



New Paradigm of CAE,

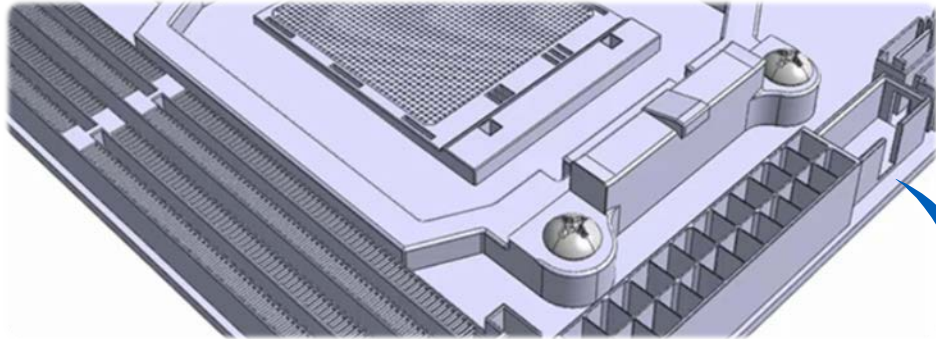
MeshFree-免網格分析軟體

台灣邁達斯
翁嘉駿

jim.weng@midasuser.com.tw

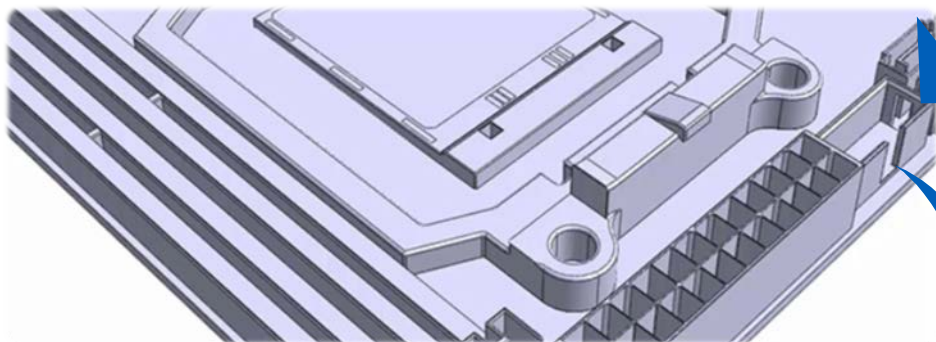


現有-分析流程



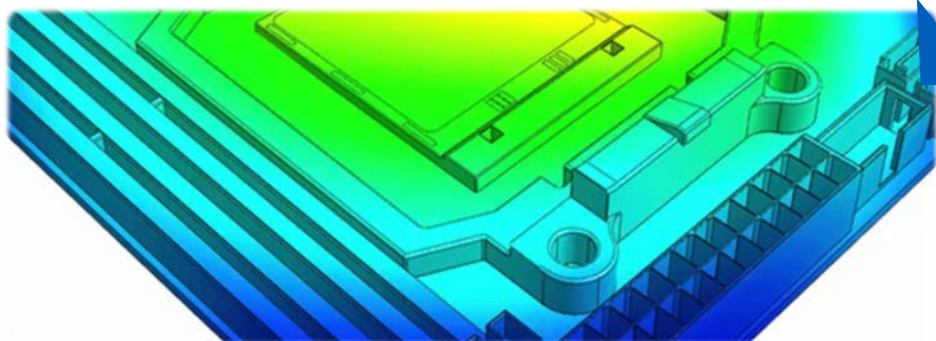
CAD 模型簡化

※ 需要手動清理，花費許多時間



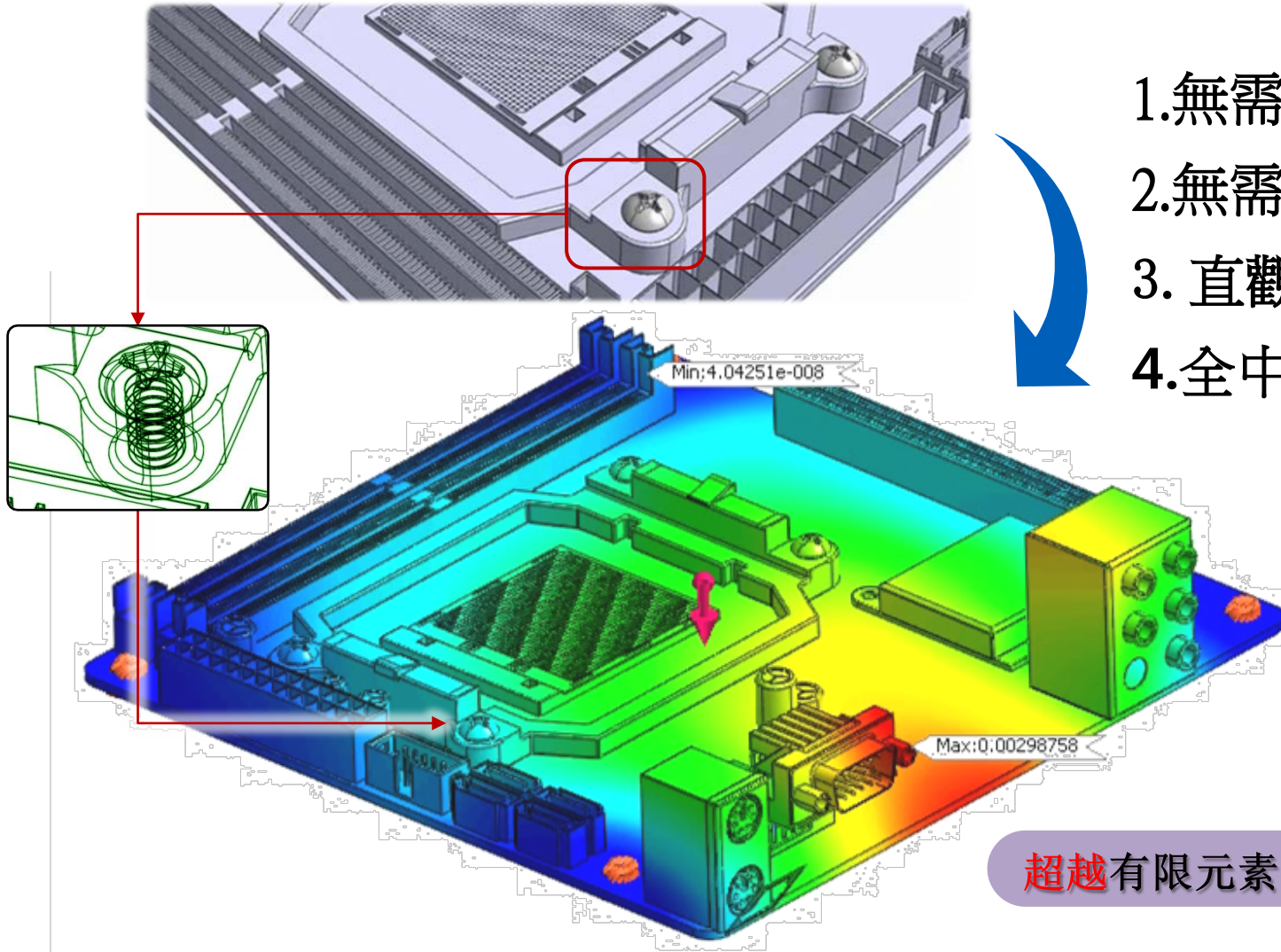
生成網格以及進行分析

※ 網格的品質對結果的影響很大



有限元素軟體的局限性

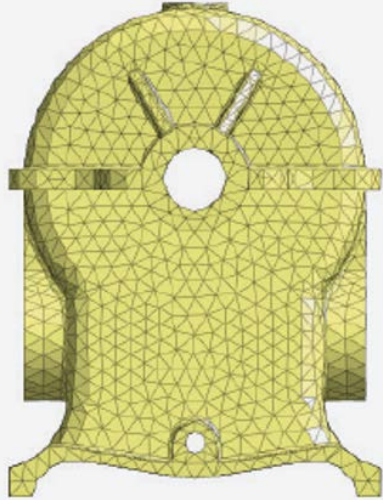
MeshFree-革命性的分析流程



1. 無需模型簡化
2. 無需網格劃分
3. 直觀操作
4. 全中文化

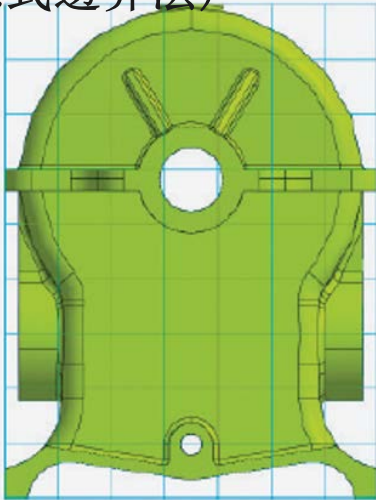
超越有限元素軟體的局限性

FEA (有限元素法)



- 生成網格時需要考慮模型各種形狀
- 為了生成高品質的網格，需要進行簡化/清理工作。
- 經常會遇到生成網格問題
(無法生成高品質的網格以及自動網格化功能的局限性)

IBM (隱式邊界法)



- 直接進行分析
- 不管3D模型有多複雜，照樣可進行分析。
- 省下無效率清理幾何&網格化時間
- 專門為設計人員而開發的革命性設計分析工具

三步驟完成分析



STEP1

導入CAD



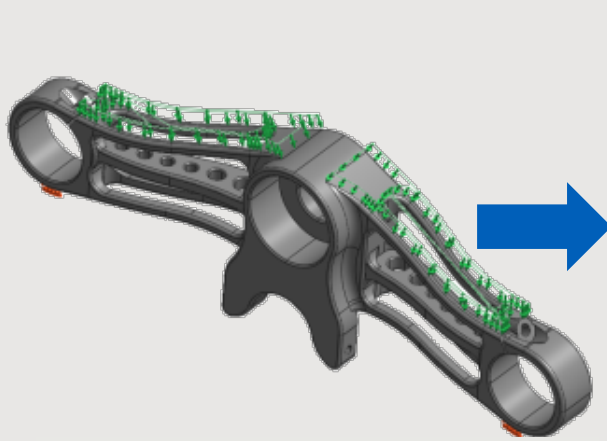
STEP2

輸入荷載和邊界條件

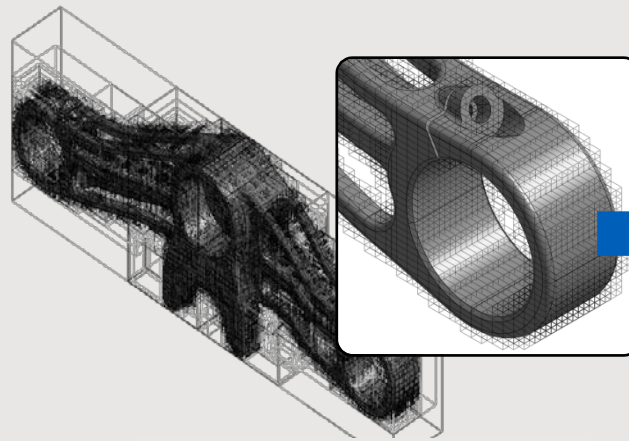


STEP3

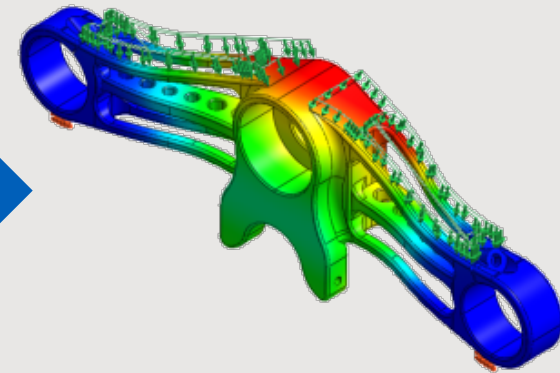
查看分析結果



全中文化&圖形化界面



免網格&直接計算



NVIDIA 3D顯示技術

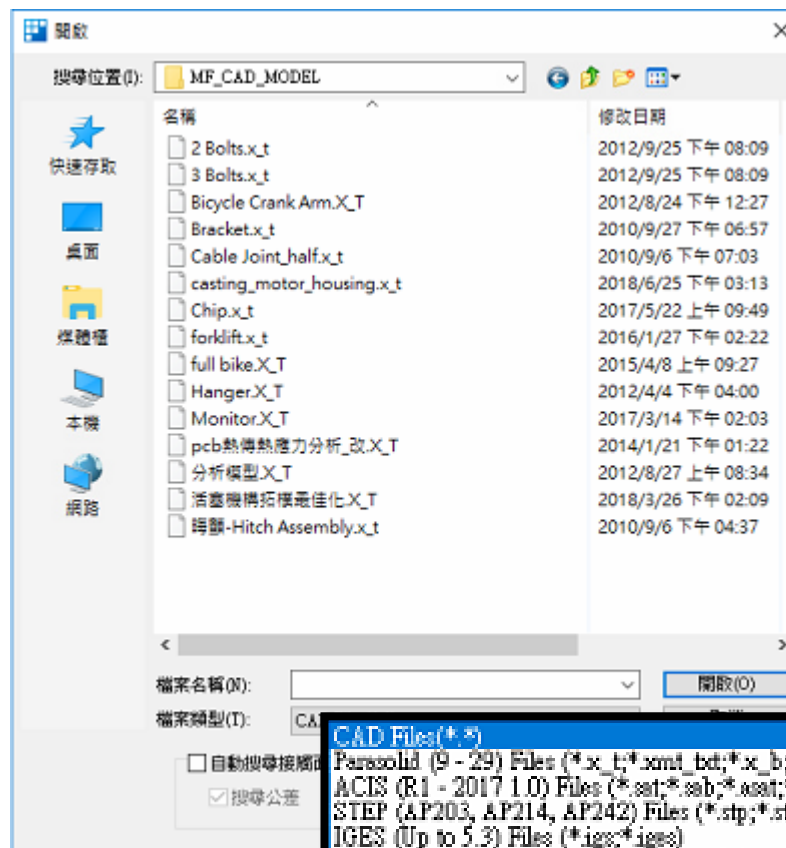
→ 支援標準3D CAD格式

1. 標準CAD格式：

ACIS(*.SAT)、Parasolid
(*.X_T)、STEP(*.STP)、
IGES(*.igs)

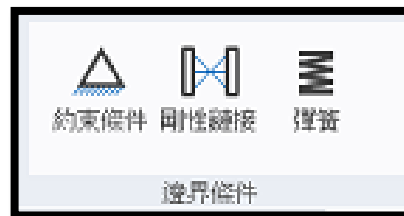
2. 3D CAD各別格式：

SOLIDWORKS(*.SLDPRT)、
PRO/E(.PRT)、CATIA
V4~V5、UG、Inventor、
Solid Edge

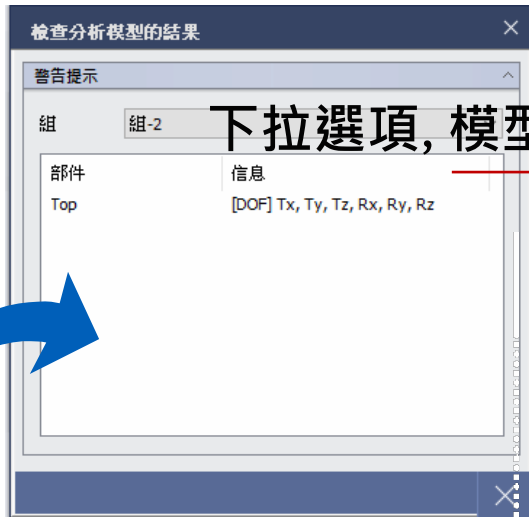
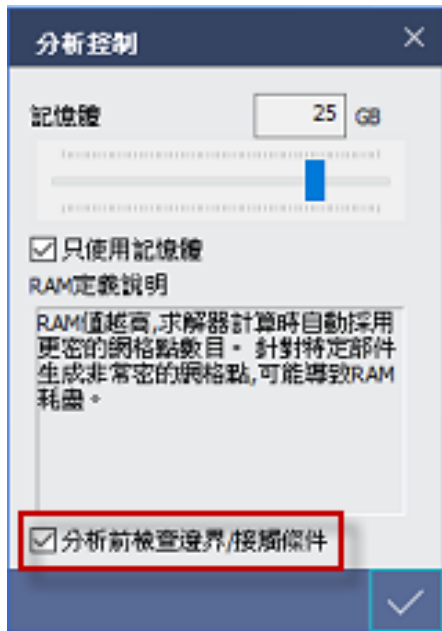


CAD Files (*.*)
 Parasolid (9 - 29) Files (*.x_t;*.xmt_bct;*.x_b;*.xmt_bcm)
 ACIS (R1 - 2017 1.0) Files (*.sat;*.sab;*.asat;*.asob)
 STEP (AP203, AP214, AP242) Files (*.stp;*.step)
 IGES (Up to 5.3) Files (*.igs;*.iges)
 Pro-E (16 - Creo 3.0) Files (*.prt;*.prt.*;*.asm;*.asm.*)
 CATIA V4 (CATIA 4.1.9 - 4.2.4) Files (*.model;*.exp;*.session)
 CATIA V5 (V5R8 - V5-6R2016) Files (*.CATPart;*.CATProduct)
 Solid Works (98 - 2017) Files (*.sldprt;*.sldasm)
 Unigraphics (11 - NX11) Files (*.prt)
 Inventor Part (Y6 - Y2017) Files (*.ipt)
 Inventor Assembly (Y11 - Y2017) Files (*.iam)
 Solid Edge (Y18 - ST9) Files (*.par;*.asm;*.pasm)

→ 中文化&直觀操作

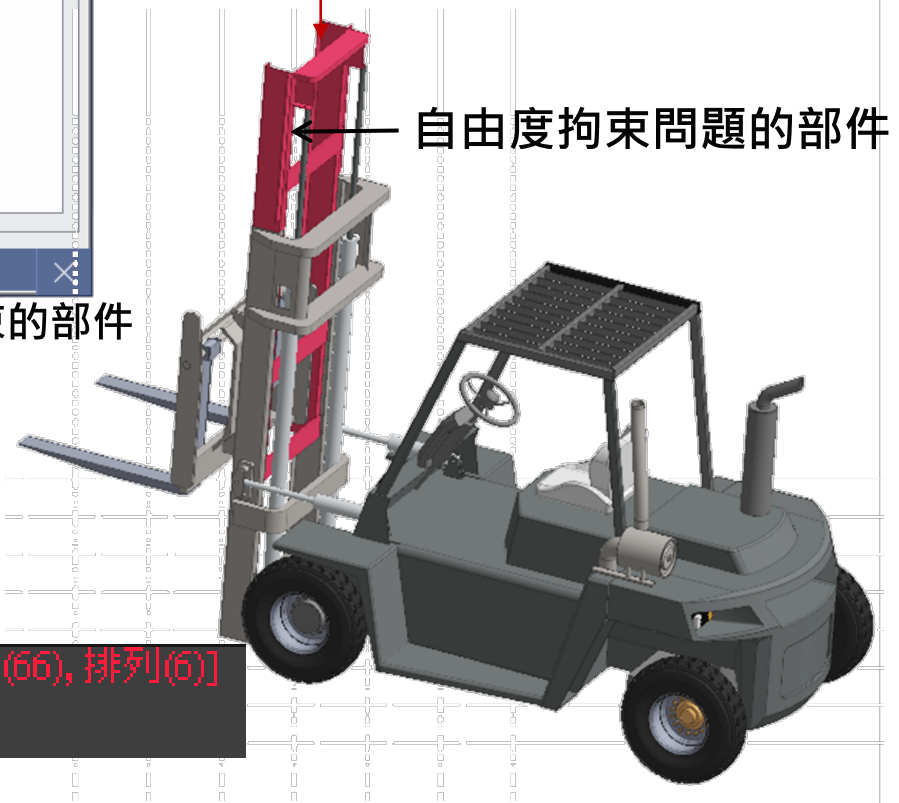


→ 分析前檢查接觸和邊界條件



下拉選項, 模型有問題的部件點選顯示

顯示沒有施加自由度拘束的部件
(約束條件及接觸錯誤)



※檢查分析模型

→檢查奇異點錯誤

中文化-錯誤提示

- > [錯誤] 邊界條件的定義不夠充分。 [整體剛體自由度(66), 排列(6)]
- > [錯誤] 邊界條件定義不正確。

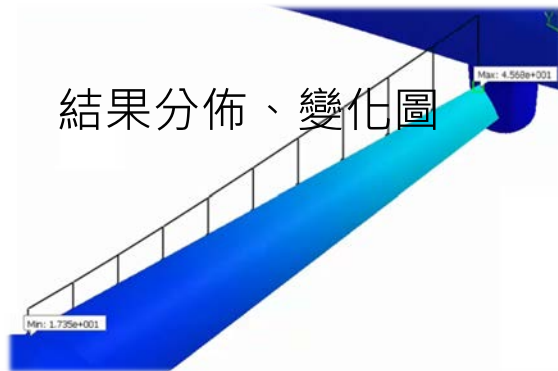
後處理



分析类型
步驟
結果

- 模态-1
- MODE 10 (FREQ=1.7346e+003)
 - MODE 1 (FREQ=5.4515e+001)
 - MODE 2 (FREQ=5.7096e+001)
 - MODE 3 (FREQ=1.3243e+002)
 - MODE 4 (FREQ=1.7132e+002)
 - MODE 5 (FREQ=2.7935e+002)
 - MODE 6 (FREQ=4.6324e+002)
 - MODE 7 (FREQ=1.0744e+003)
 - MODE 8 (FREQ=1.1669e+003)
 - MODE 9 (FREQ=1.6408e+003)
 - MODE 10 (FREQ=1.7346e+003)

結果分佈、變化圖

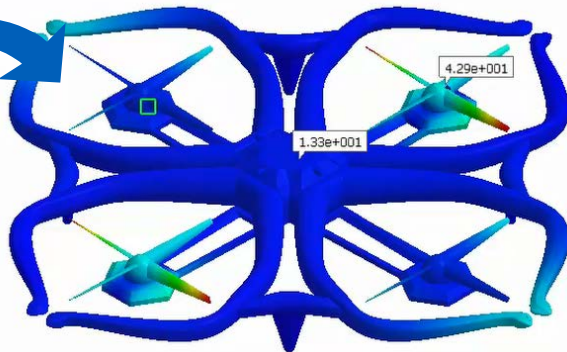


選擇結果 (頻率)

分析結果標記

結果坐标: -952 481, 847 514, 970 003

顯示	位置	值
<input checked="" type="checkbox"/>	-420, 490, 756	1.39849e-002
<input checked="" type="checkbox"/>	-240, 531, 853	2.80439e-002



結果查詢

模态表格

模态数量	特征值	固有频率	自然频率	周期	广义质量	广义刚度	正交误差	误差估计
1	1.1733e+005	3.4253e+002	5.4515e+001	1.8343e-002	1.0000e+000	1.1733e+005	0.0000e+000	1.9895e-008
2	1.2370e+005	3.5975e+002	5.7096e+001	1.7514e-002	1.0000e+000	1.2370e+005	0.0000e+000	4.8940e-007
3	6.9235e+005	8.2026e+002	1.3243e+002	7.5512e-003	1.0000e+000	6.9235e+005	0.0000e+000	1.8923e-005
4	1.1587e+006	1.0764e+003	1.7132e+002	5.8370e-003	1.0000e+000	1.1587e+006	0.0000e+000	8.9371e-008
5	3.0809e+006	1.7553e+003	2.7935e+002	3.5787e-003	1.0000e+000	3.0809e+006	0.0000e+000	2.7634e-007
6	8.4719e+006	2.9107e+003	4.6324e+002	2.1587e-003	1.0000e+000	8.4719e+006	0.0000e+000	2.0119e-007
7	4.5572e+007	6.7501e+003	1.0744e+003	9.3075e-004	1.0000e+000	4.5572e+007	0.0000e+000	2.7256e-008
8	5.3757e+007	7.3319e+003	1.1669e+003	8.5998e-004	1.0000e+000	5.3757e+007	0.0000e+000	3.7079e-009
9	1.0829e+008	1.6310e+004	1.6408e+003	6.0945e-004	1.0000e+000	1.0829e+008	0.0000e+000	2.9794e-006
10	1.1878e+008	1.6969e+004	1.7346e+003	5.7950e-004	1.0000e+000	1.1878e+008	0.0000e+000	8.4806e-008

模态数量	T1	T2	T3	R1	R2	R3
1	1.0825e-003	3.2907e-010	2.2083e-010	4.9854e-008	1.7038e-001	8.4897e-002
2	5.0728e-010	7.1749e-004	4.5000e-004	1.1407e-001	1.0427e-007	6.3854e-009
3	2.7304e-009	3.6788e-011	2.1255e-010	7.1507e-010	2.3415e-001	7.5344e-001
4	6.8979e-012	5.1959e-004	2.9554e-004	9.8570e-004	1.0248e-007	7.7345e-008
5	2.0267e-004	2.0210e-011	2.2891e-011	4.3339e-011	4.6259e-001	2.6658e-001
6	0.0000e+000	2.1539e-005	1.4120e-004	3.3487e-001	2.7693e-010	1.1019e-009
7	3.5505e-005	2.3963e-012	0.0000e+000	6.8963e-009	1.8742e-001	2.7489e-002
8	3.6335e-012	1.7614e-005	1.0681e-005	1.5954e-002	2.2072e-008	1.9175e-009
9	1.2172e-007	0.0000e+000	0.0000e+000	6.8725e-010	8.9429e-004	8.5944e-005
10	0.0000e+000	2.9422e-006	1.1191e-006	2.2015e-003	4.2822e-010	1.2666e-011
总和	1.3320e-003	1.7742e-003	1.3329e-003	4.6782e-001	1.0795e+000	1.1363e+000
整个模型总和	1.3542e-003	1.3542e-003	1.3542e-003	8.7487e-001	1.1657e+000	1.2201e+000

模态数量	T1	T2	T3	R1	R2	R3
1	80.75%	0.00%	0.00%	0.00%	14.62%	6.84%
2	0.00%	59.28%	23.27%	12.04%	0.00%	0.00%
3	0.00%	0.00%	0.00%	0.00%	20.09%	61.75%
4	0.00%	38.07%	53.87%	0.11%	0.00%	0.00%
5	14.89%	0.00%	0.00%	0.00%	41.41%	21.26%

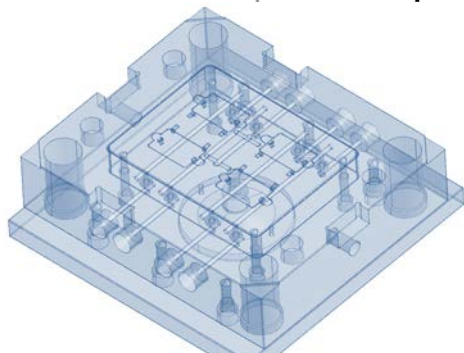
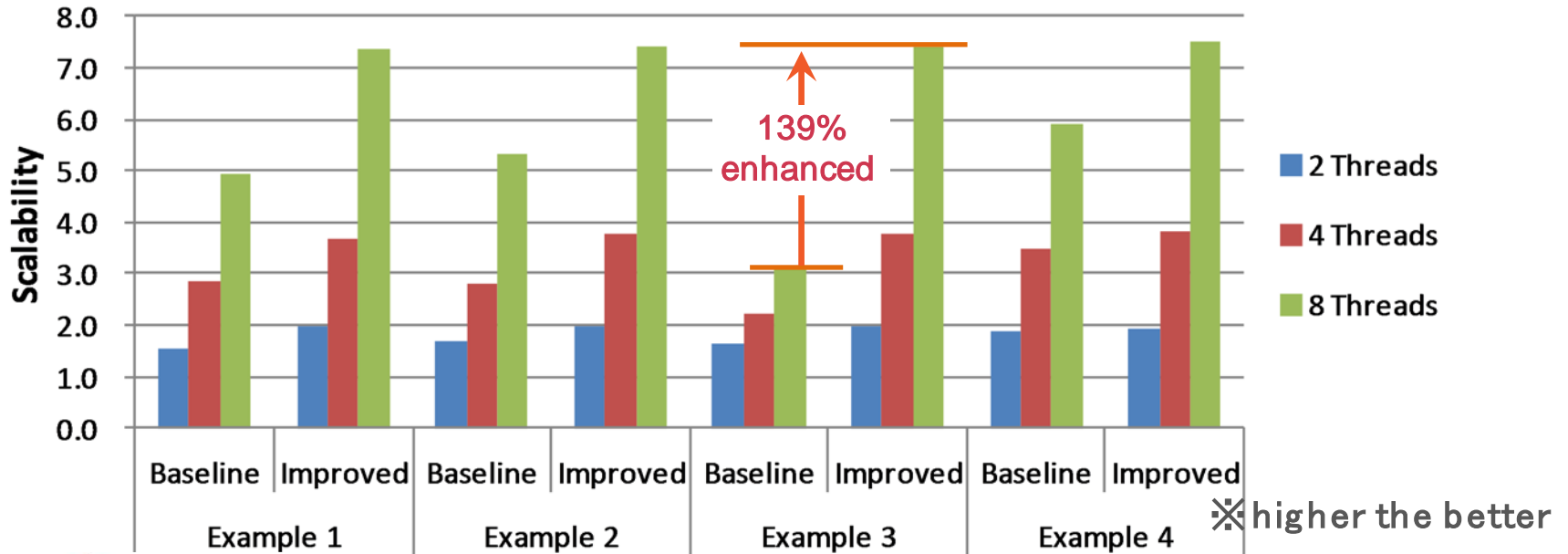
結果表格 (模态分析)



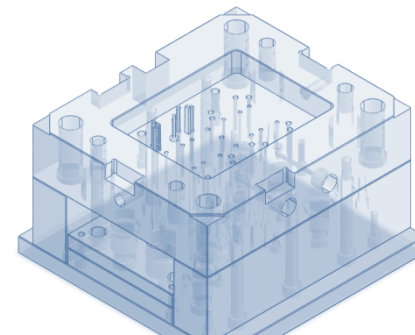
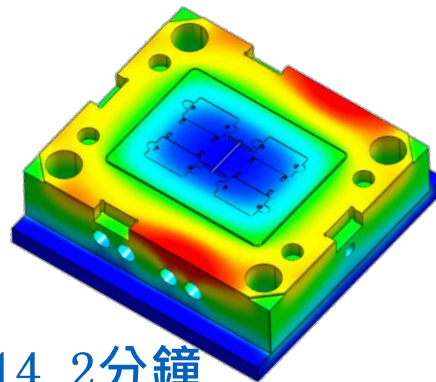
動畫 (支持avi及Animated GIF)

高性能-平行計算

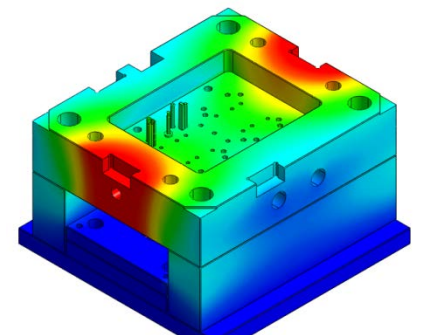
• Parallel Performance (Scalability) - 理想平行計算性能



〈分析時間〉 14.2分鐘



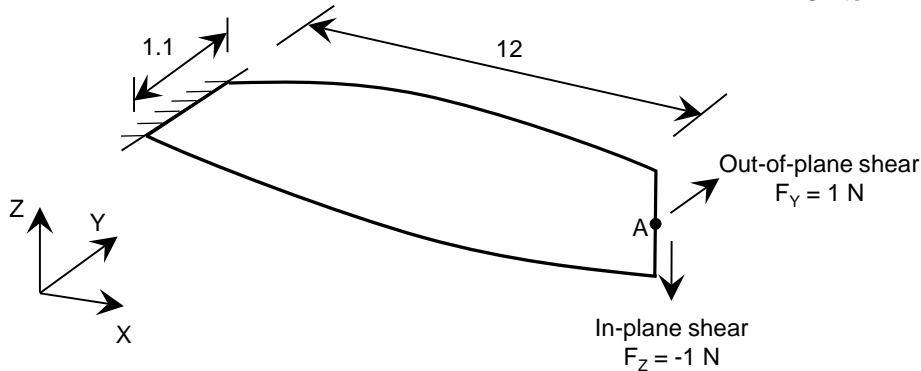
〈分析時間〉 22.3分鐘



分析結果的準確性



Twisted beam under tip load

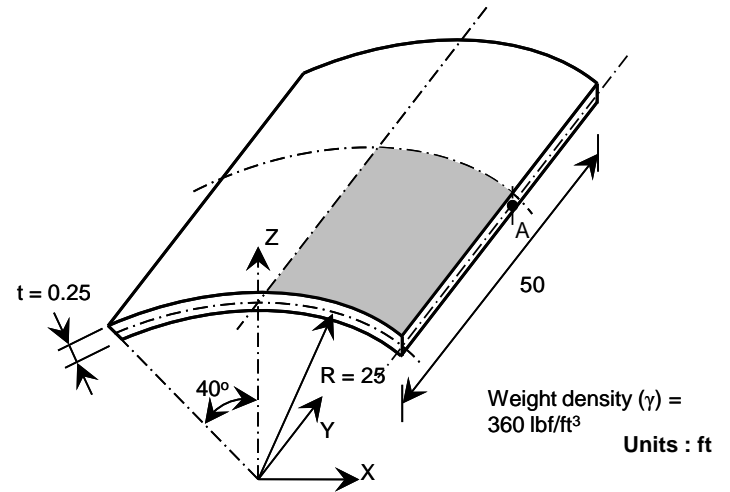


Units : m

Material data	Young's modulus	$E = 29 \text{ MPa}$
	Poisson's ratio	$\nu = 0.22$
Section property	Thickness	$t = 0.32 \text{ m}$

	UZ at point A (shear force FZ)	UY at point A (shear force FY)
Reference	5.424×10^{-3}	1.754×10^{-3}
FEM (TETRA10) 144 elements	5.444×10^{-3}	1.771×10^{-3}
FEM (HEXA20) 2x12x1 elements	5.426×10^{-3}	1.754×10^{-3}
MeshFree (11x2x2 grid)	5.303×10^{-3}	1.750×10^{-3}
MeshFree (22x3x3 grid)	5.409×10^{-3}	1.785×10^{-3}

Scordellis-Lo barrel vault (gravity load)

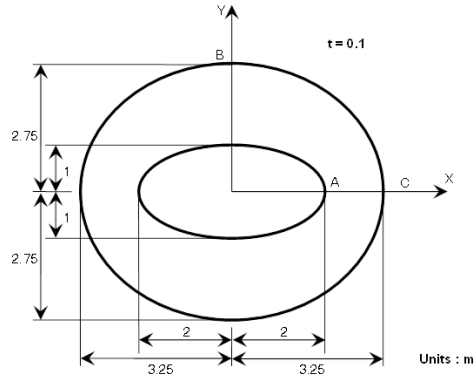


	Vertical displacement at point A [ft]
Reference	-0.3024
FEM (PENTA15) 2x8x8x1 elements	-0.2978
FEM (HEXA20) 8x8x1 elements	-0.3038
MeshFree 5x8x2 grid	-0.2945

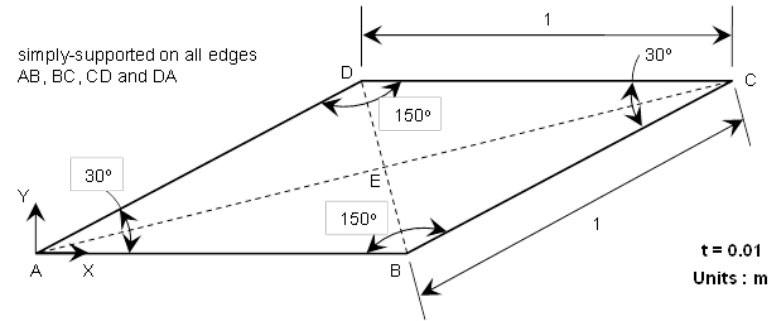
分析結果-準確性



均勻壓力作用-橢圓膜



均勻壓力作用-傾斜板



Material data	Young's modulus	$E = 210 \text{ GPa}$
	Poisson's ratio	$\nu = 0.3$
Section property	Thickness	$t = 0.1 \text{ mm}$

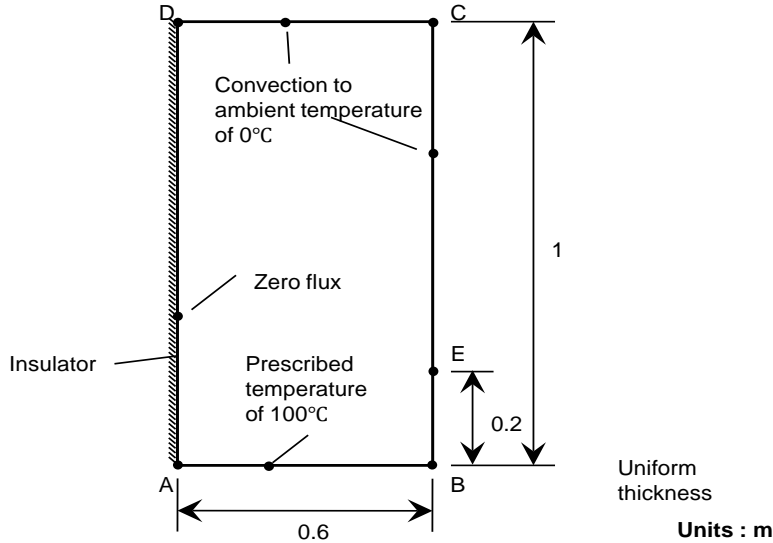
	Stress _{yy} at point A
Reference	92.7 [MPa]
FEM (PENTA15) 6x4x2 elements	93.2
FEM (HEXA20) 6x4x2 elements	91.8
MeshFree (12x8x2 grid)	105 (roughly averaged)
MeshFree (50x40x2 grid)	92.6 (node near the point A)

	Stress _{P1} at point E
Reference	0.802 [MPa]
FEM (PENTA15) 8x8x2 elements	0.792
FEM (HEXA20) 8x8x2 elements	0.723
MeshFree (20x20x2 grid)	0.703
MeshFree (40x40x2 grid)	0.767

分析結果-準確性



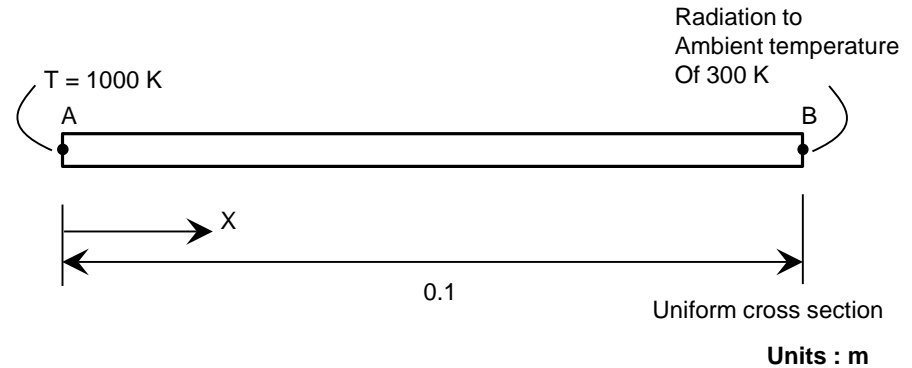
2維熱傳與熱對流



Material data	Conductivity	$k = 52 \text{ J/m}\cdot\text{hr}\cdot^\circ\text{C}$
	Convection coefficient	$h = 750.0 \text{ WJ/kg}\cdot^\circ\text{C}$

	Temperature at point E
Reference	18.3
FEM (HEXA8) 60 elements	18.9
FEM (HEXA20) 15 elements	17.9
MeshFree (6x10x1 grid)	18.1

1維熱傳與輻射熱



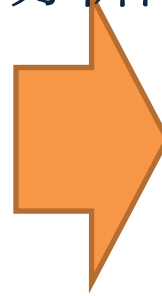
	Temperature at point B
Reference	927
FEM (HEXA8) 10 elements	926.4
FEM (HEXA20) 10 elements	926.4
MeshFree (10x1x1 grid)	926.4

MeshFree標準版

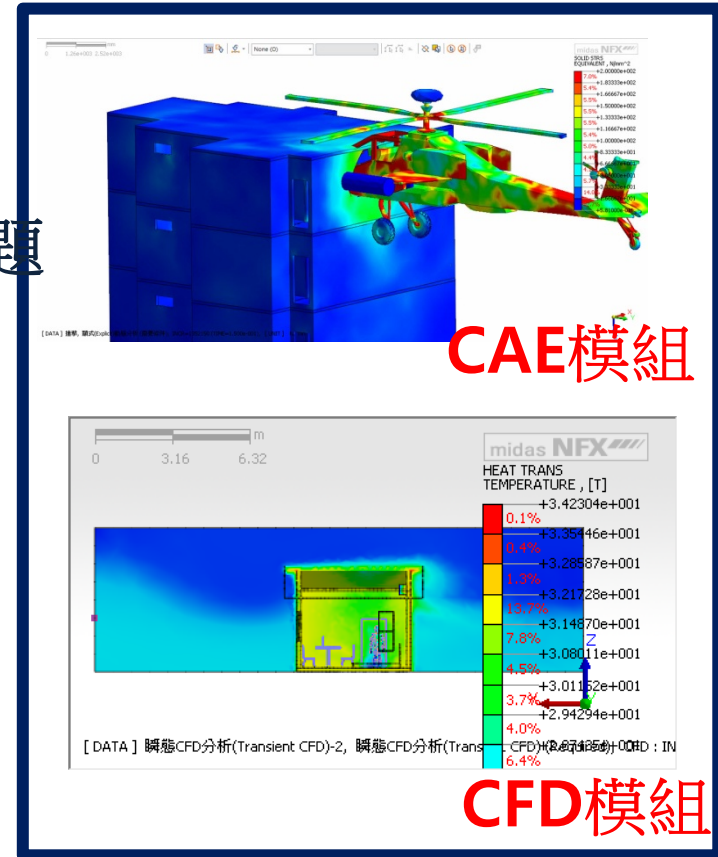


進階分析問題

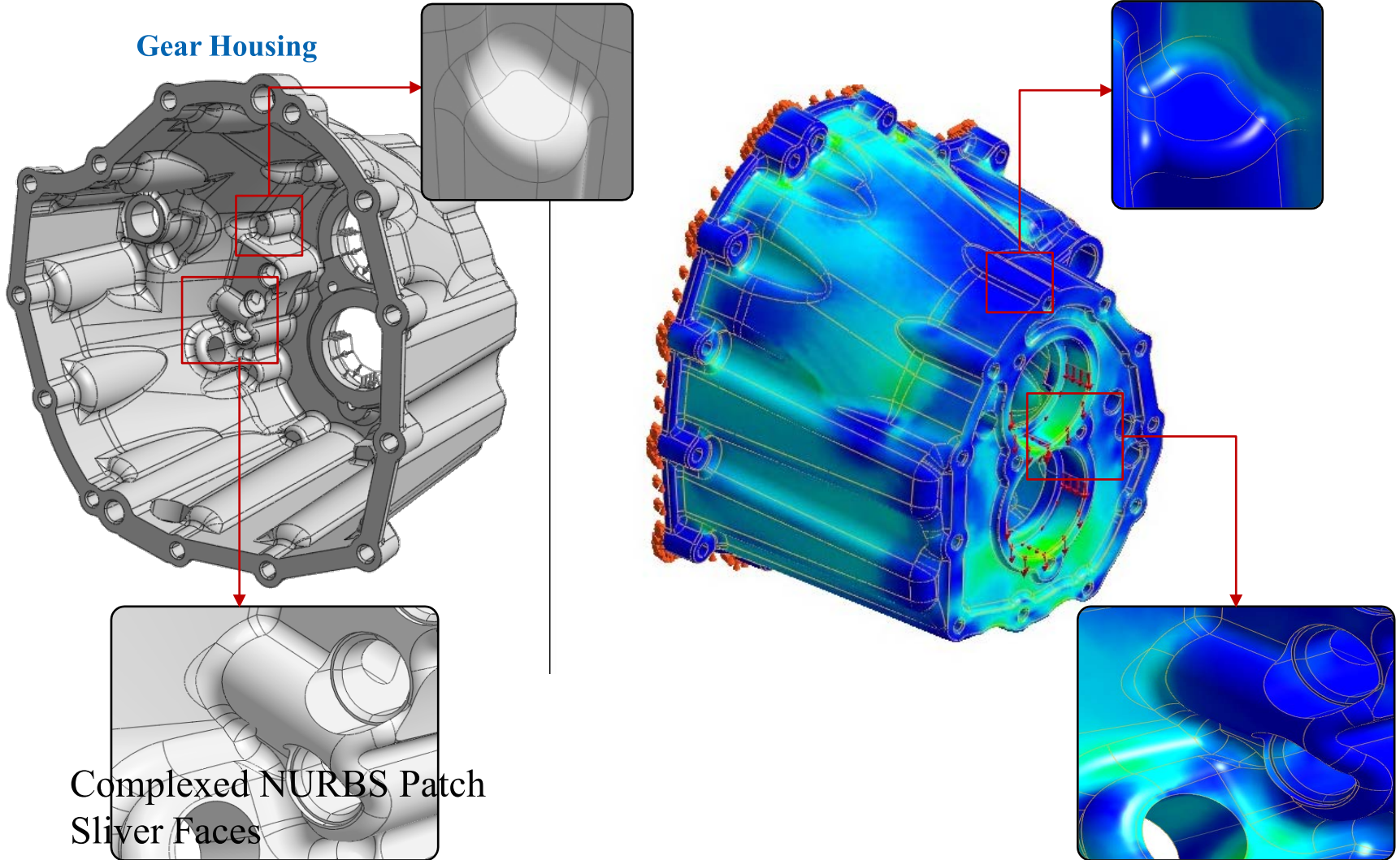
MeshFree進階版



NFX CAE/CFD軟體

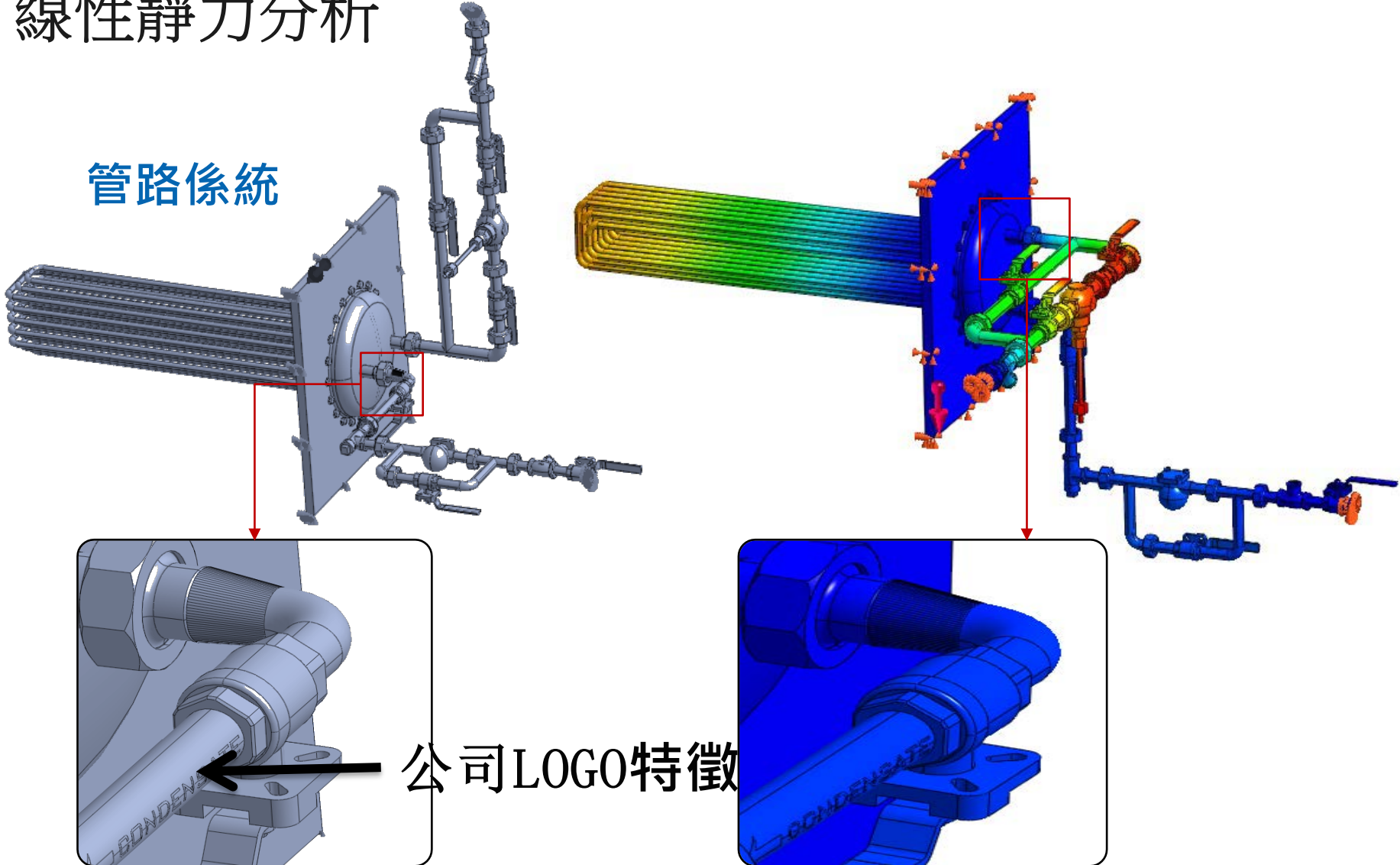


線性靜力分析



線性靜力分析

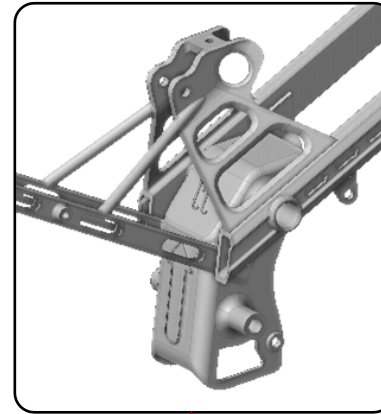
管路係統



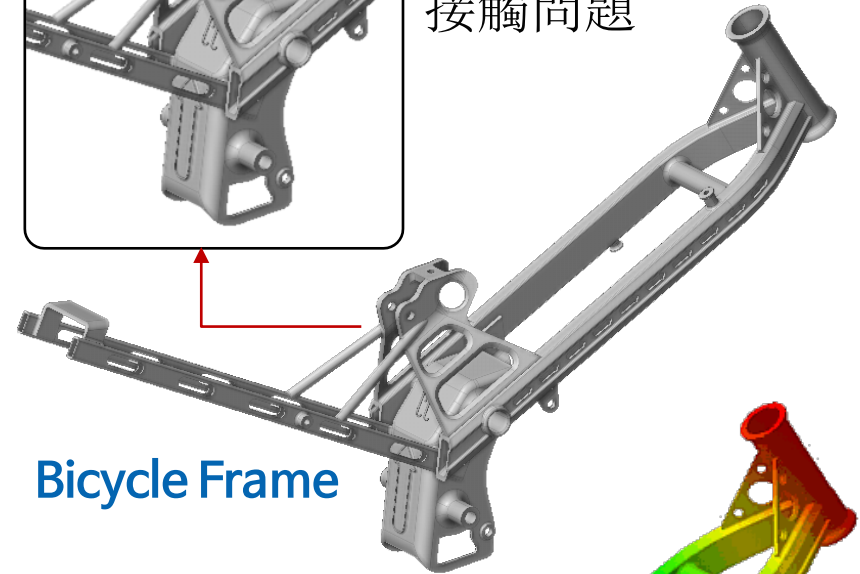
公司LOGO特徵

New Paradigm of CAE, midas MeshFree

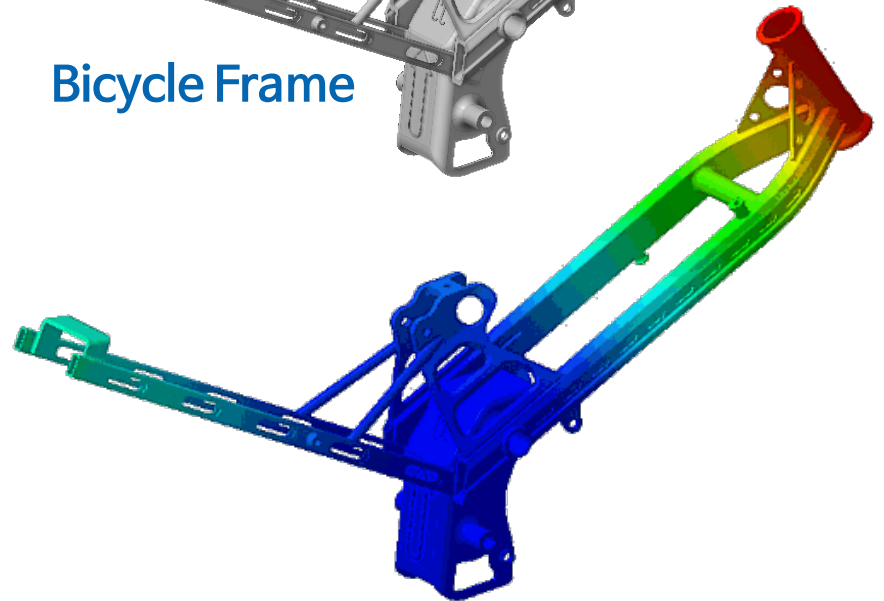
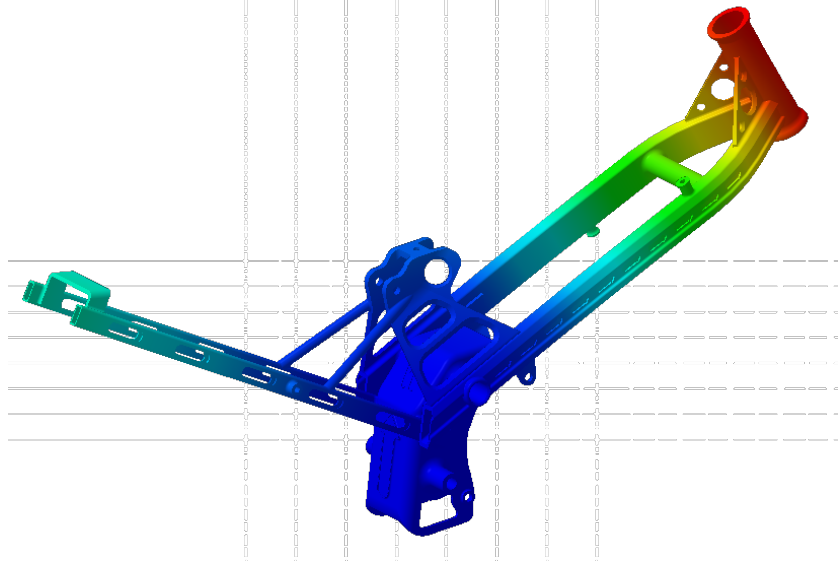
線性靜力分析



複雜薄壁結構的
接觸問題

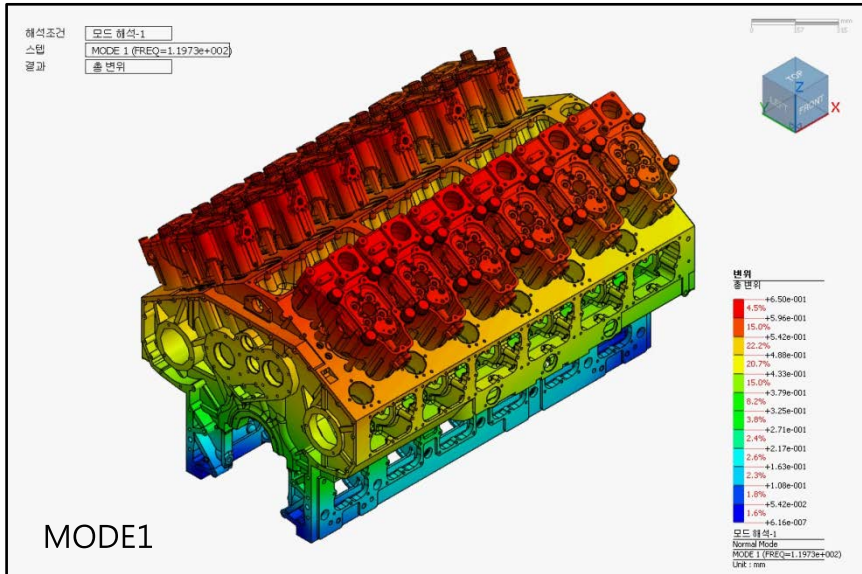
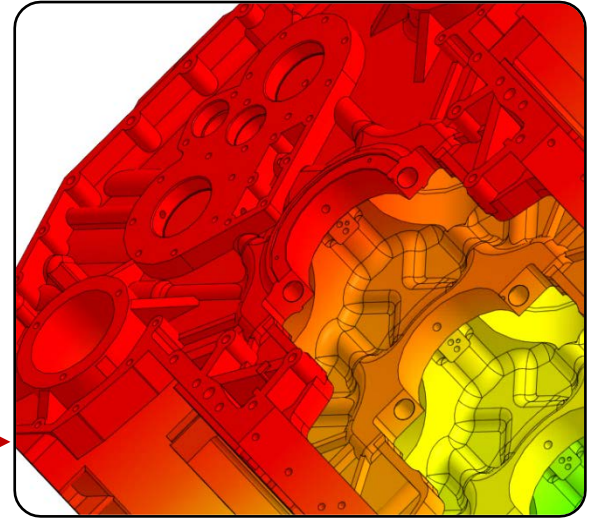
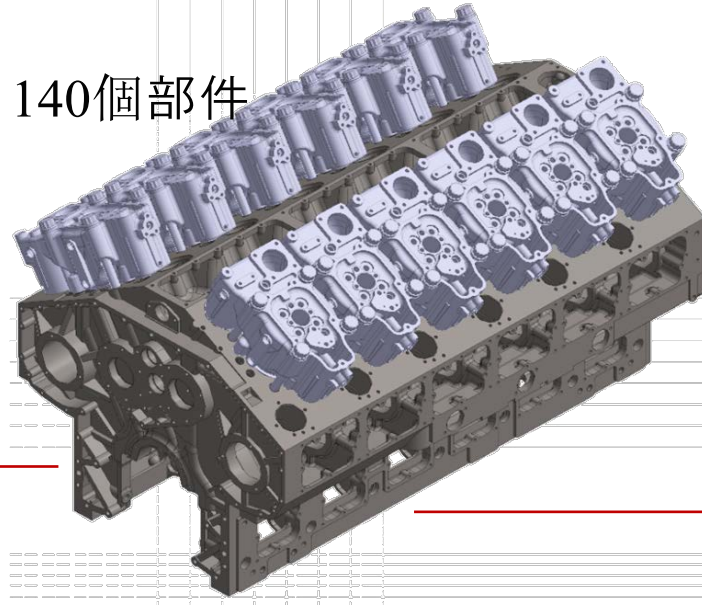
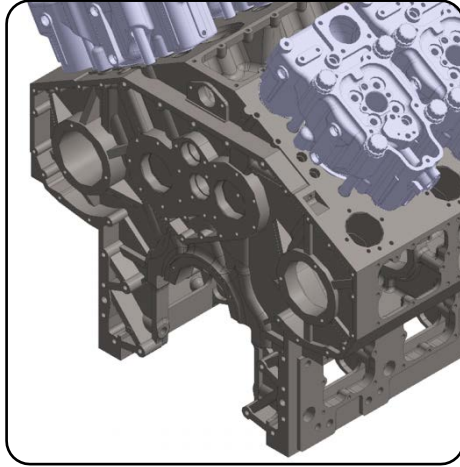


Bicycle Frame

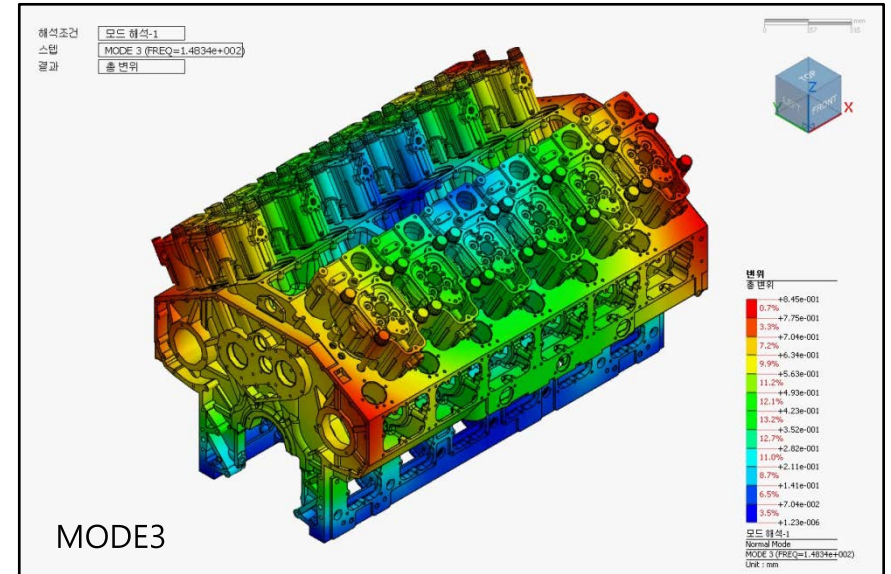


模態分析

140個部件

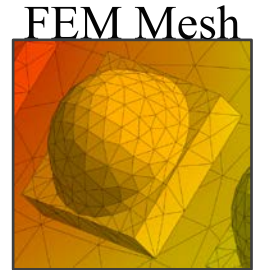
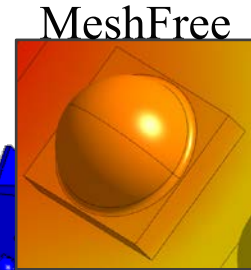
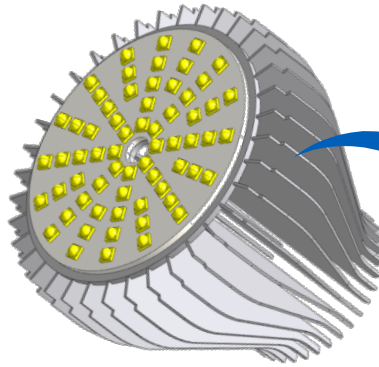
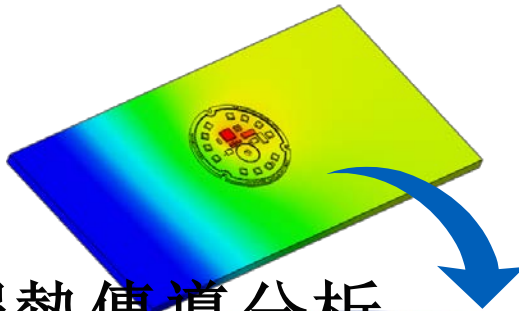


MODE1

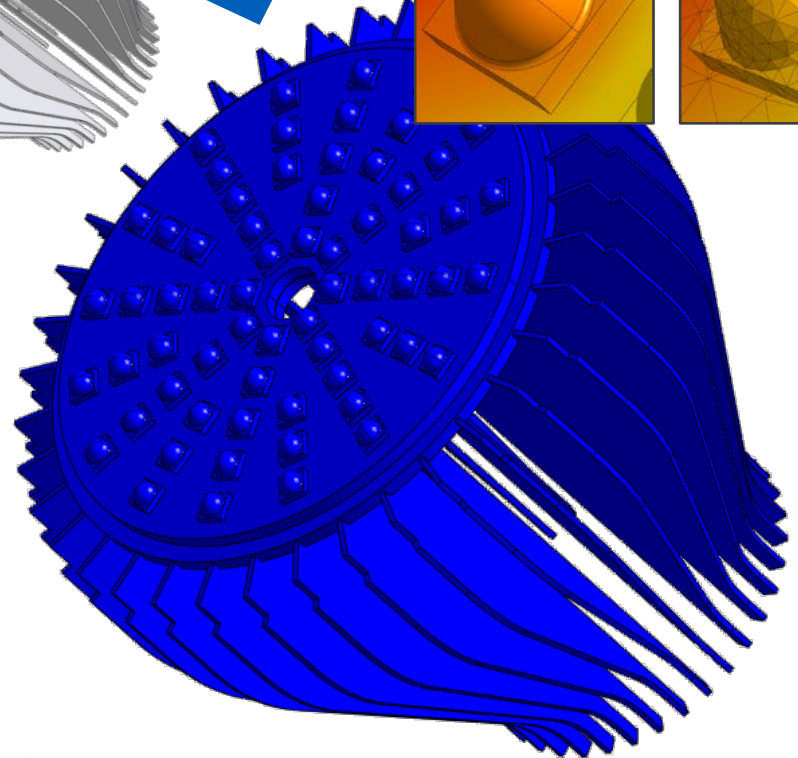
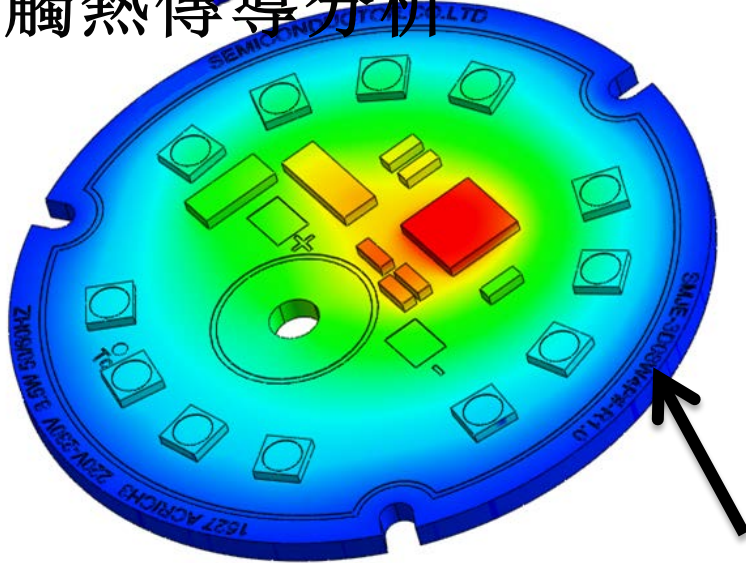


MODE3

熱傳分析

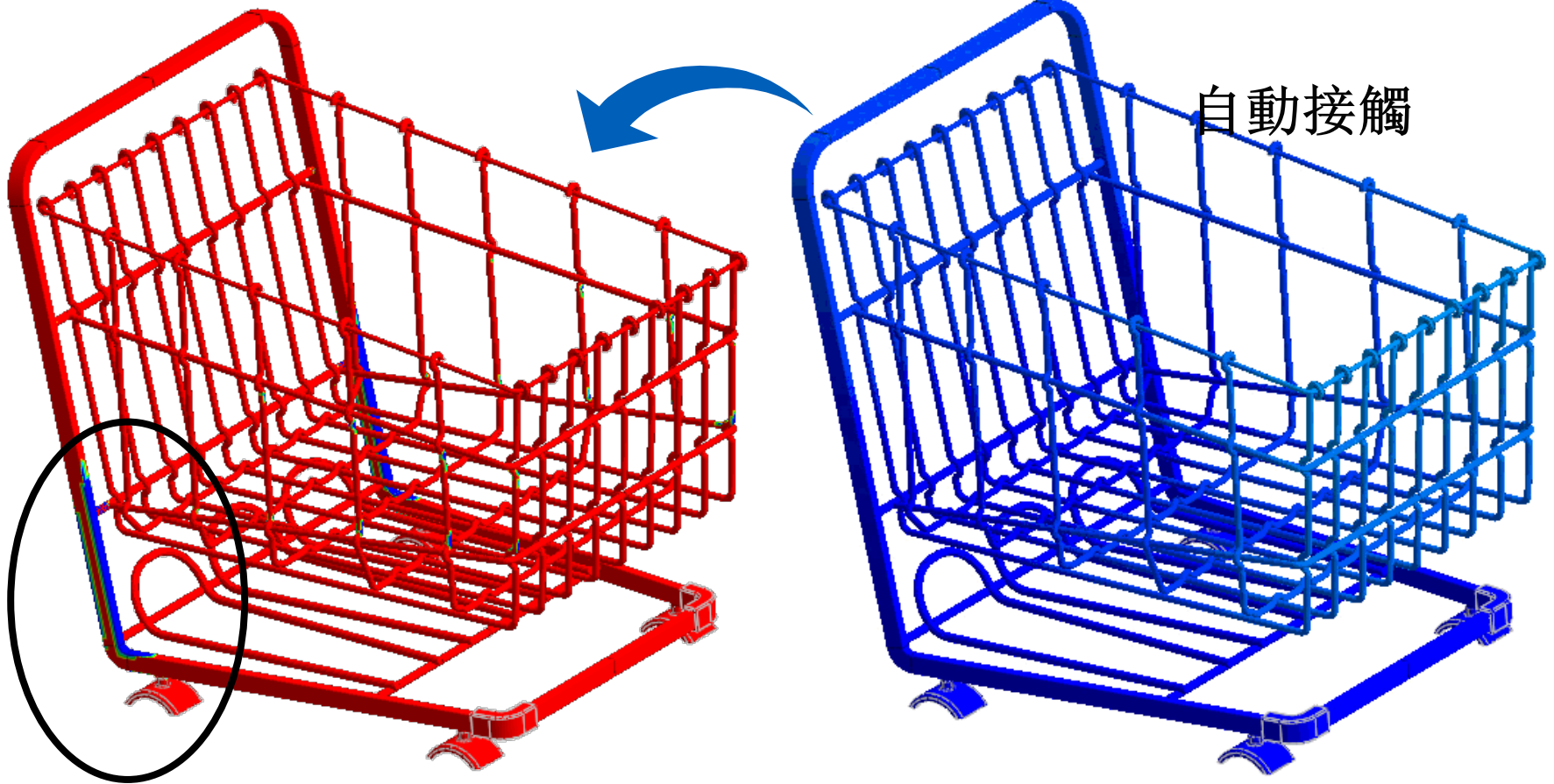


接觸熱傳導分析



公司LOGO特徵

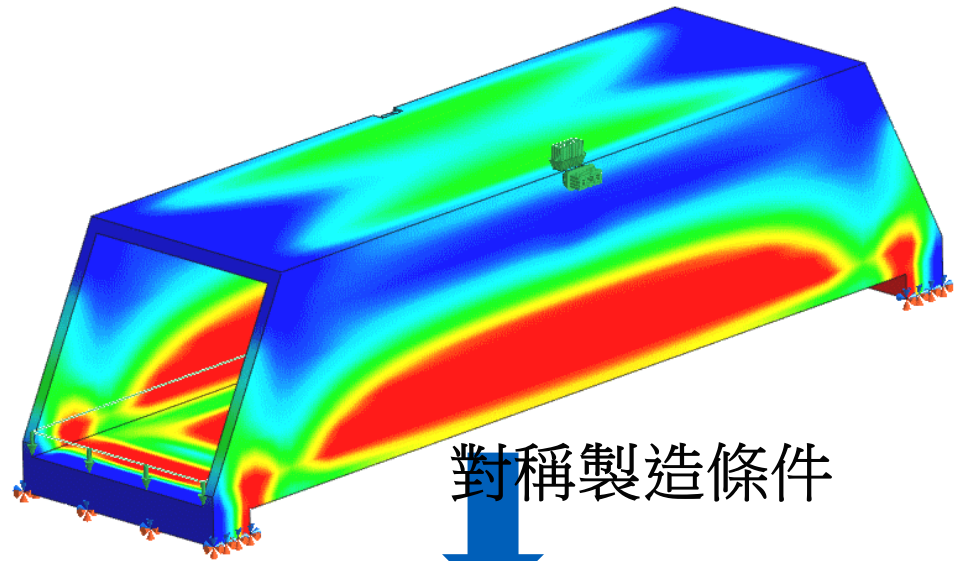
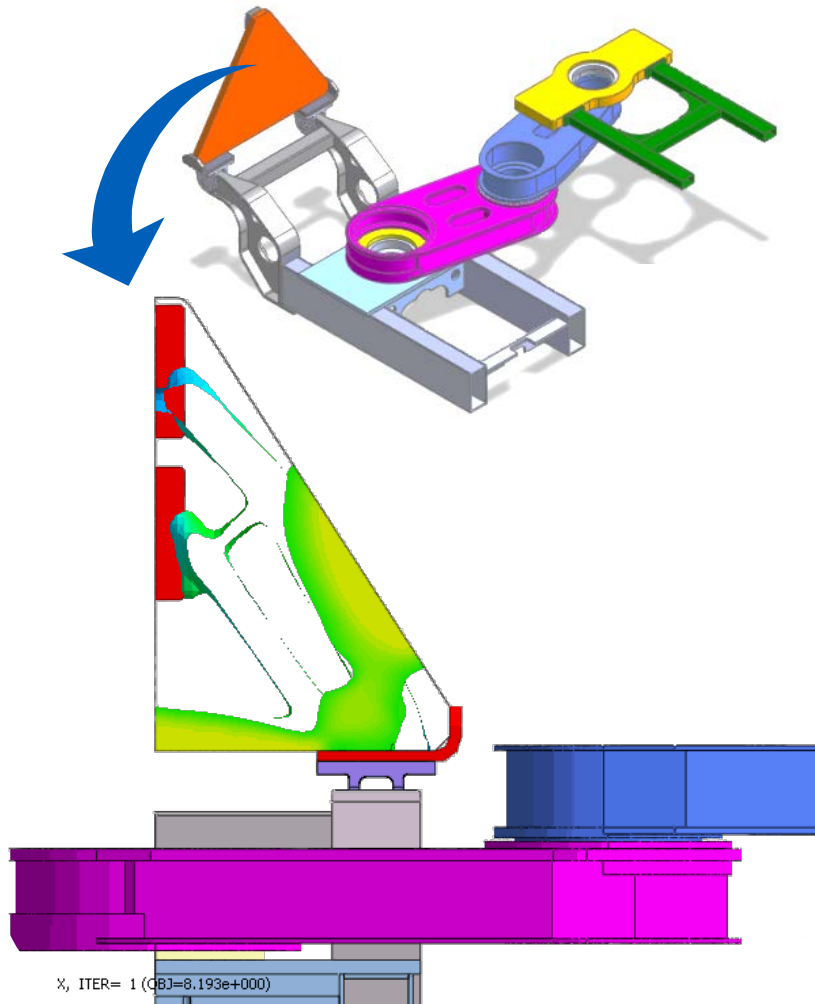
疲勞分析



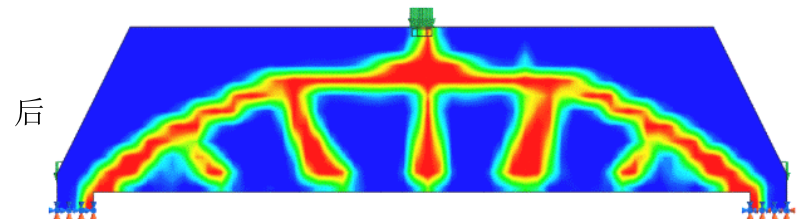
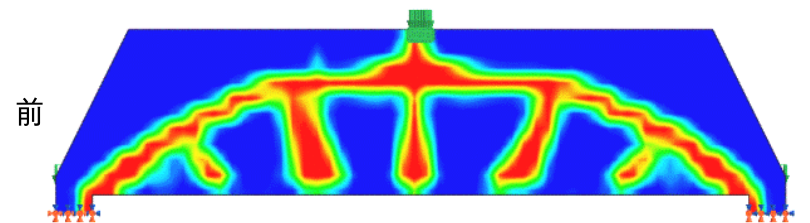
疲勞分析 (Life Cycle)

線性結構分析

拓撲優化分析

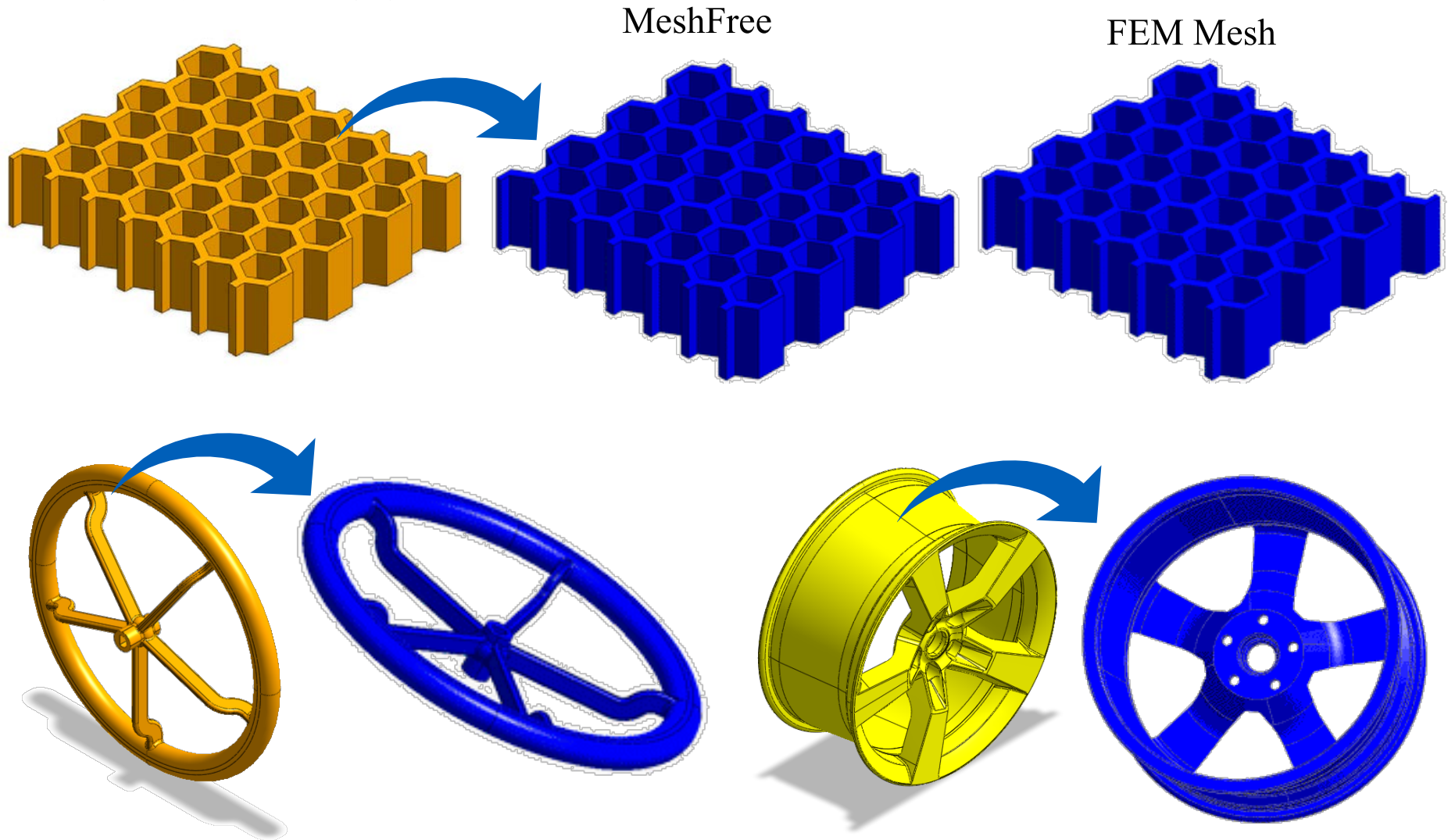


對稱製造條件



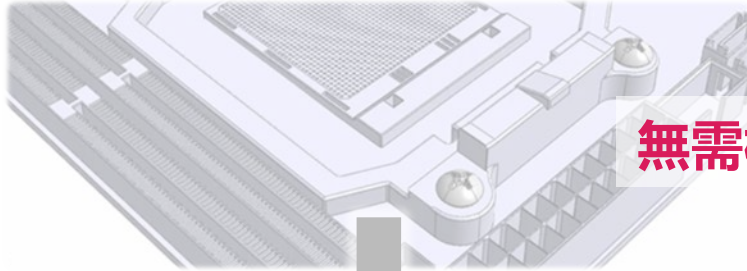
New Paradigm of CAE, midas MeshFree

線性動態分析

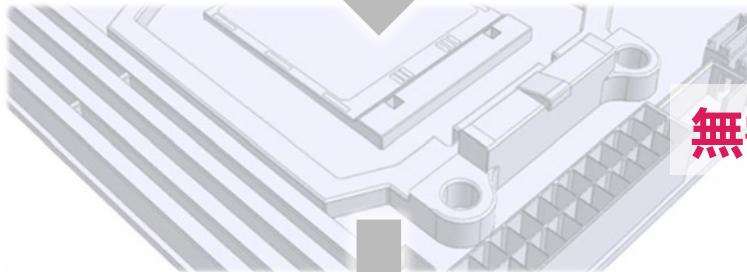


midas MeshFree 最大特點

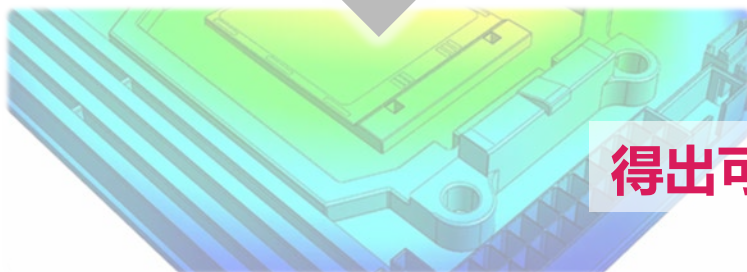
傳統有限元方法 (FEM)



無需模型清理簡化



無需網格劃分

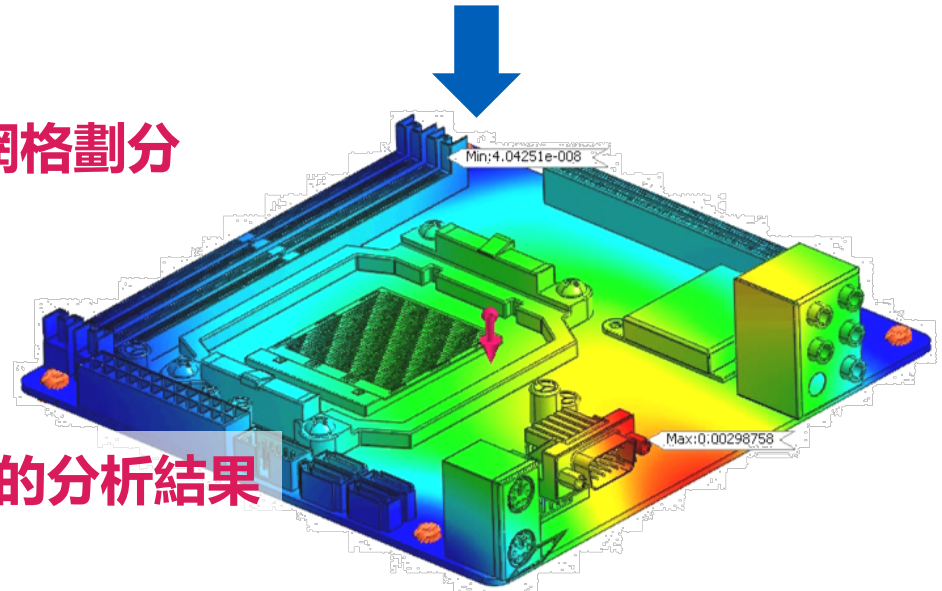
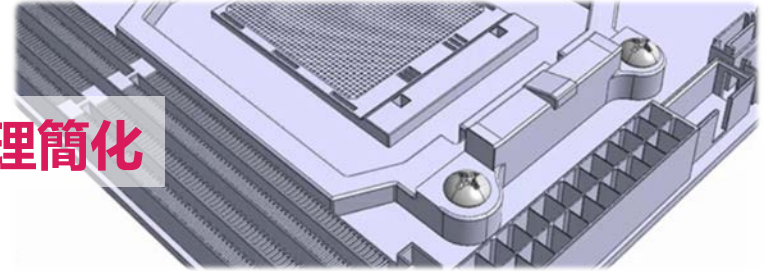


得出可靠的分析結果



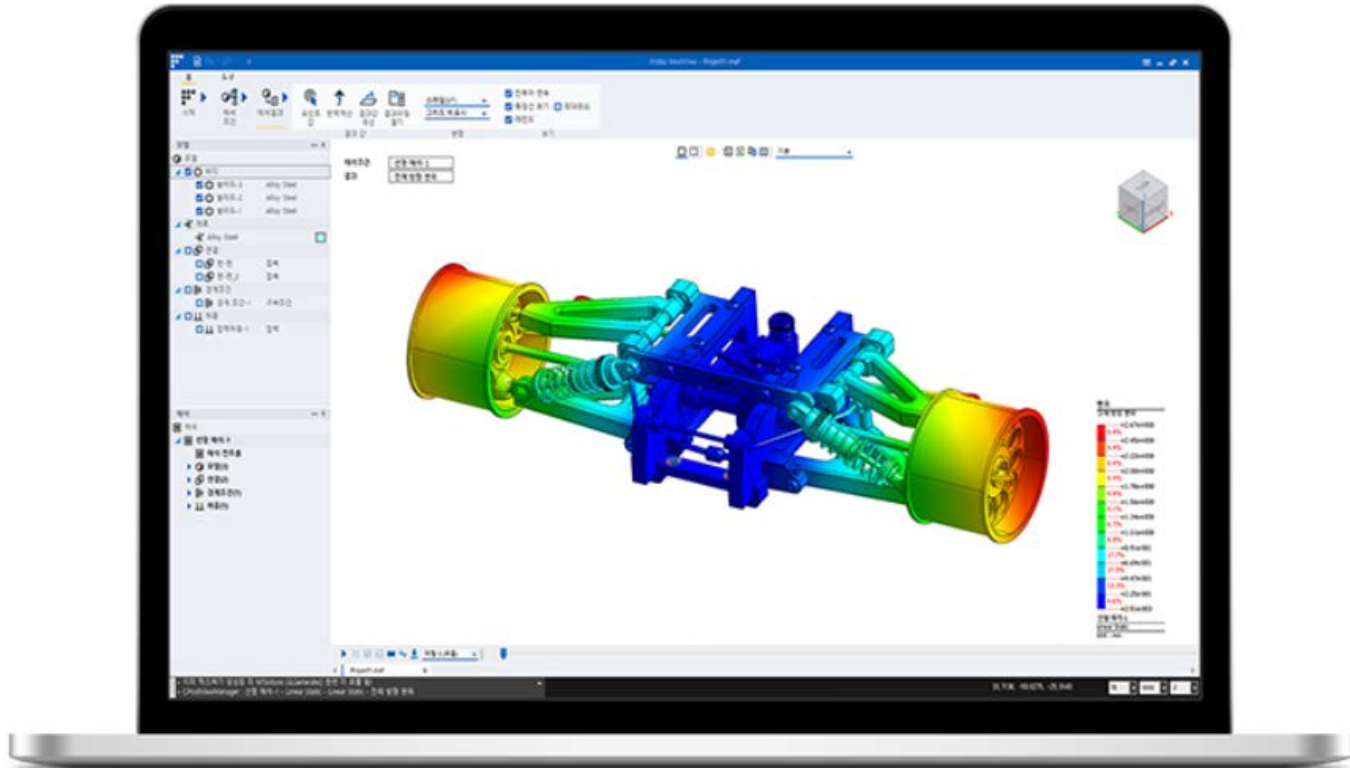
手動簡化工作

midas MeshFree (IBM)



電腦自動化處理

全新的CAE免網格分析軟體, -MeshFree





MIDAS

MESH FREE

Thank you!!

Simple, but Everything.

