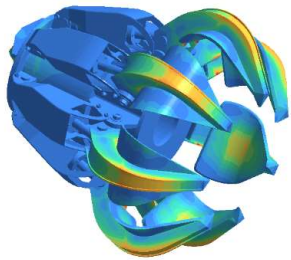
Altair Solutions(OptiStruct & Inspire) for Additive Manufacturing

BROAD PORTFOLIO OF ALTAIR SOFTWARE

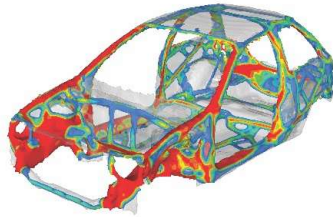


시뮬레이션, 데이터 인텔리전스 및 클라우드 컴퓨팅을 위한
포괄적인 개방형 아키텍처 솔루션

Design, Modeling
and Visualization



Physics
Simulation



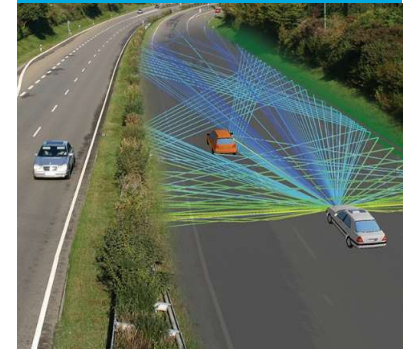
Data
Intelligence



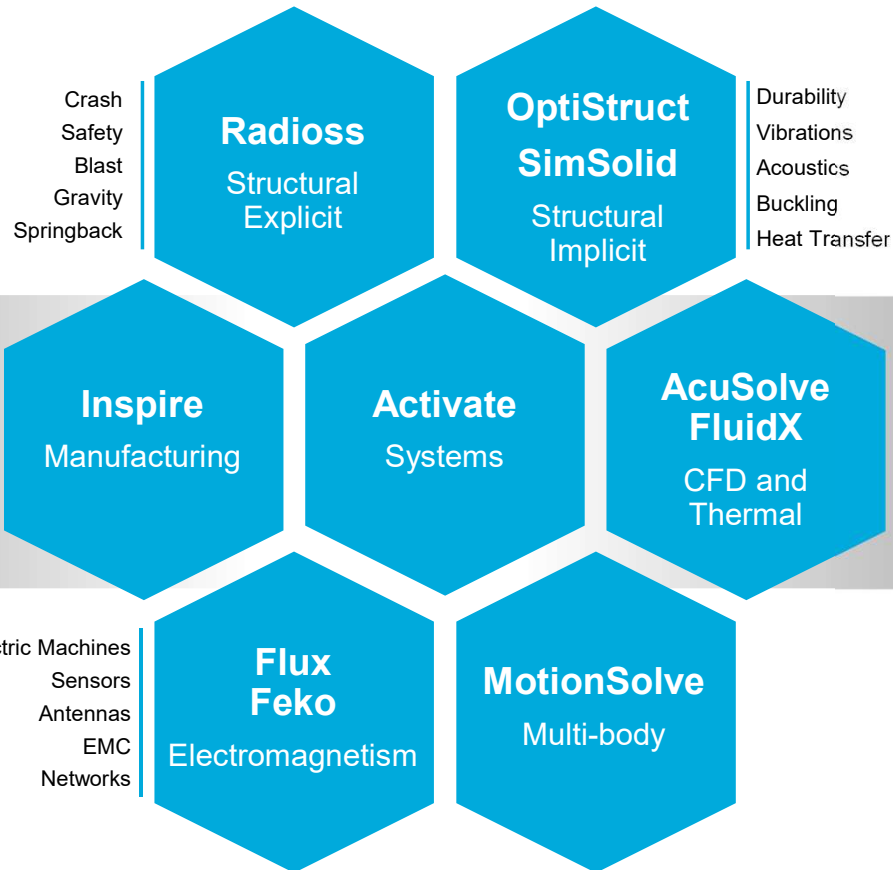
High-Performance
Cloud Computing



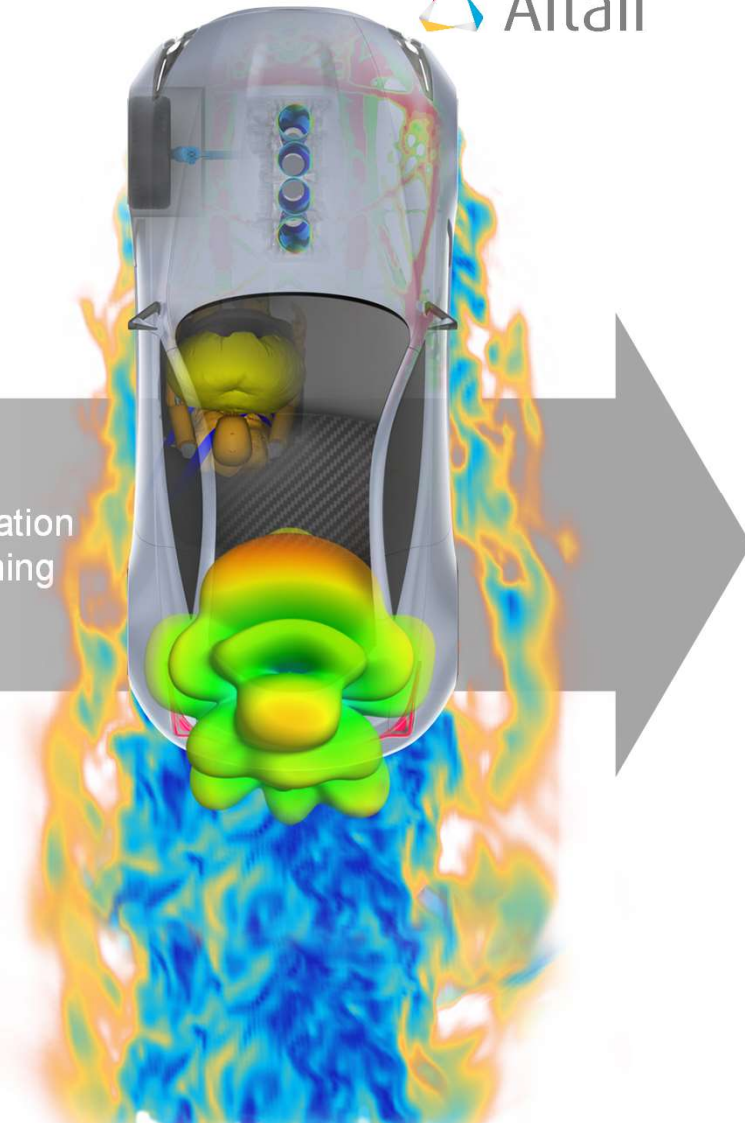
Internet of Things



ALTAIR SOLVER TECHNOLOGY



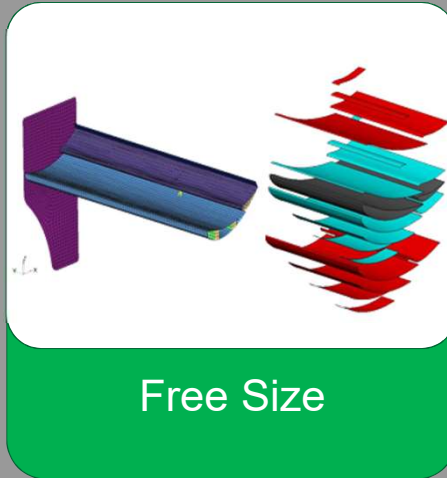
Design Optimization
Machine Learning



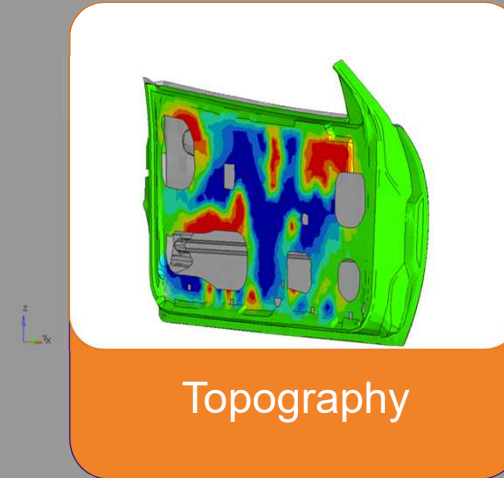
OPTIMIZATION TECHNOLOGY IN ALTAIR SOLUTIONS



Topology

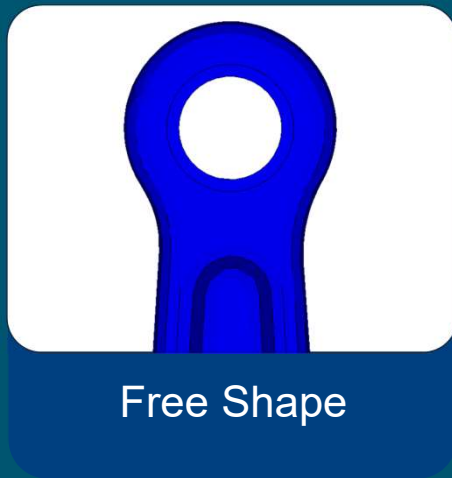


Free Size

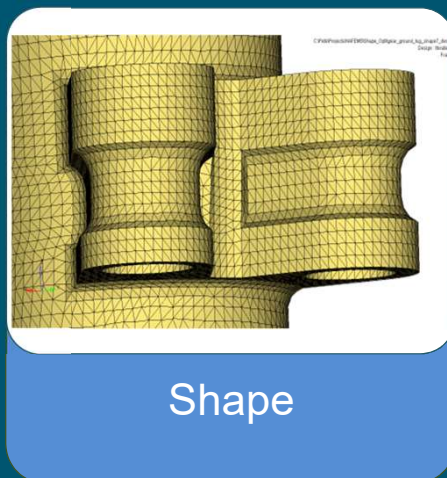


Topography

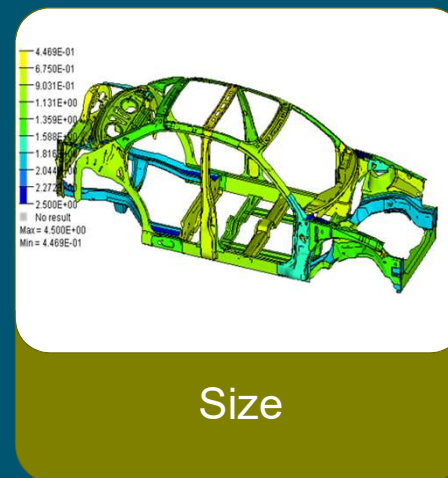
Concept
Design



Free Shape



Shape



Size

Design Fine
Tuning

TOPOLOGY OPTIMIZATION(위상 최적화)

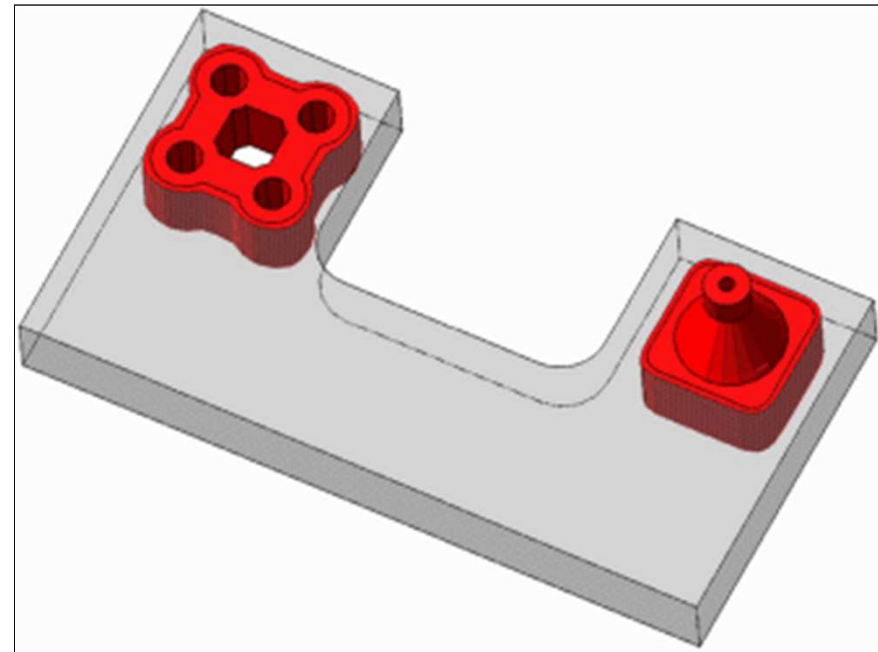


Topology Optimization 이란 ?

패키지 공간, 제조의 제약 조건 그리고 하중 조건이 주어지면 구조에 대한 견고함을 최대화, 질량을 최소화 등 설계의 목표와 같은 엔지니어링 성능 기준을 충족하는 이상적인 형상을 생성합니다.

대부분의 시뮬레이션은 설계가 성능 기준을 충족하는지 알려줍니다.

Topology Optimization은 성능 기준에 맞는 디자인을 만듭니다.



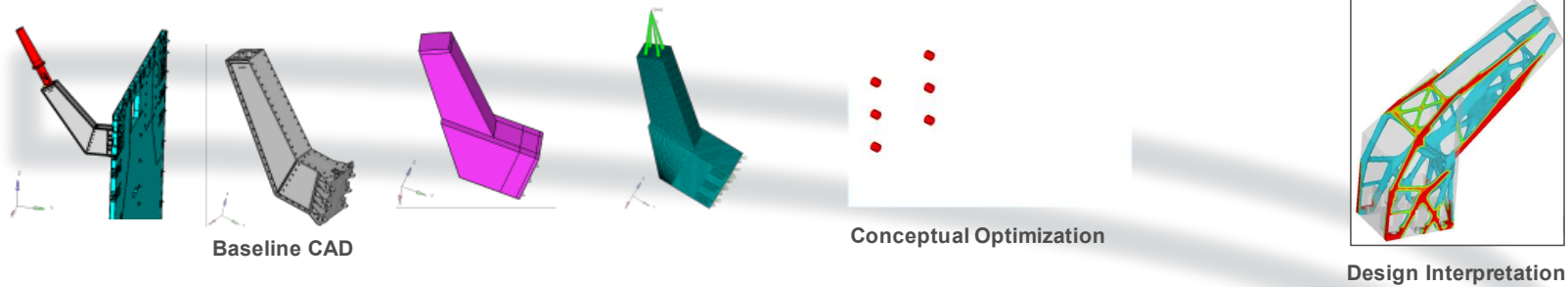
사례연구: 인공위성 안테나 브라켓

Simulation-Driven Design



사례연구: 인공위성 안테나 브라켓

Simulation-Driven Design

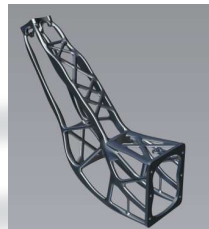


고유진동수 증가
(70Hz → 90 Hz)

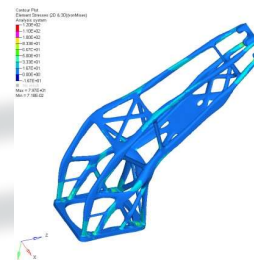
43% Mass Reduction



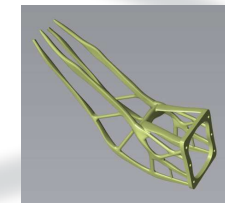
Manufacturing



Geometry validation



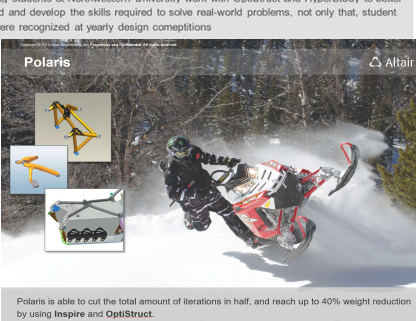
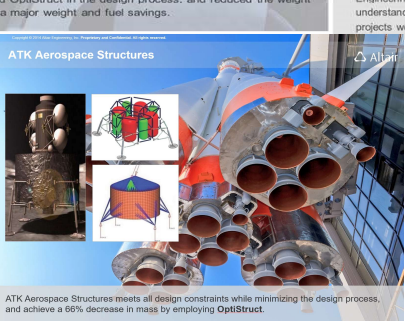
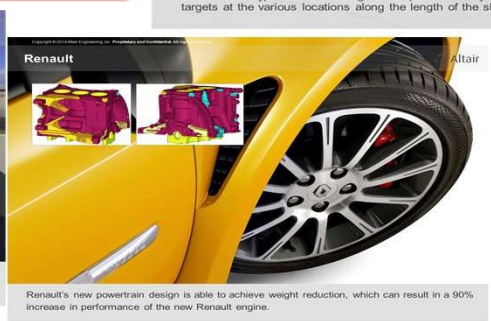
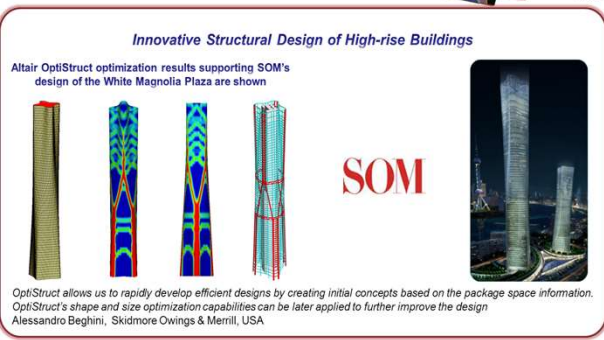
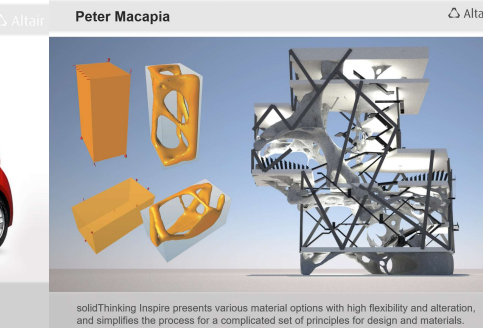
Evaluation of design



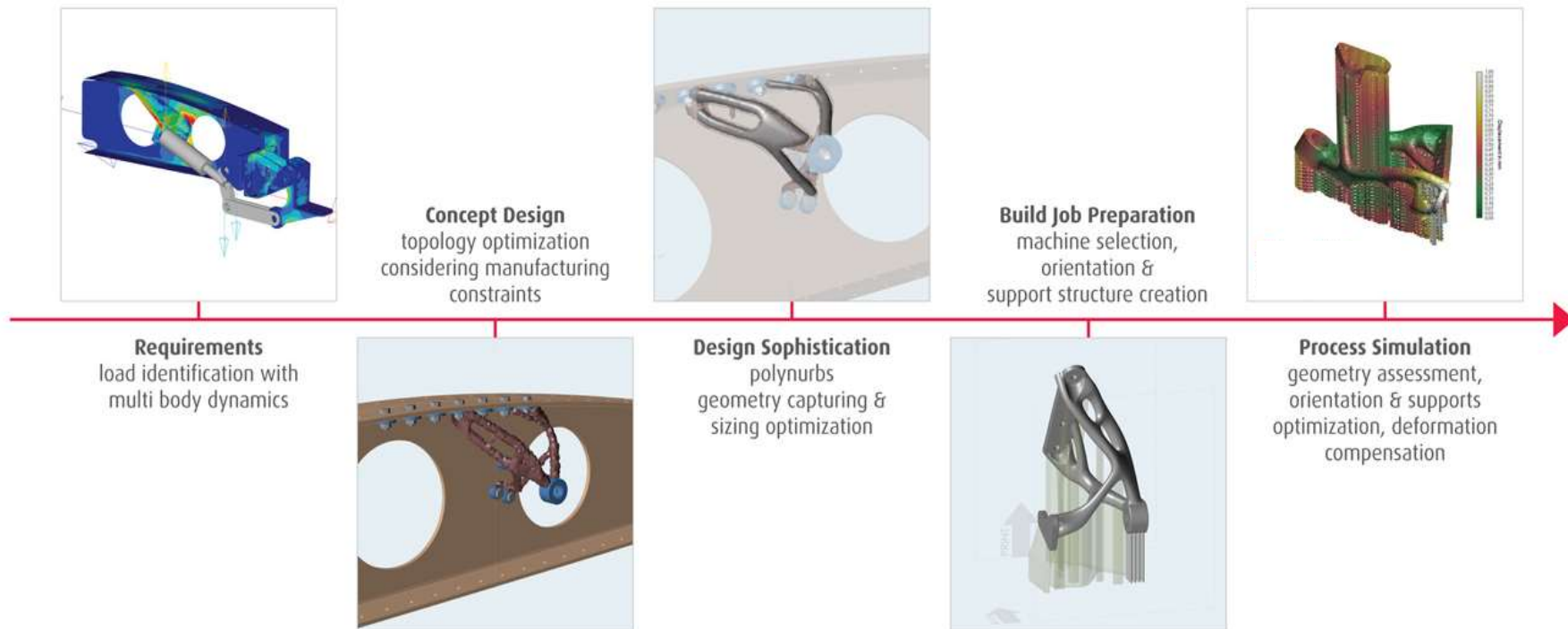
Geometry creation

Together
ahead. **RUAG**

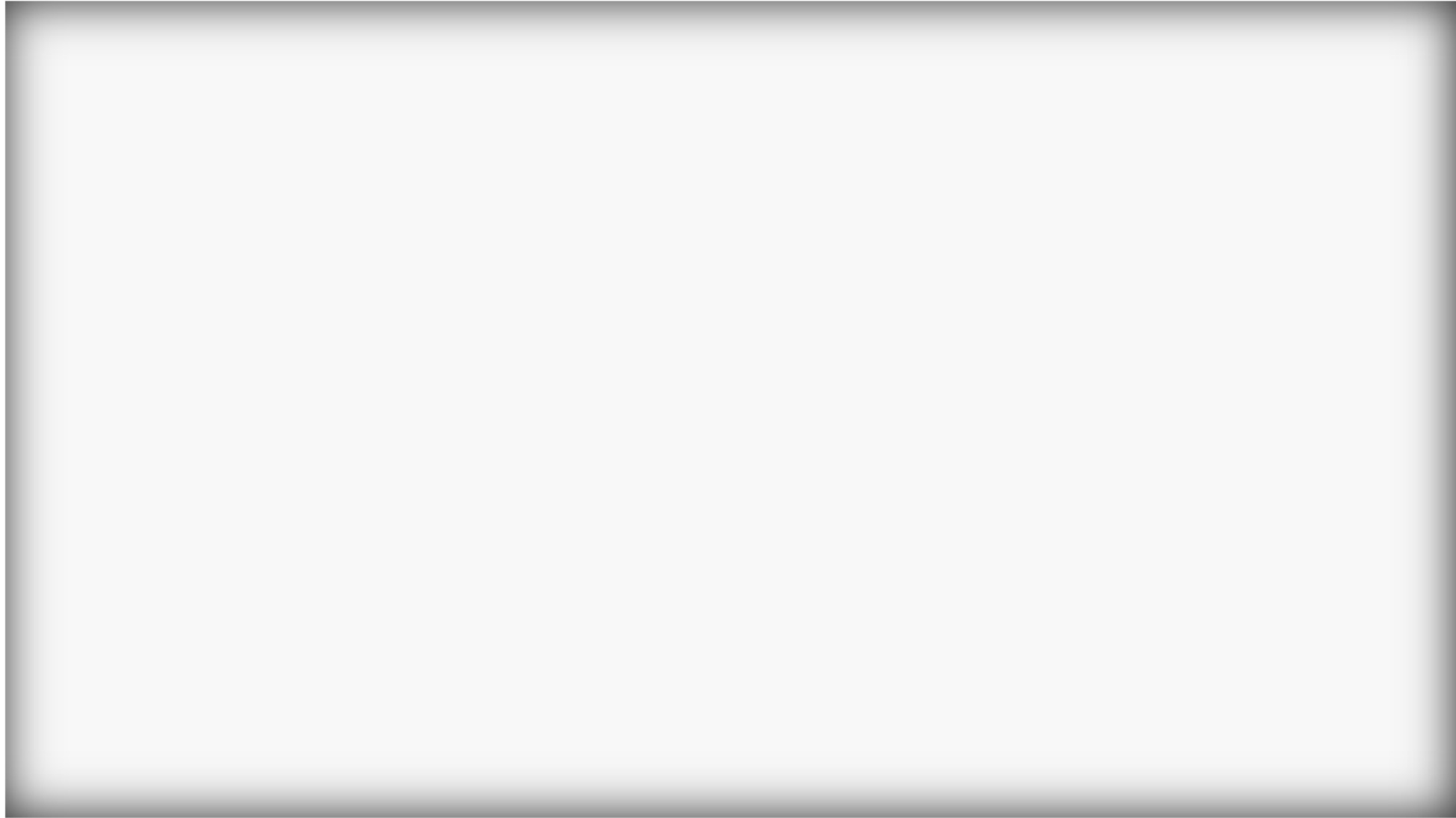
ALTAIR – OPTIMIZATION DRIVEN DESIGN FOR INDUSTRIES



ADDITIVE MANUFACTURING PROCESS FLOW

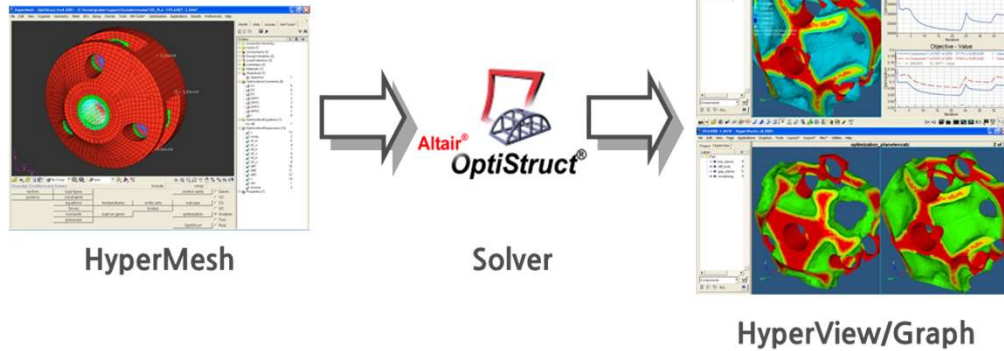


ALTAIR INSPIRE의 제안

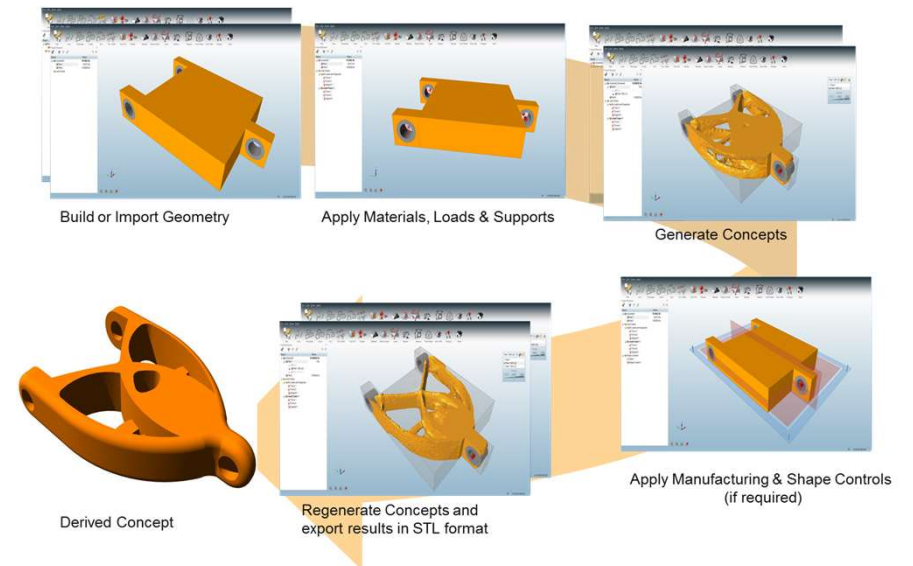


ALTAIR SOLUTIONS

전문 CAE 엔지니어



설계 엔지니어, 제품 개발자

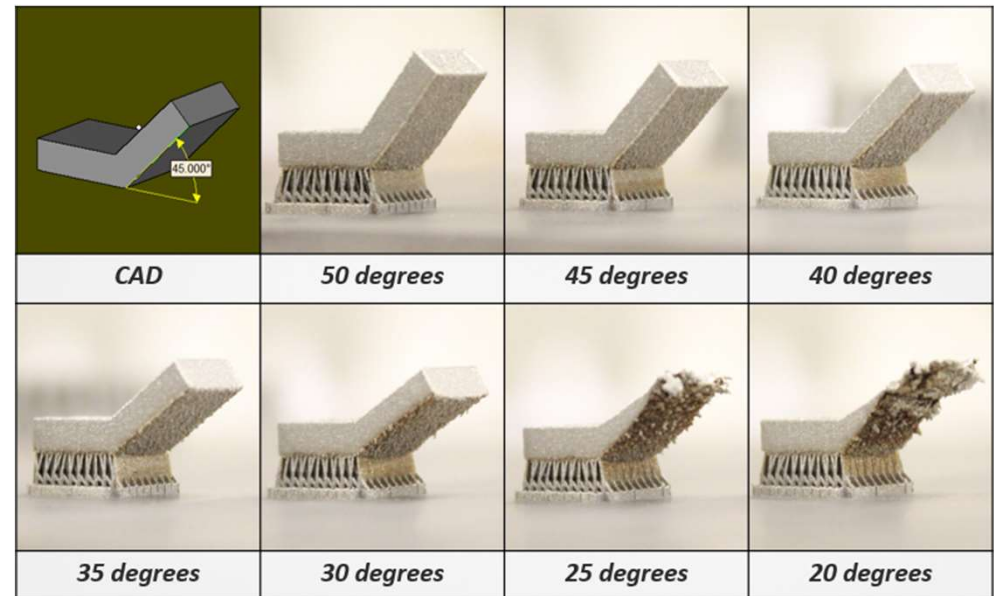
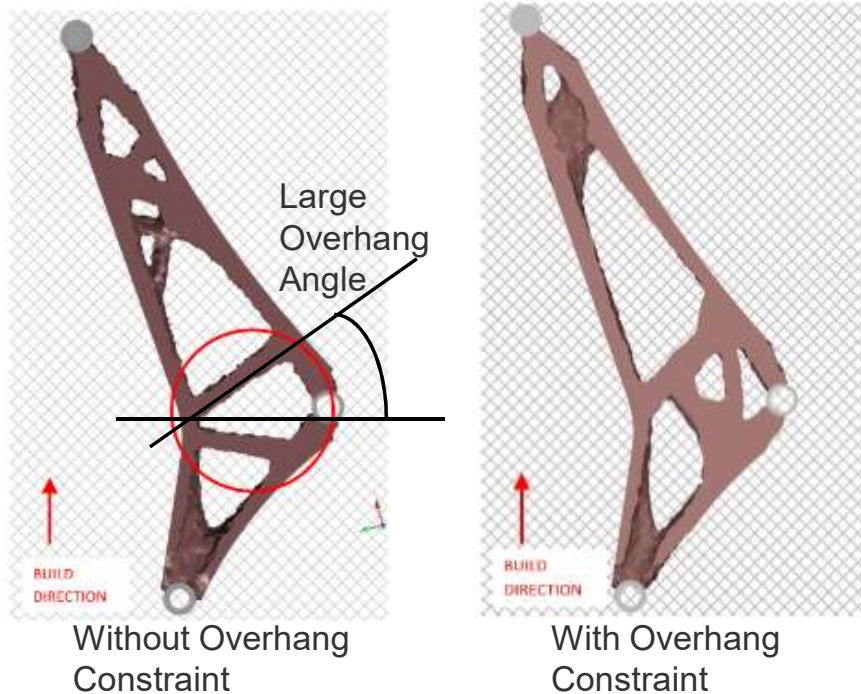


OVERHANG ANGLE 제한 조건



Overhang Angle 란?

OptiStruct /INSPIRE는 이 문제를 극복하기 위해 Overhang Angle제한이 포함됩니다.



OVERHANG ANGLE, 적층방향 제한 조건

ANGLE에 따른 효과

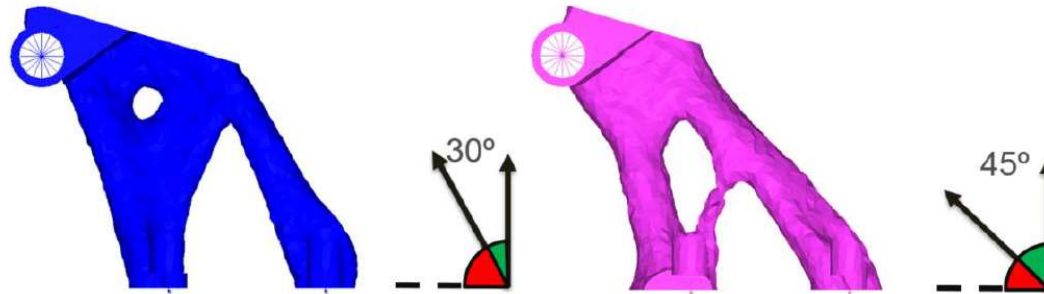
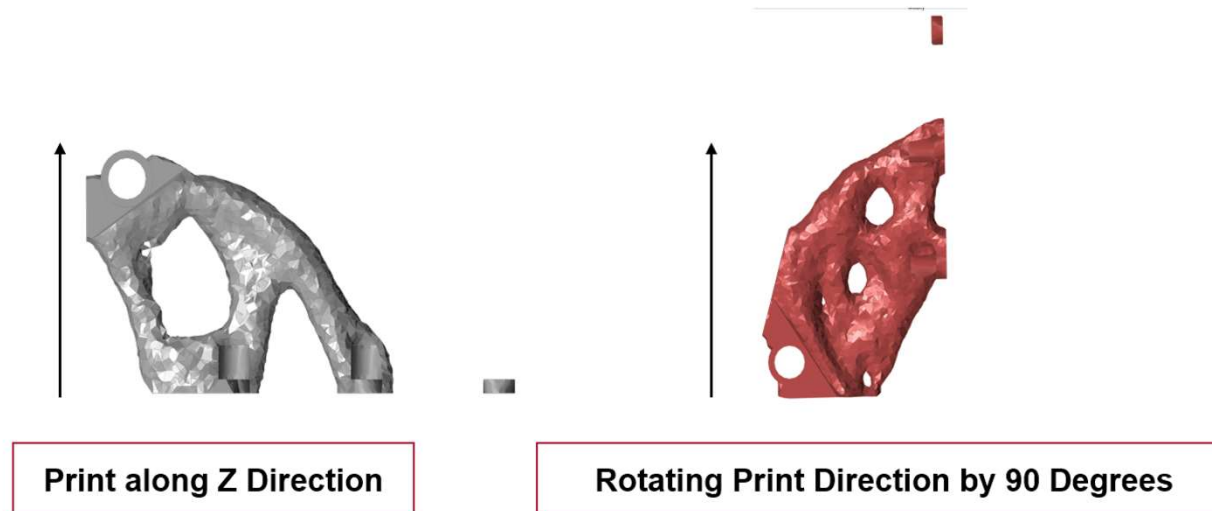
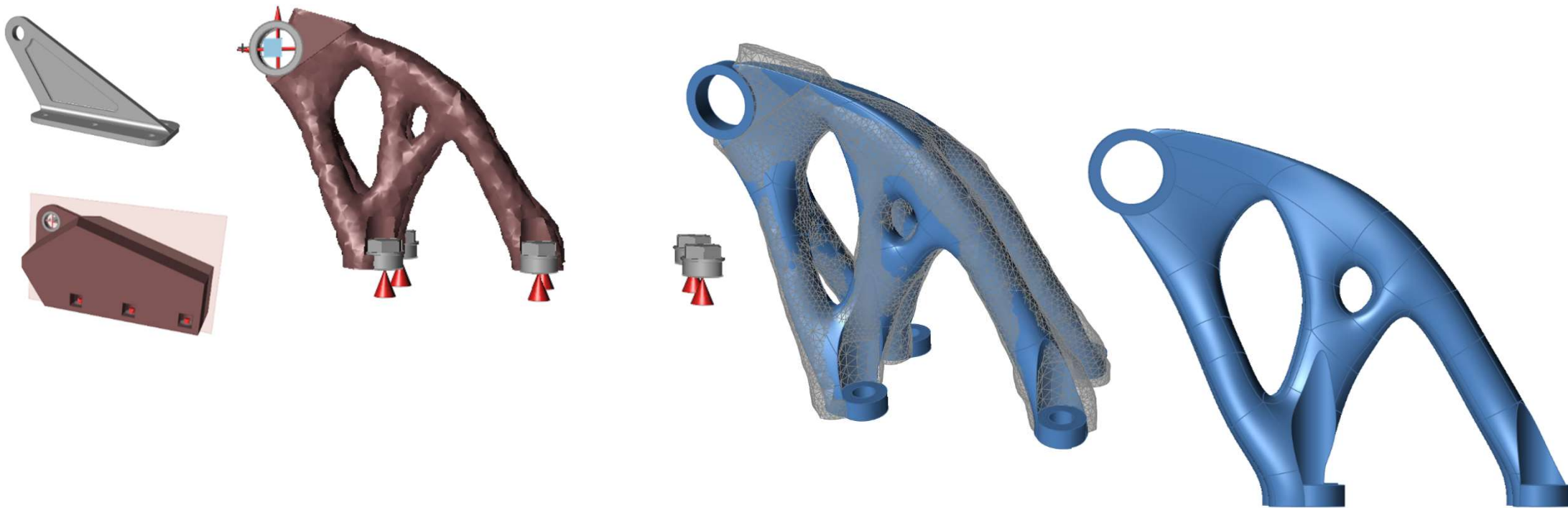


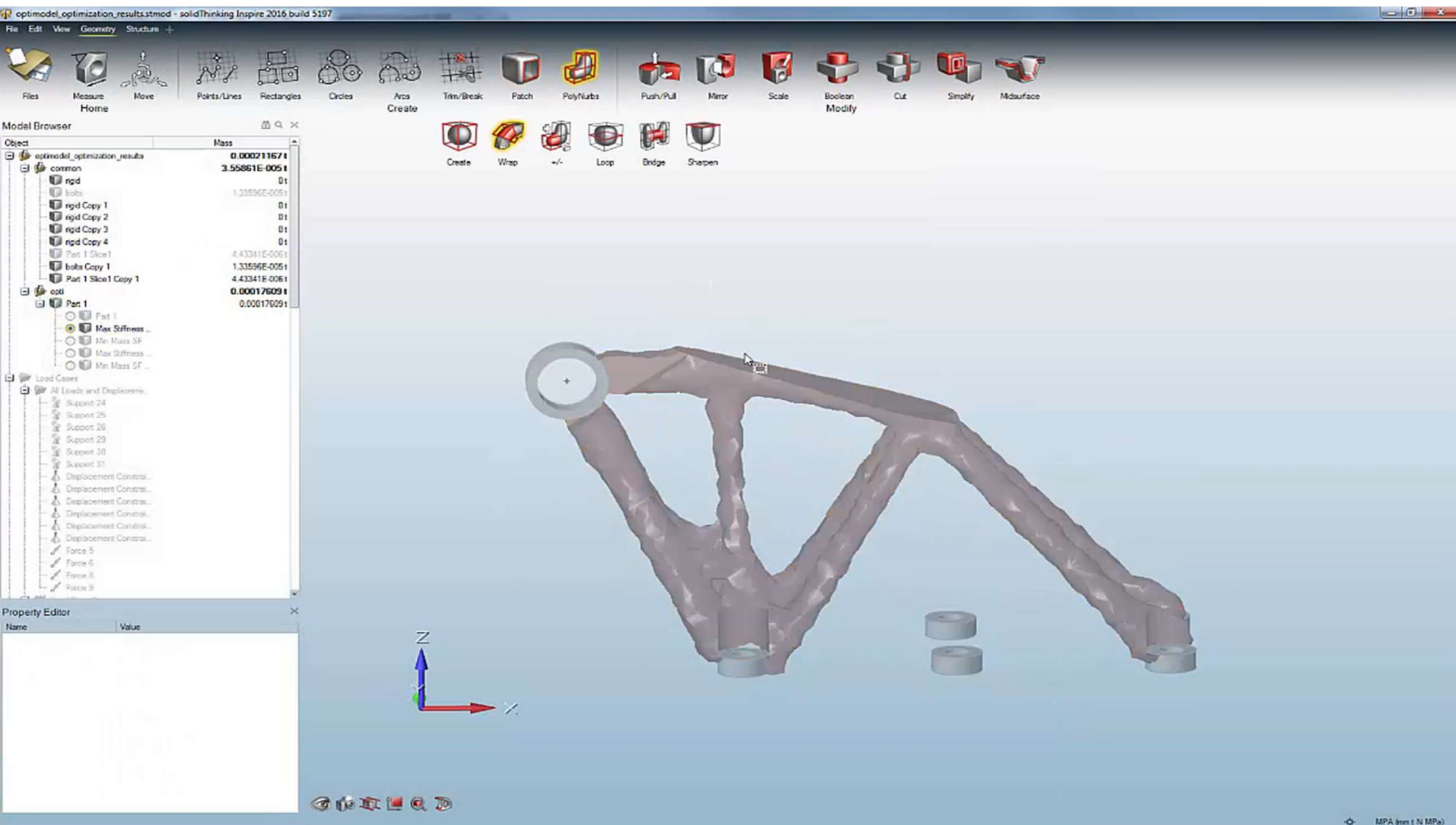
Figure 3: Example of the result obtained by varying allowable OHA parameter.

적층방향 변경에 따른 효과



POLY NURBS

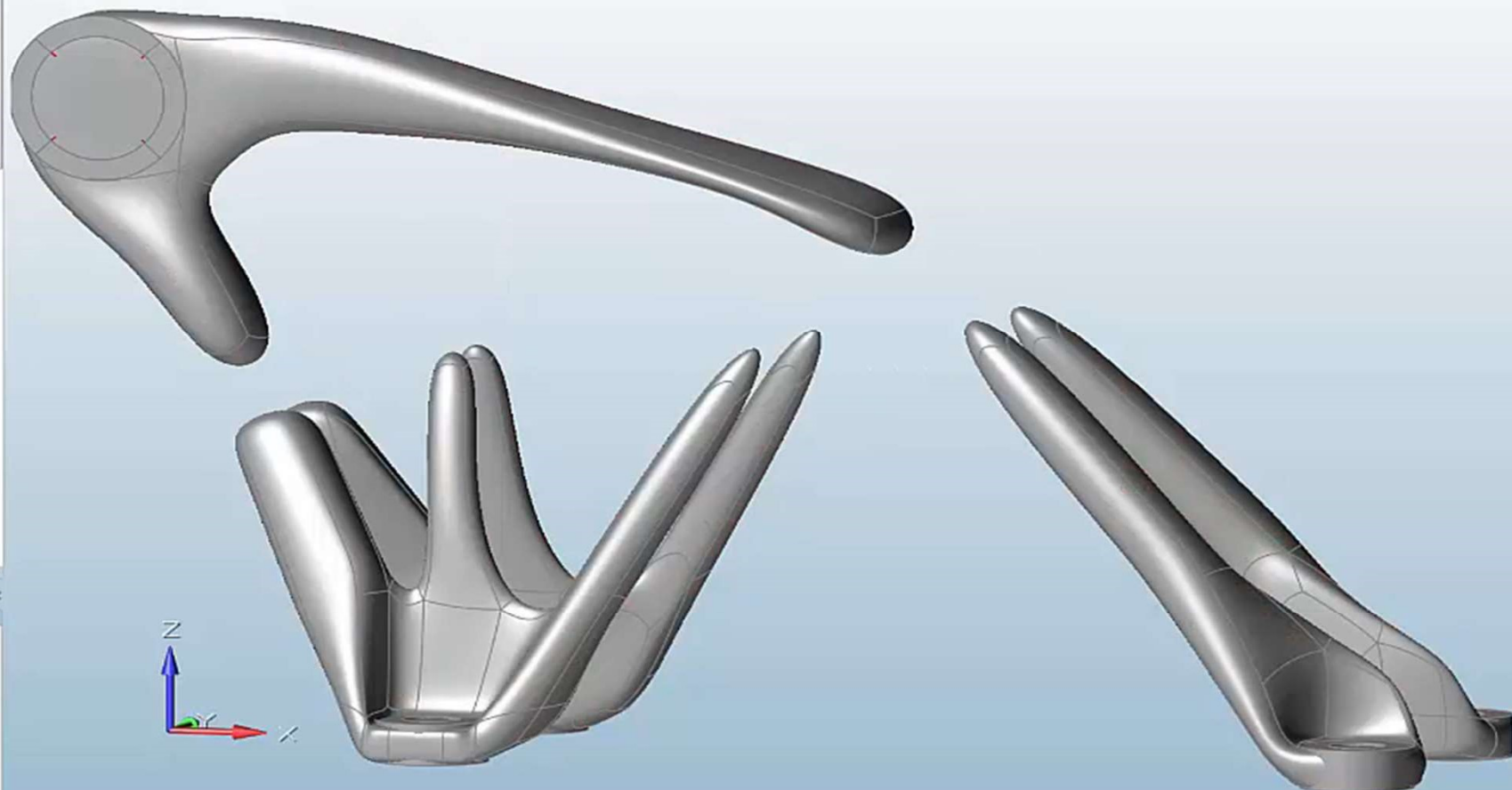
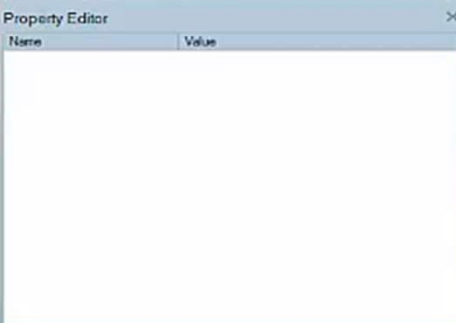






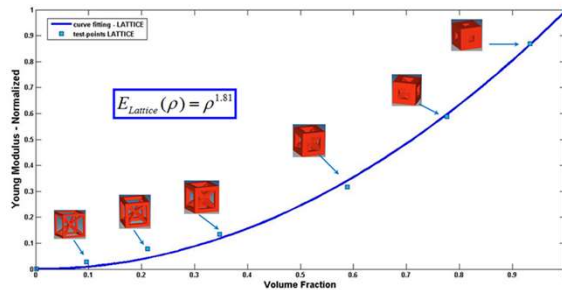
Model Browser

Object	Mass
optmodel_optimization_poly...	0.000698251
common	5.626171E-0051
rigid	01
bolts	1.33595E-0051
rigid Copy 1	01
rigid Copy 2	01
rigid Copy 3	01
rigid Copy 4	01
Part 1 Slice1	4.43341E-0061
bolts Copy 1	2.2255E-0051
Part 1 Slice1 Copy 1	4.43341E-0061
bolts Copy 1 Solid 1	6.36173E-0061
bolts Copy 1 Solid 2	6.36173E-0061
bolts Copy 1 Solid 3	6.36173E-0061
bolts Copy 1 Solid 4	6.36173E-0061
bolts Copy 1 Solid 5	6.36173E-0061
cut	0.000176091
Part 1	0.000176091
Part 1	
Max Stiffness	
Min Mass SF	
Max Stiffness	
Min Mass SF	
PolyNURBS Block Mirror...	0.00046521
Load Cases	
All Loads and Displace...	
Support 24	
Support 25	
Support 26	
Support 29	
Support 30	
Support 31	
Displacement Constrai...	
Displacement Constrai...	
Displacement Constrai...	
Displacement Constrai...	

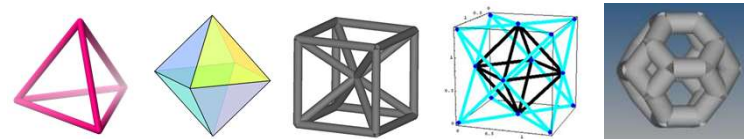


LATTICE구조의 디자인 – TOPOLOGY WITH POROSITY

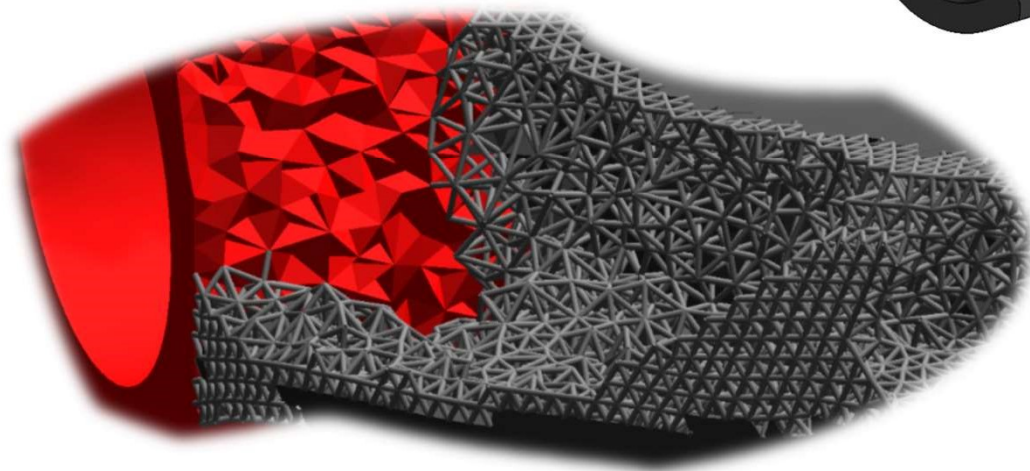
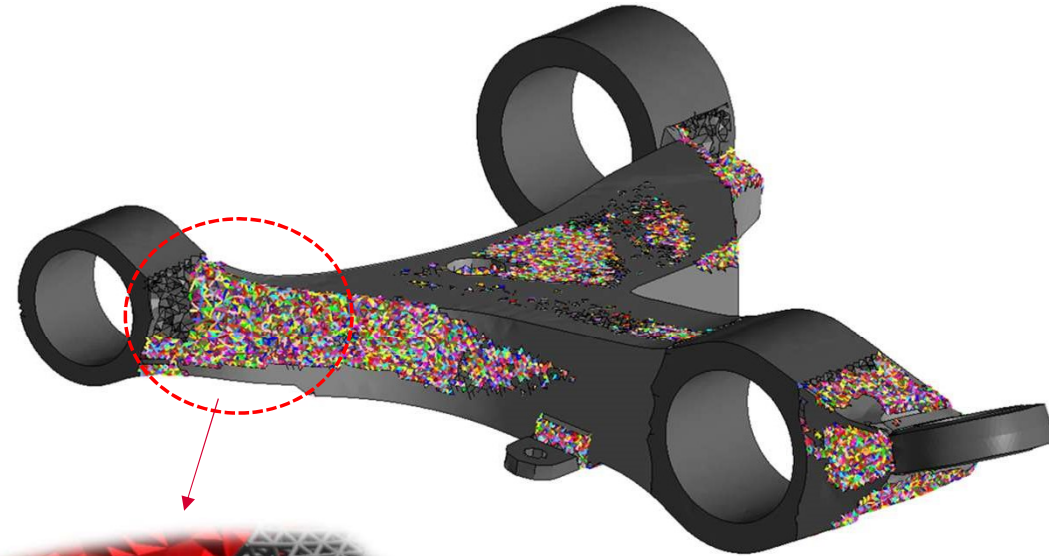
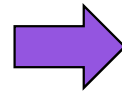
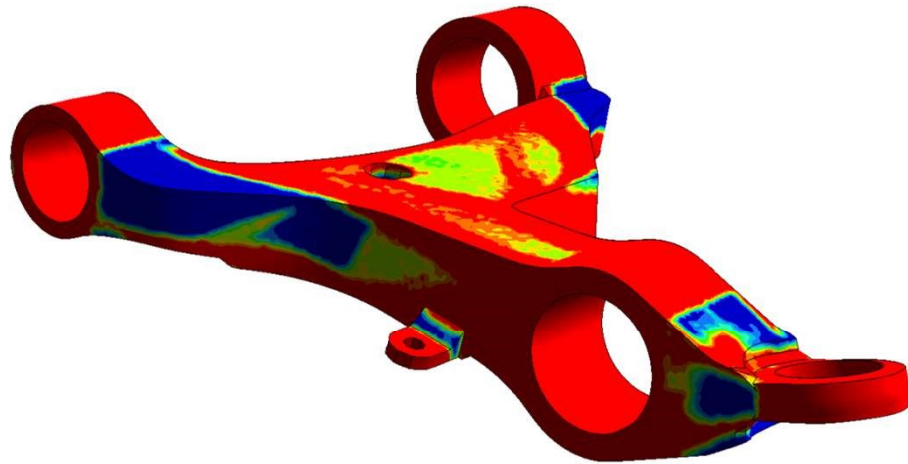
- multi-scale optimization : macro /micro 구조
- 2 단계 최적화 과정
 - Topology Optimization: 경량화된 최적 재료 분포



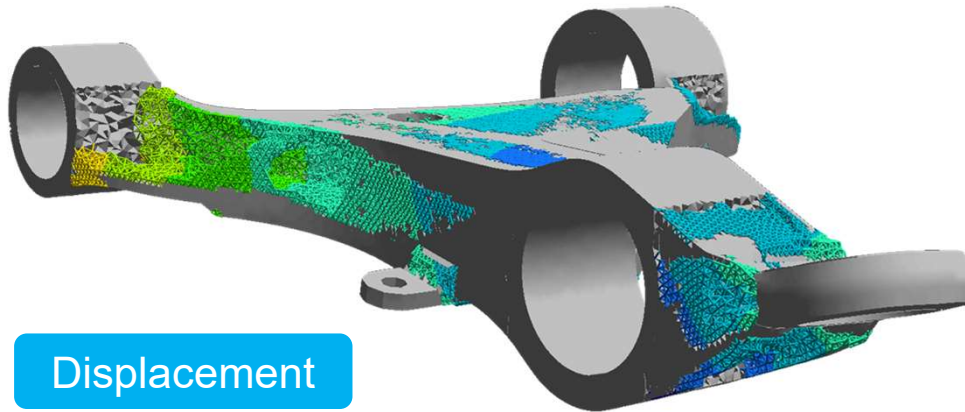
- Size optimization: Lattice 구조 최적화
 - Including detailed design constraints like stress and local buckling



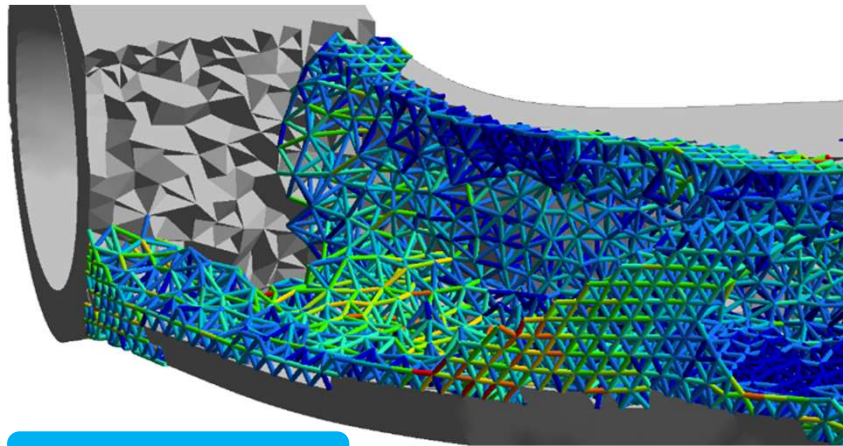
CONCEPT DESIGN TO LATTICE STRUCTURE DESIGN



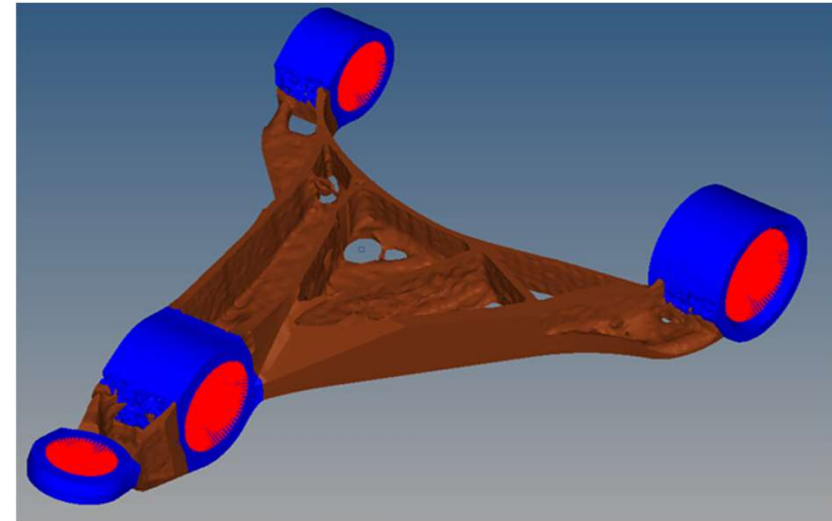
CONCEPT DESIGN TO LATTICE STRUCTURE DESIGN



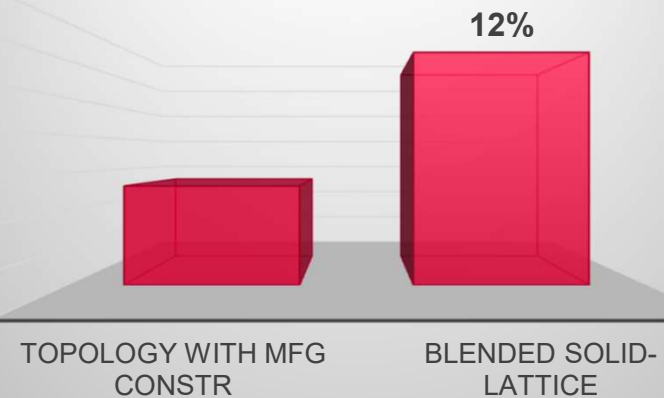
Displacement



Bar Stresses



Stiffness Improvement



Spider Bracket Optimization Overview

SPIDER BRACKET OPTIMIZATION REVIEW



Inspire Model Set-Up – Material Properties and Design/Non-Design Space

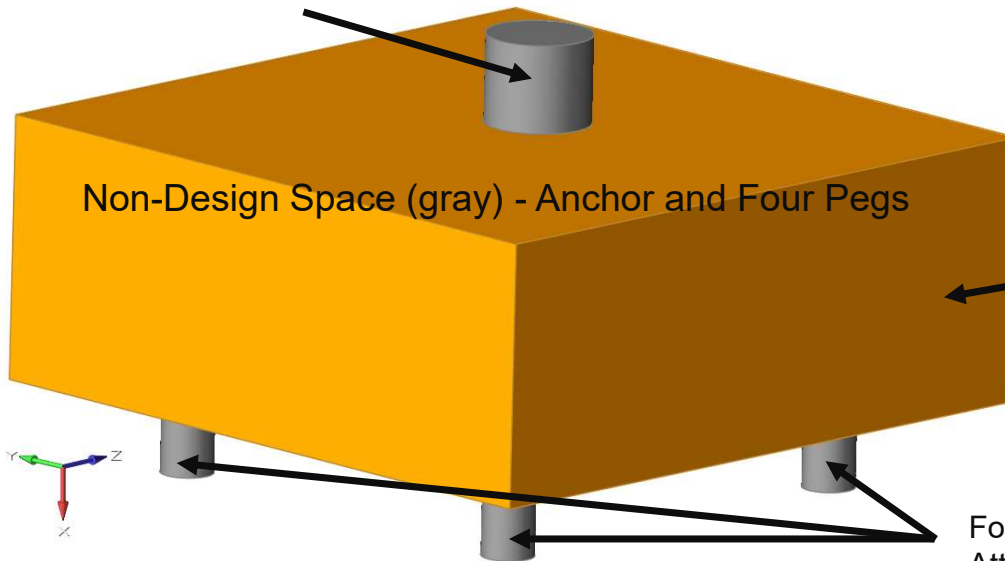
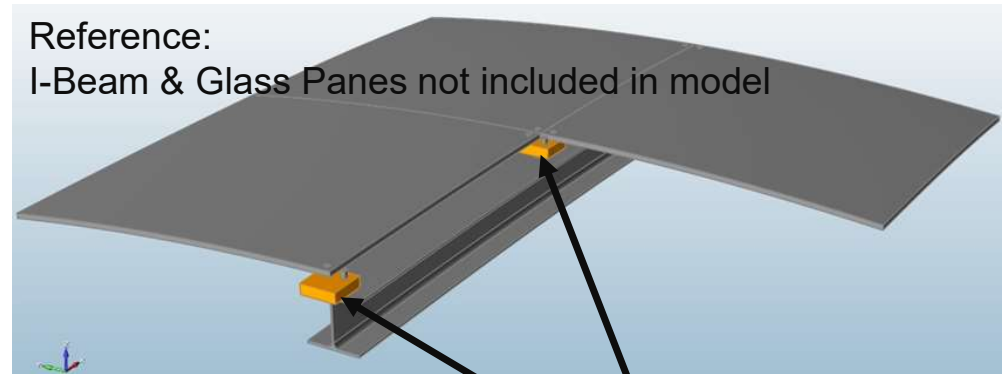
All parts are 304 Stainless Steel
E : 195,000 MPa
Nu : 0.29
Rho : 8.0E-9 Mg/mm³
Yield Stress : 215 MPa

Anchor - fixed to structural I-Beam

Non-Design Space (gray) - Anchor and Four Pegs

Design Space (orange)

Four pegs (one hidden from this view)
Attach to four separate panes of glass



SPIDER BRACKET OPTIMIZATION REVIEW



Inspire Model Set-Up – Loads and Boundary Conditions

Same loadcase from a topology perspective

Loads (all loads applied at X-most face of four pegs)

InterPerp

4000 N +X-direction (slight -Z component 0.0332)
Divided evenly between four pegs (1000N/peg)

WindPerp

4000 N -X-direction (slight +Z component 0.0332)
Divided evenly between four pegs (1000N/peg)

Gravity

2940 N -X-direction

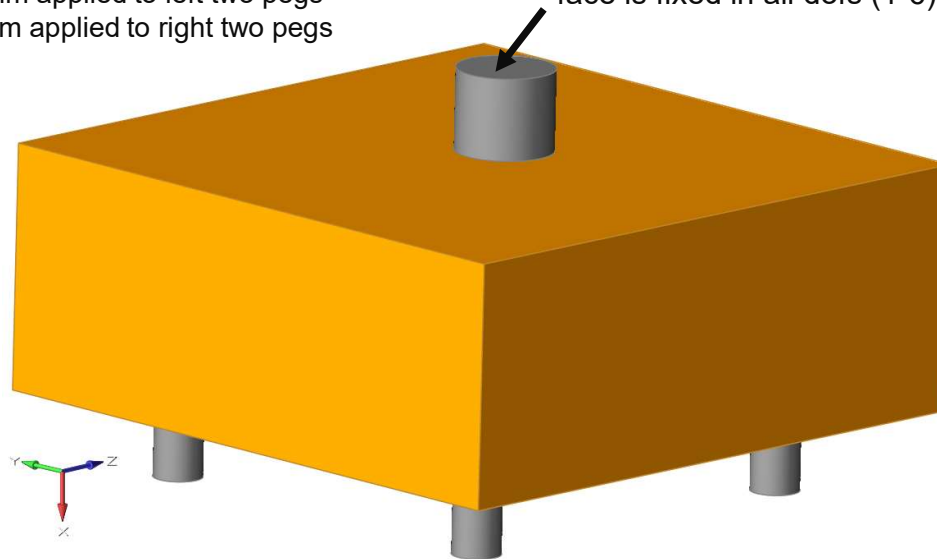
Divided evenly between four pegs (735N/peg)

7000 N-mm X-Moment (slight Z component 0.0332)

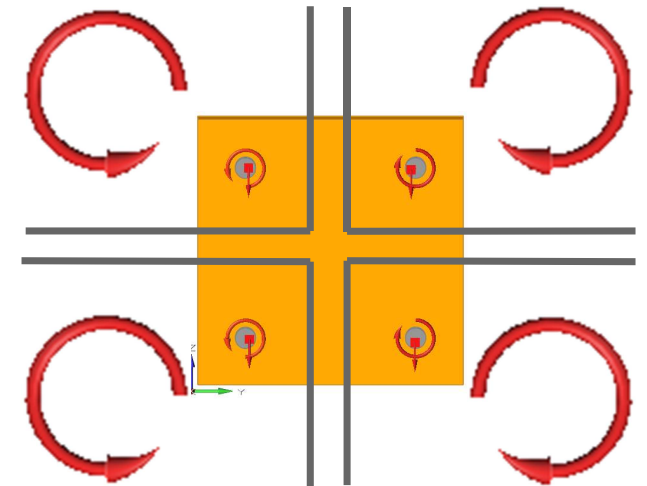
+7000 N-mm applied to left two pegs

-7000 N-mm applied to right two pegs

For all loadcases the top anchor face is fixed in all dofs (1-6)

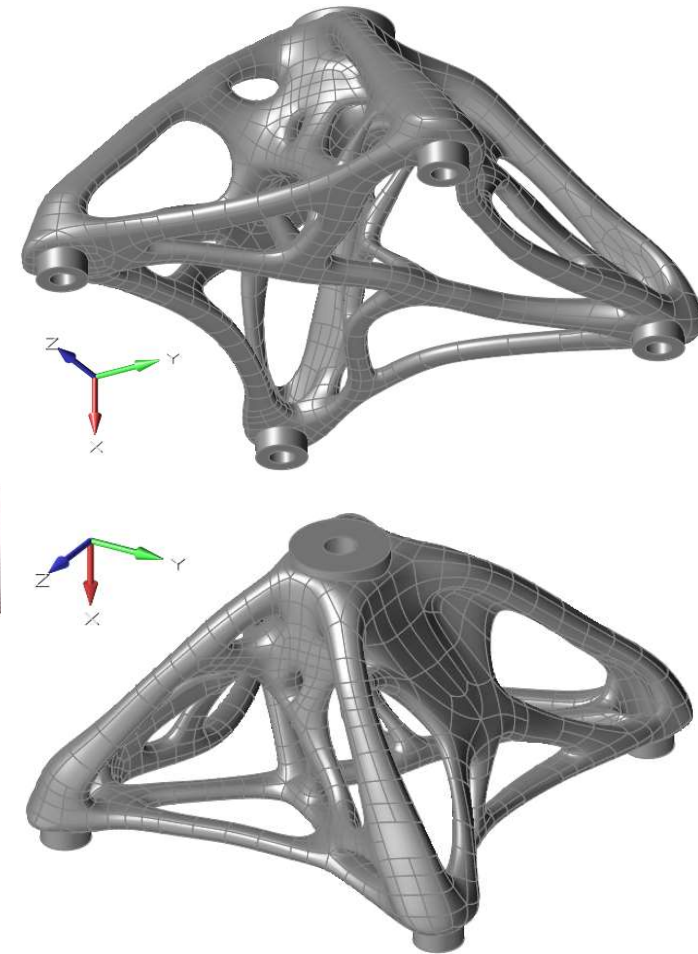
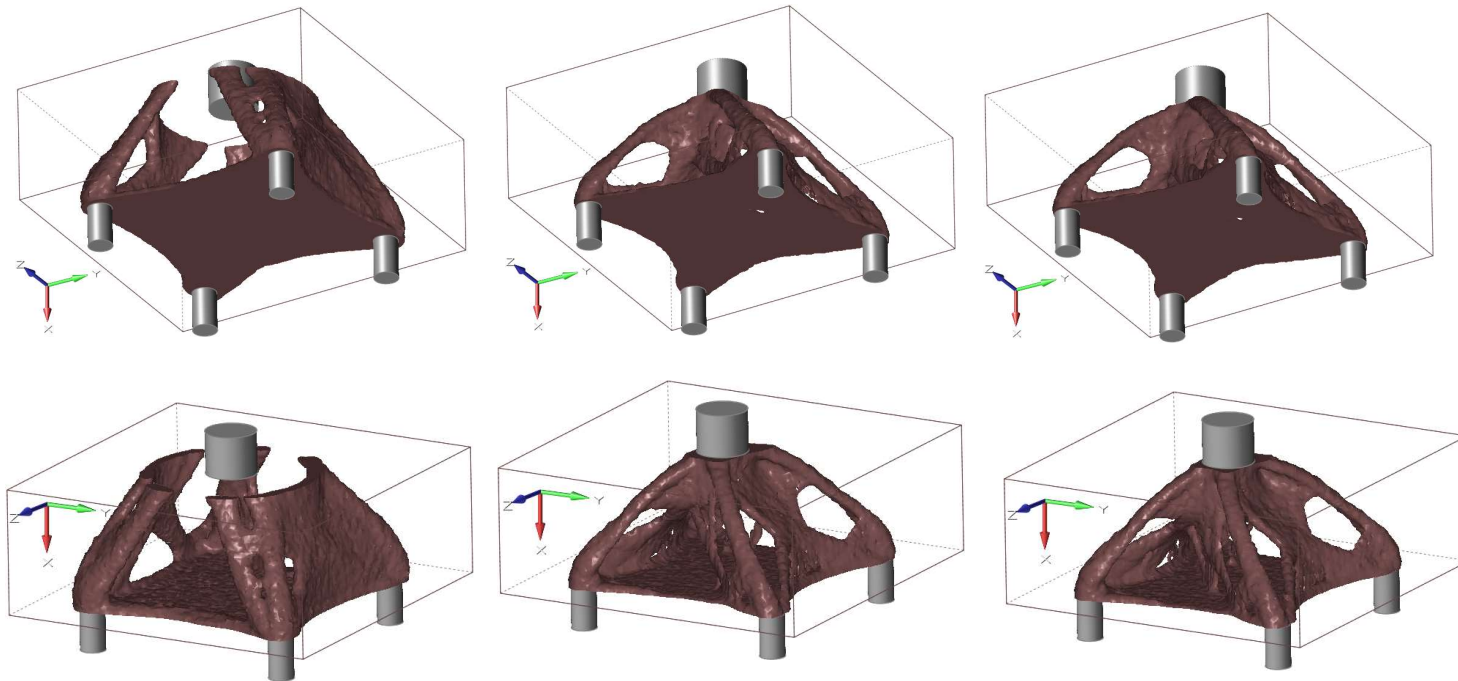


Mass of window panes (gray lines) torque each peg separately



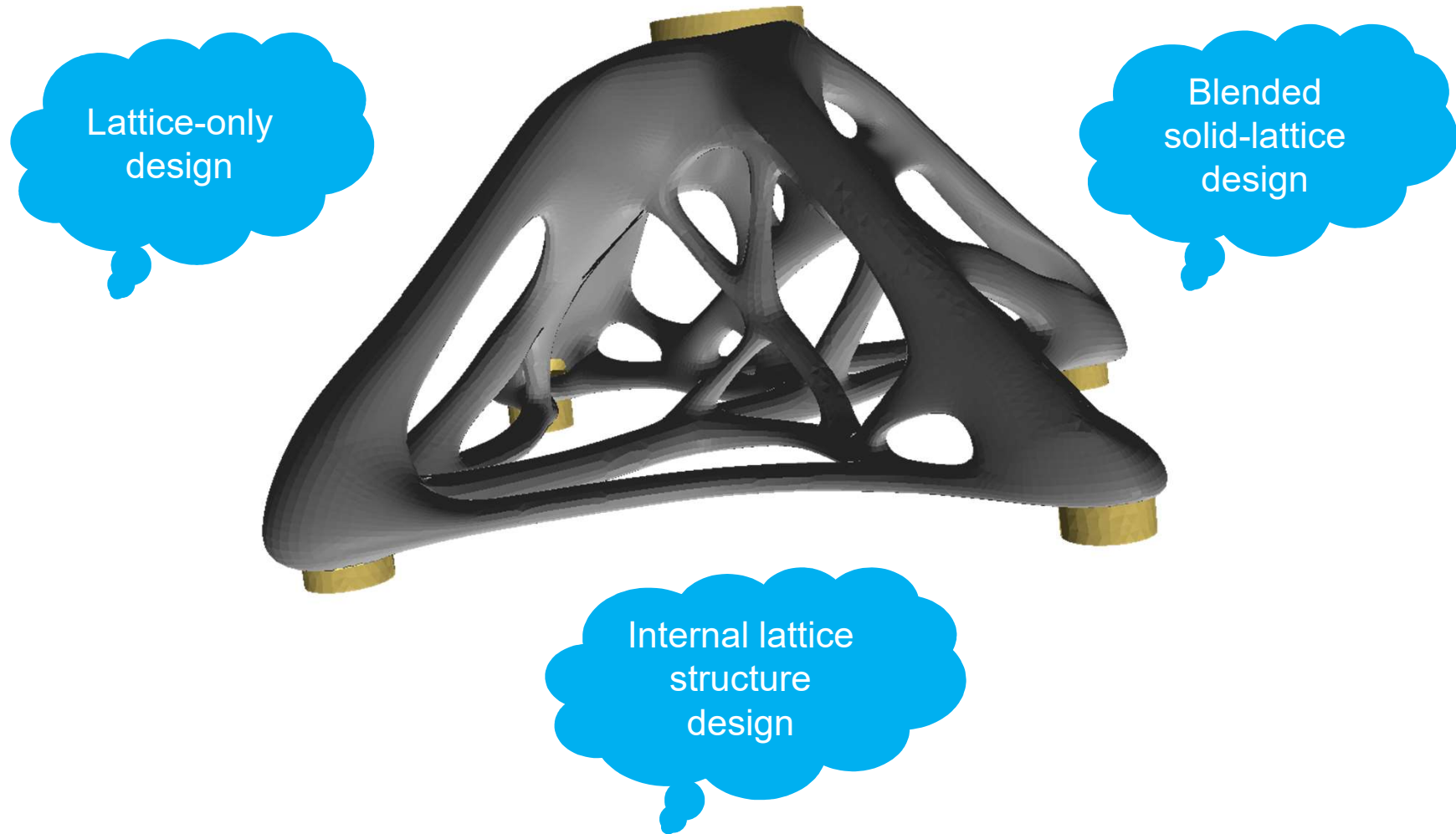
SPIDER BRACKET OPTIMIZATION REVIEW

Inspire Model Topology Results and Interpretation

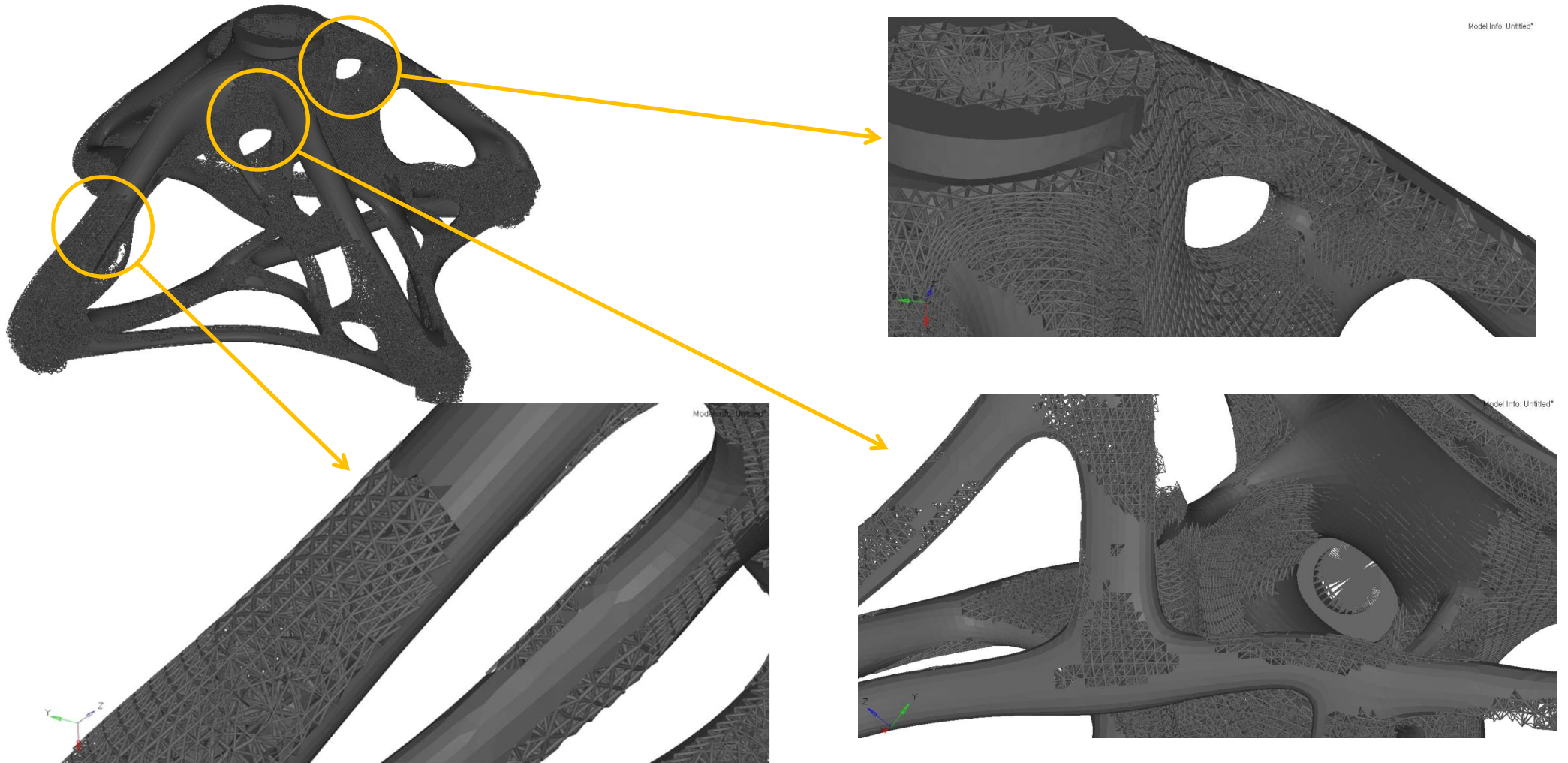


The bottom plate was not included in the topology interpretation. This shows up as a major structural member in all the Inspire/topology results in the model provided. Other than that the topology interpretation matches the results very well.

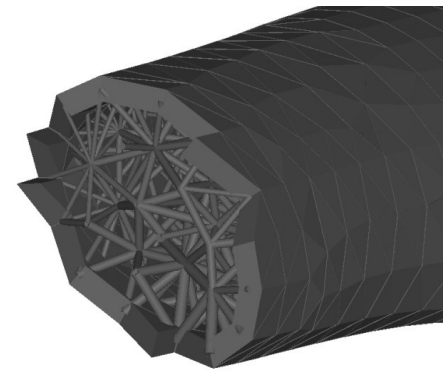
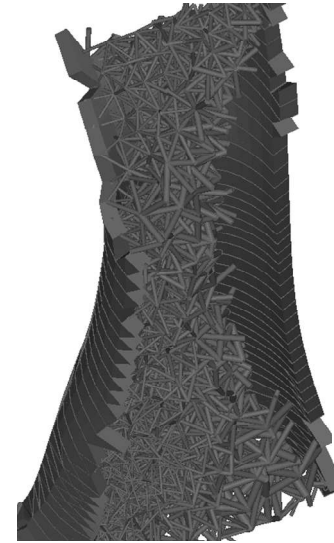
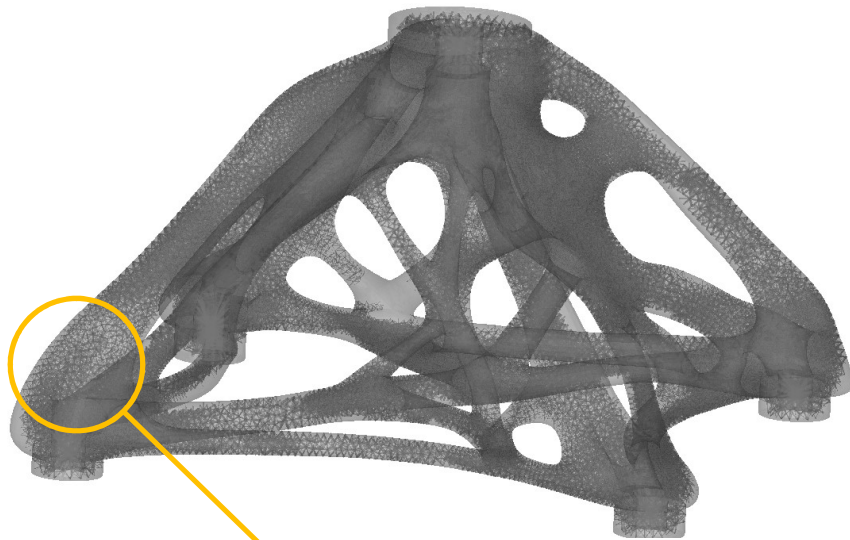
ARCHITECTURAL SPIDER BRACKET : LATTICE VARIATIONS Altair



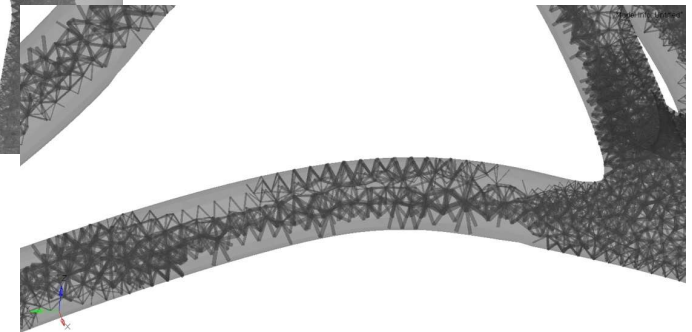
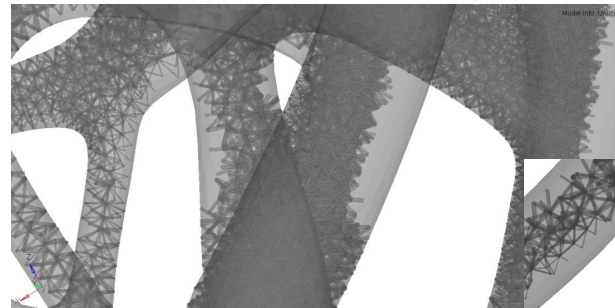
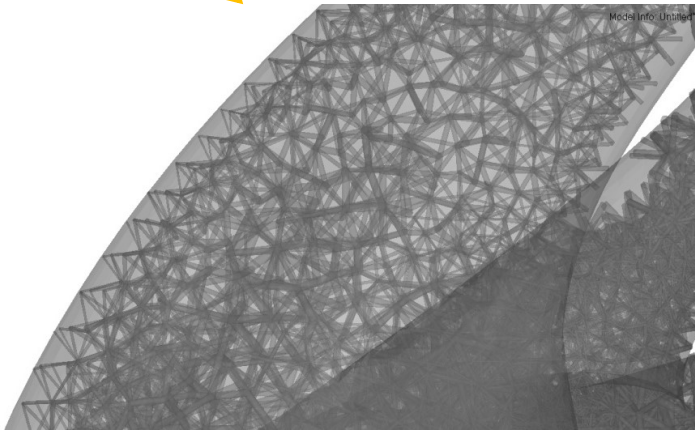
SPIDER BRACKET OPTIMIZATION REVIEW



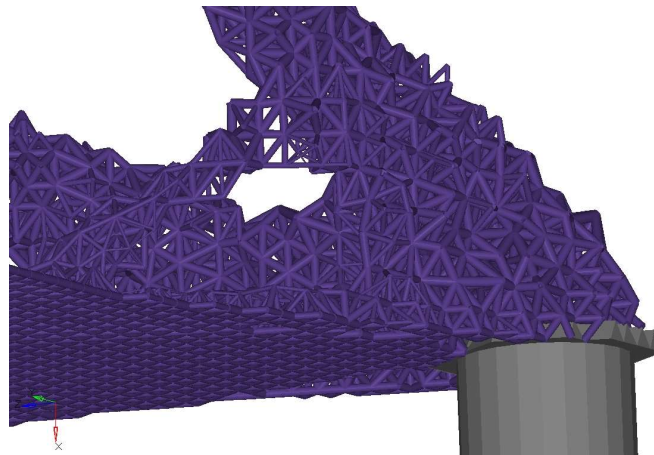
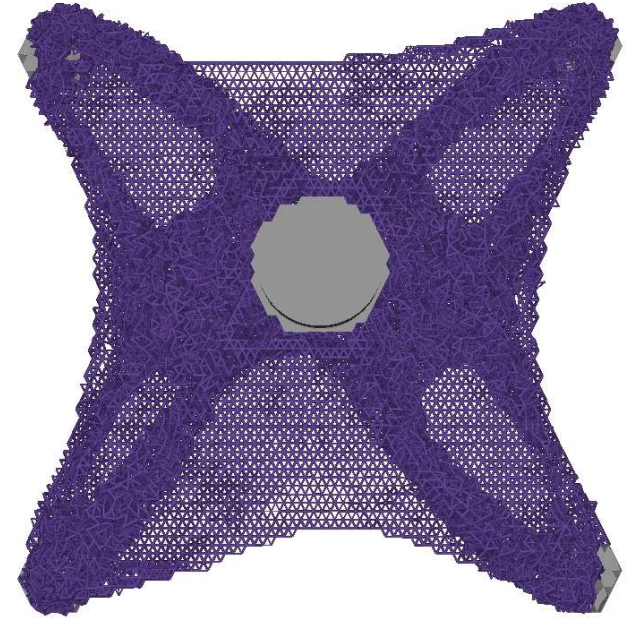
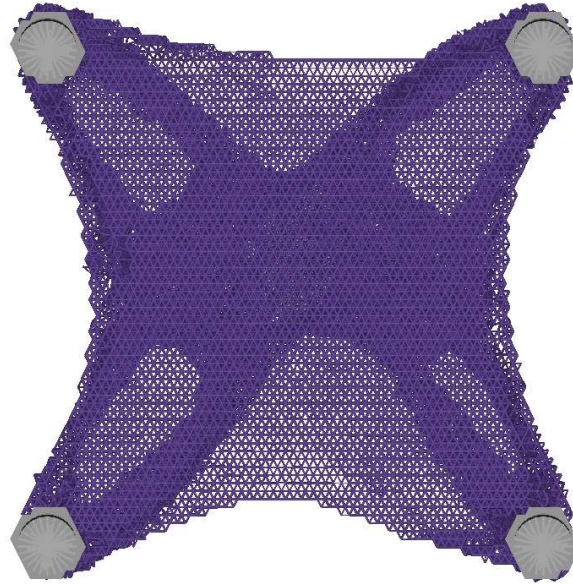
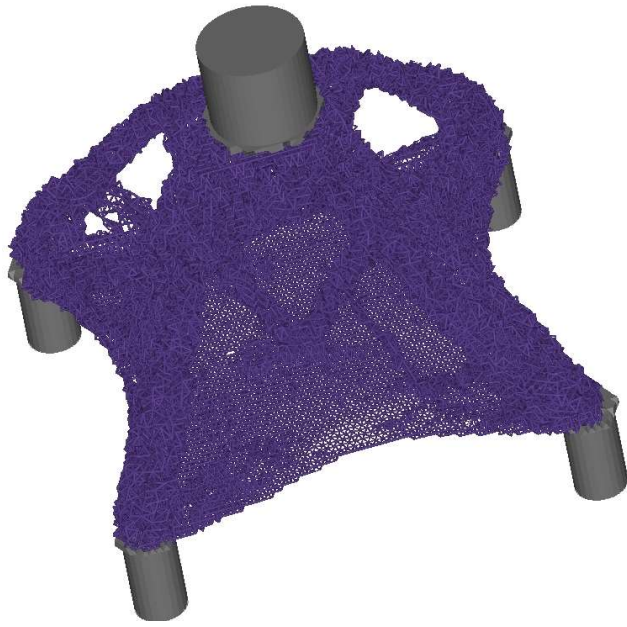
SPIDER BRACKET OPTIMIZATION REVIEW



Typical section



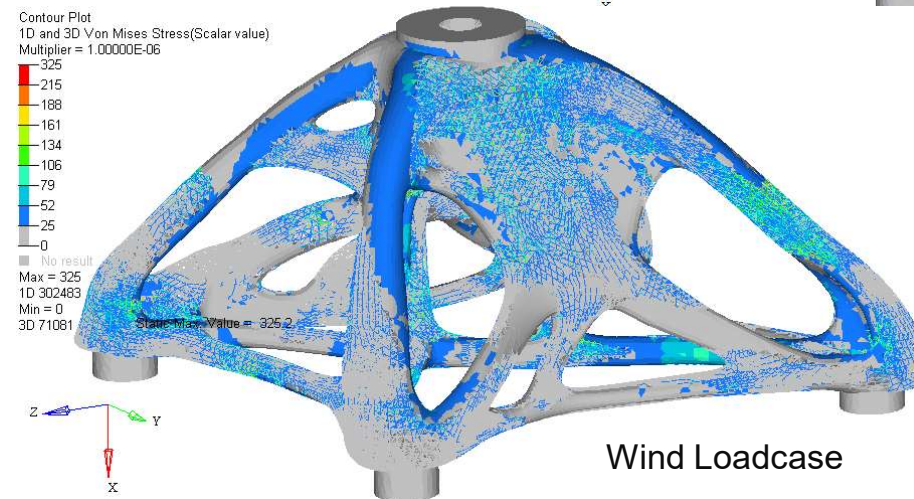
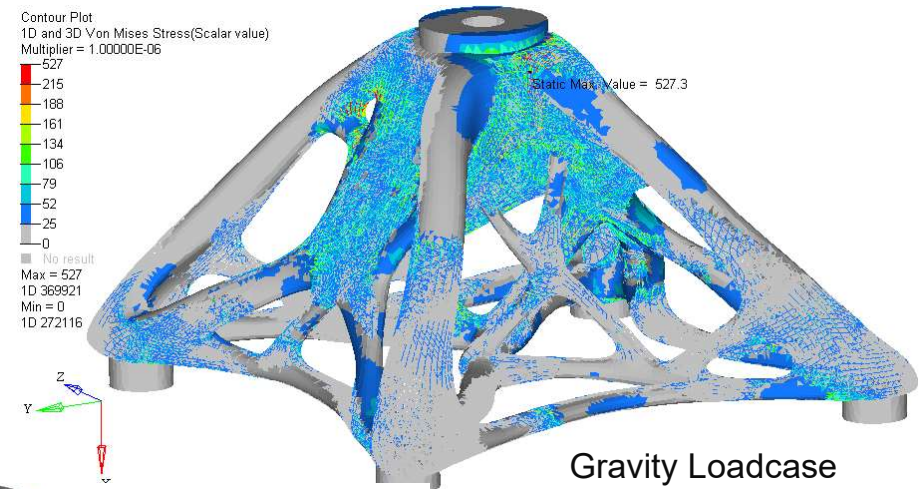
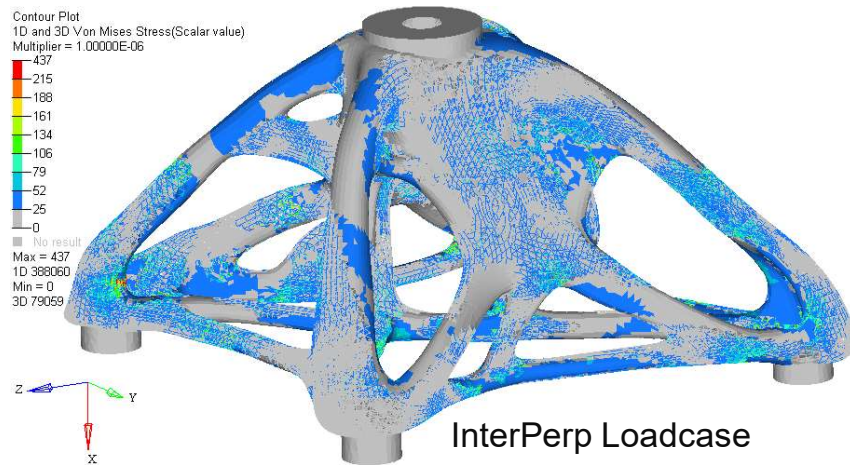
SPIDER BRACKET OPTIMIZATION REVIEW



SPIDER BRACKET OPTIMIZATION REVIEW



Von Mises Stress Contour [MPa] – 1Ds and Solids





Thank you!