Your True Partner for CAE CFD ICSC2016

IDAJ CAE Solution Conference

基于仿真的研发创新平台及ANSYS CFD新功能

ANSYS

ANSYS China 技术部

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仿真与产品研发的发展趋势

将伟大的想法转变成创新的产品

挑战

- 在产品研发过程中发现问题太晚
- 新的设计概念总是存在很多不确定性
- 创新缓慢，无重大突破

解决方案

- 在产品研发流程的早期实施仿真
- 对全部有前景的新概念进行快速可行性研究
- 在产品研发过程中建立完整的模型

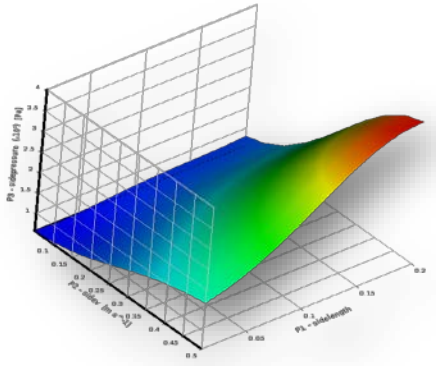
影响

- 尝试10 到30个以上的设计方案
- 设计成本降低2到4倍
- 产品上市速度提高2到5倍

- 每天测试10种设计方案。
- 通过响应表面分析在一天内完成设计改进

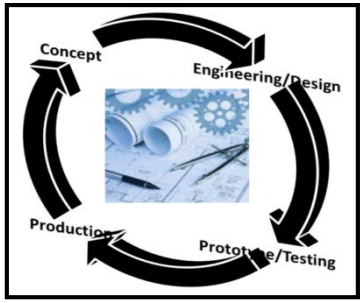
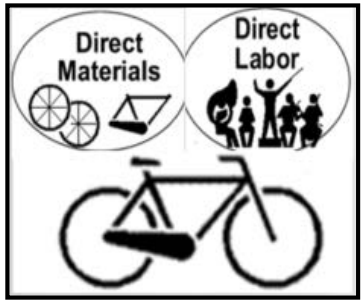
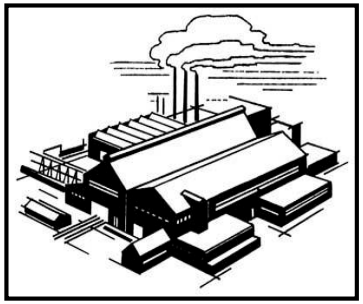
- 风扇的效率比普通风扇提高250%以上。
- 进/出气比从6倍提高到15倍。

“仅仅利用*10*个物理原型的预算和*3*个原型制造的时间，戴森的工程师就测试了200多种不同产品设计。”



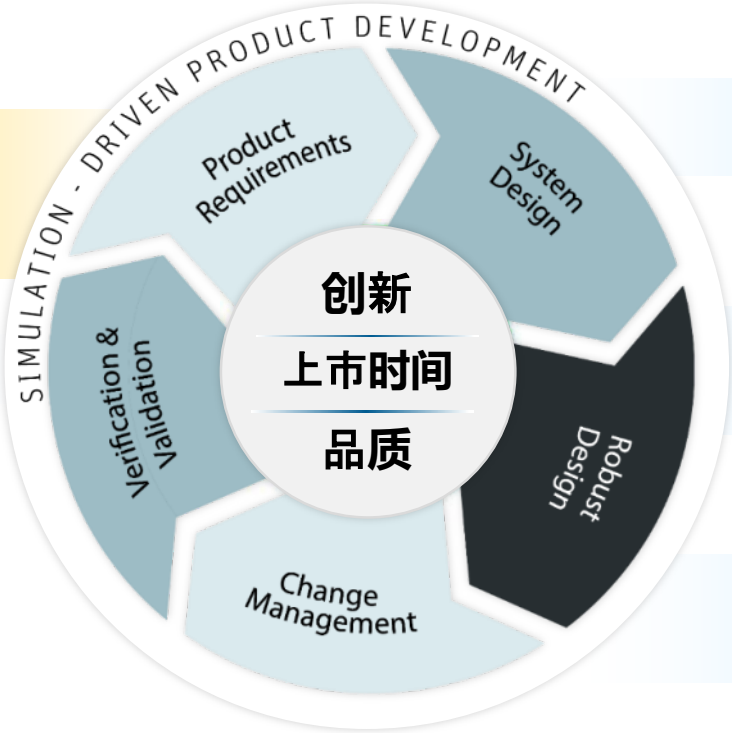
仿真影响的5种损益类型

客户价值

产品研发成本	产品成本	生产成本	上市时间	产品性能
REDUCE降低	REDUCE降低	REDUCE降低	FASTER更快	IMPROVE改进
				
1. 测试成本：系统采购和运行 2. 原型制造成本	1. 原材料成本 2. 劳动力成本	运行成本：节能，消耗品供应商成本	1. 减少产品研发周期 2. 提高整个产品生命周期内的收益	在设计早期预测产品性能

在产品开发全过程中应用仿真技术

基于仿真驱动产品研发（SDPD）的产品研发流程



概念设计

详细设计

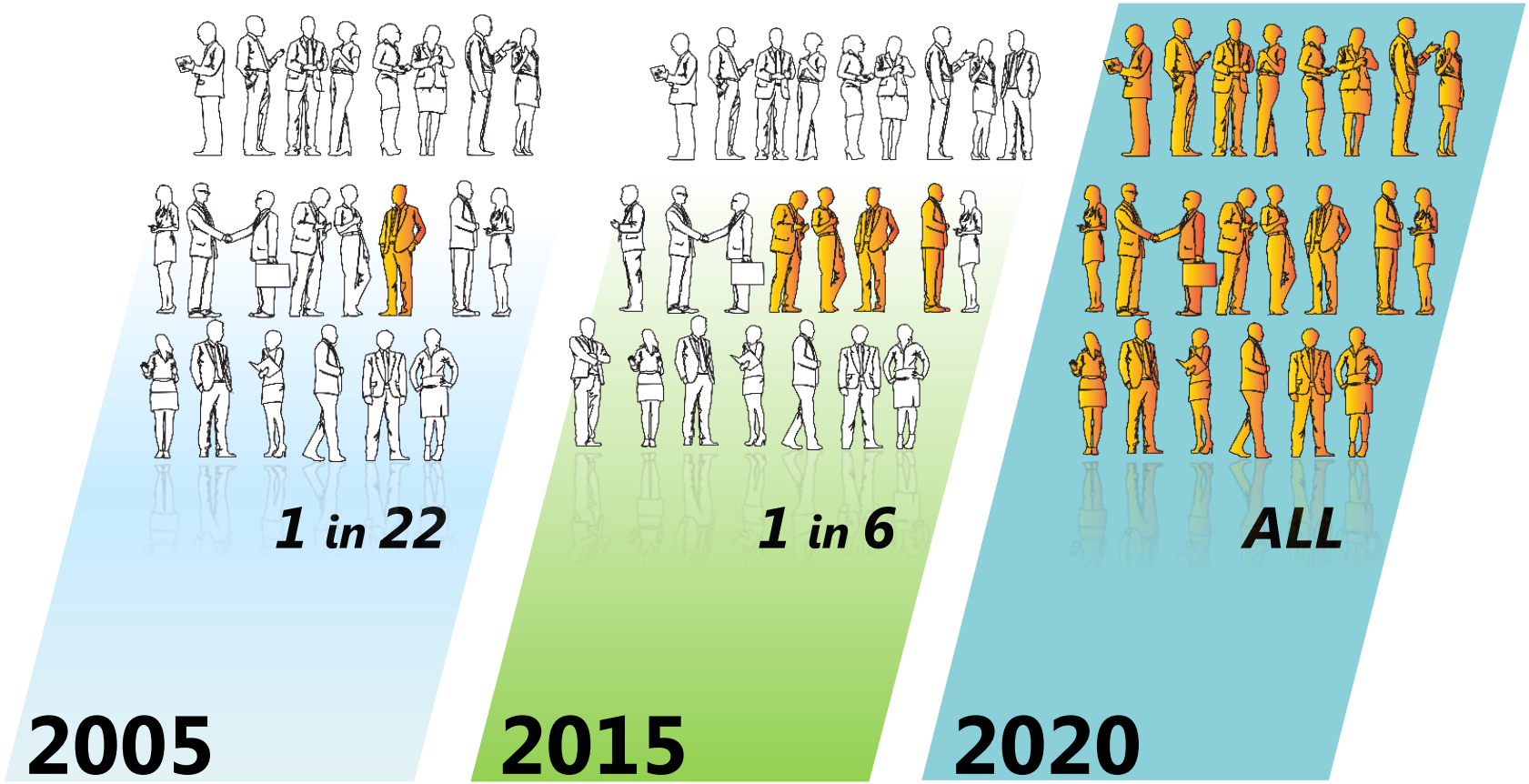
物理原型测试

最终产品

传统的产品研发流程

每个工程师都将使用仿真工具

我们最具创新力的客户都在快速和深入地利用仿真工具



从3个维度提高仿真应用成熟度

软件使用者

1. 培训与认证
2. 协同仿真环境，直接和参数化建模

3. 在设计早期系统化地应用仿真
4. 实现设计决策民主化

仿真的广度

5. 计算资源的智能化访问
6. 软件许可证集中式管理

ANSYS
完备的
仿真解决方案

7. 稳健性设计优化
8. 在设计早期进行可靠性预测与仿真

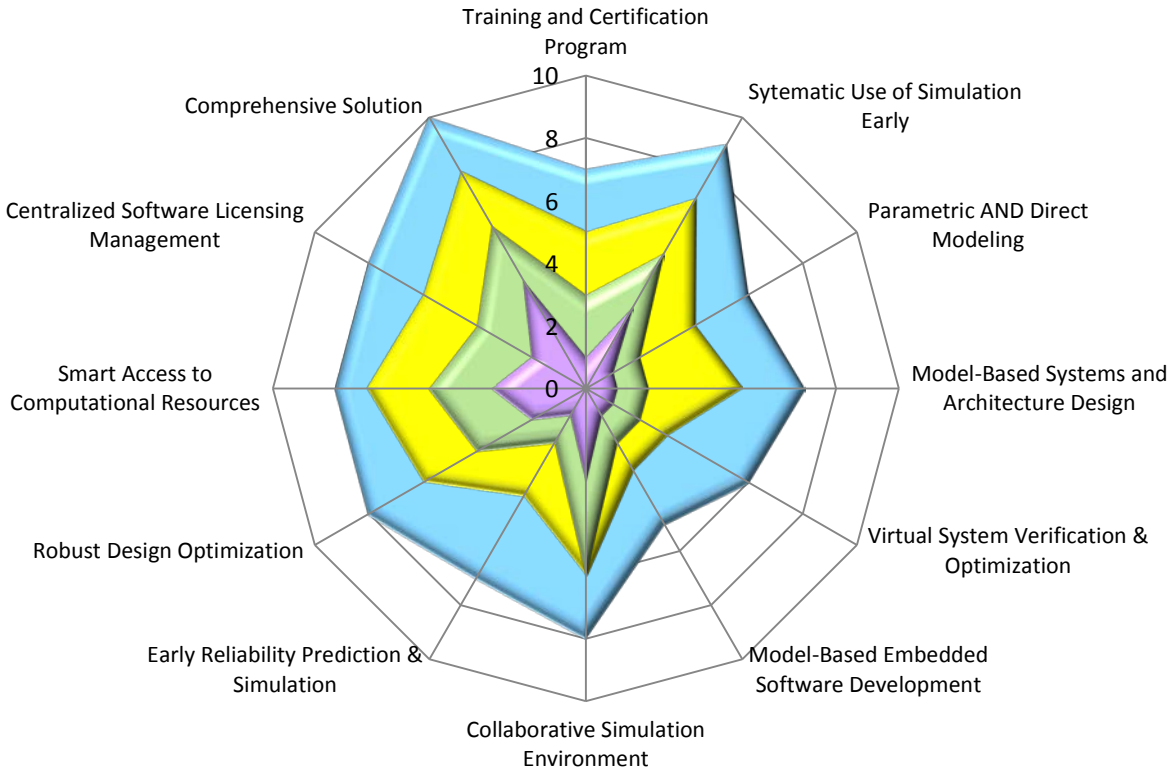
仿真的深度

9. 完备全面的多物理场仿真
10. 系统架构与功能建模
11. 系统、部件、代码协同设计
12. 集成化降阶模型，嵌入式软件建模

ANSYS 帮助企业推进仿真应用成熟度

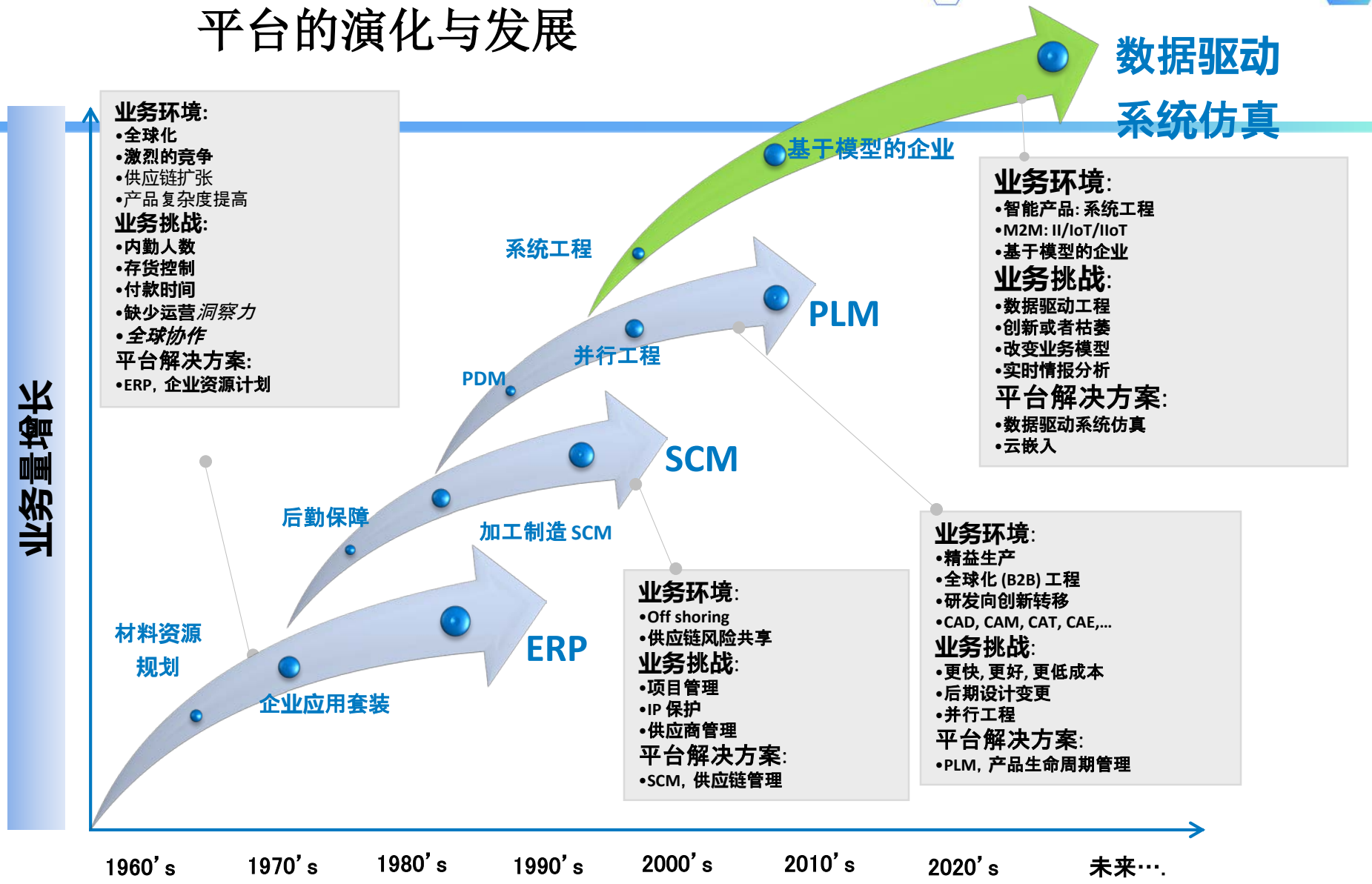
Level 1 → **Level 2** → **Level 3** → **Level 4**

Quantity/Fidelity of Simulation

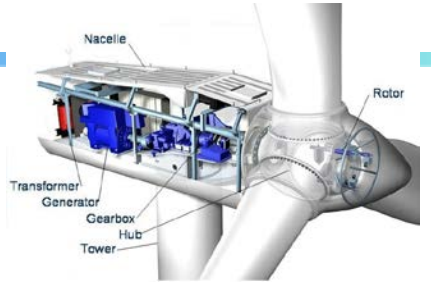


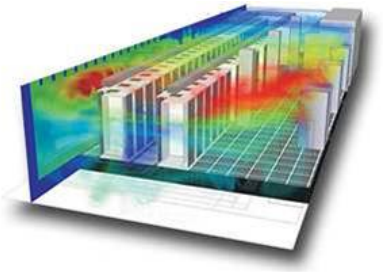
仿真平台建设

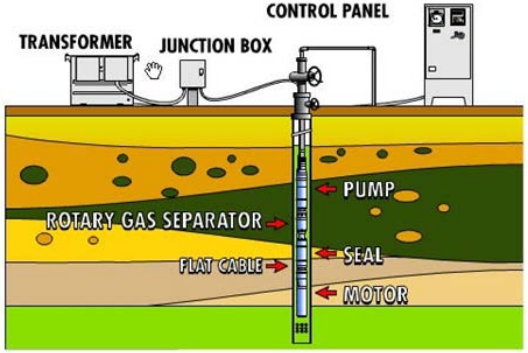
平台的演化与发展



系统 - 无处不在







这是一个创新的机会……

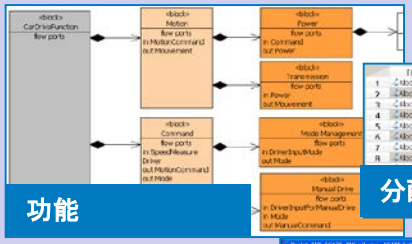
- 以新的方式供电，驱动，传感，控制产品

……获益良多

- 更好的性能
- 更高的效率
- 更低的成本
- 更高的可靠性

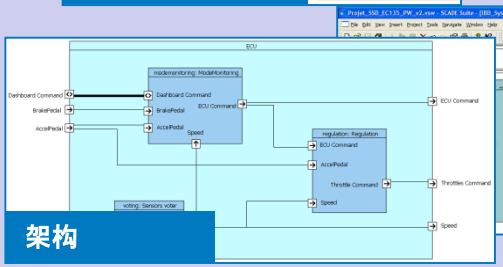
ANSYS 提供了系统工程框架与仿真平台，帮助客户实现仿真驱动产品研发

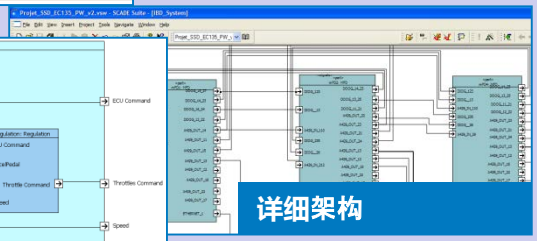
功能工程



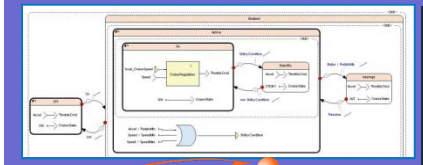
SCADE LIFECYCLE®

SCADE SYSTEM®





软件工程



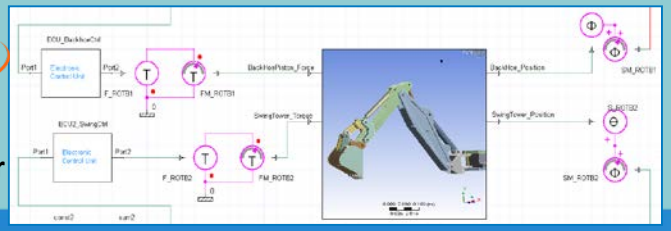
SCADE DISPLAY®

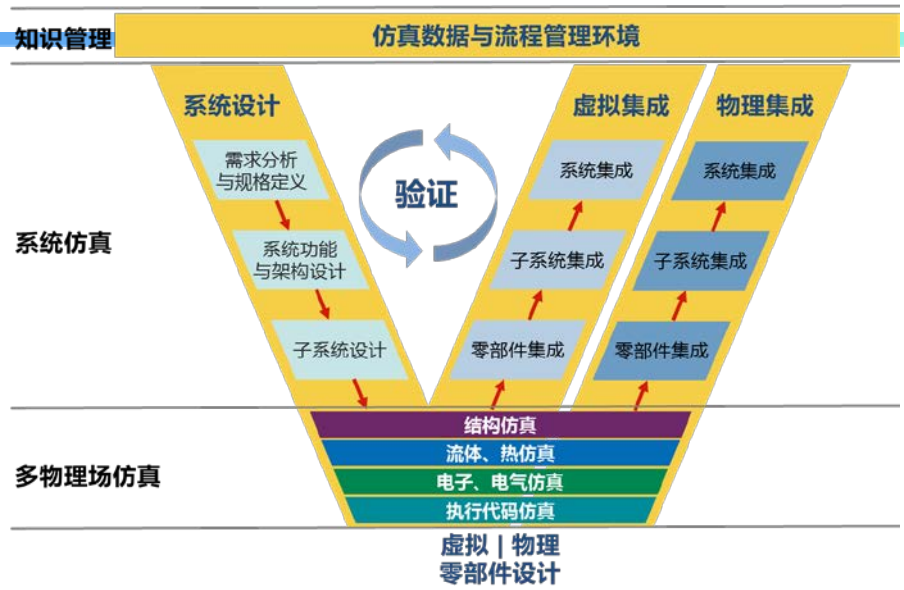
SCADE SUITE®

系统级设计

SIMPLORER®

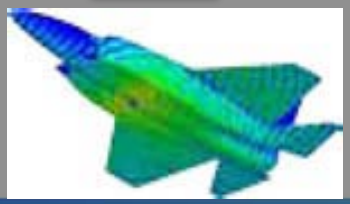
ANSYS Designer



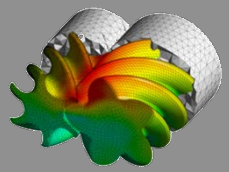


详细设计

ANSYS HFSS



ANSYS Fluent



ANSYS Mechanical

独立研究机构的结论：Aberdeen集团

统一了公司的仿真平台以后：

24%

更好地达到产品上市时间目标

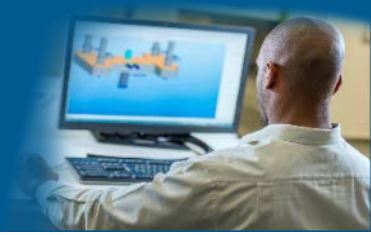
$$$

50%

更显著地减少了仿真工具的12个月TCO（总拥有成本）

37%

更多地减少了研发周期



Source: Aberdeen Group

ANSYS: 仿真行业的引领者

在每一个学科，ANSYS 均提供了市场领先深度和广度的仿真产品，并且在交叉学科领域提供集成化的仿真方案。

系统

ANSYS Simplorer　ANSYS SCADE　ANSYS HPC
ANSYS Engineering Knowledge Manager　ANSYS DesignXplorer

流体

ANSYS FLUENT
ANSYS CFX
ANSYS POLYFLOW
ANSYS Icepak

结构

ANSYS Mechanical
ANSYS AUTODYN
ANSYS LS-DYNA
ANSYS nCode

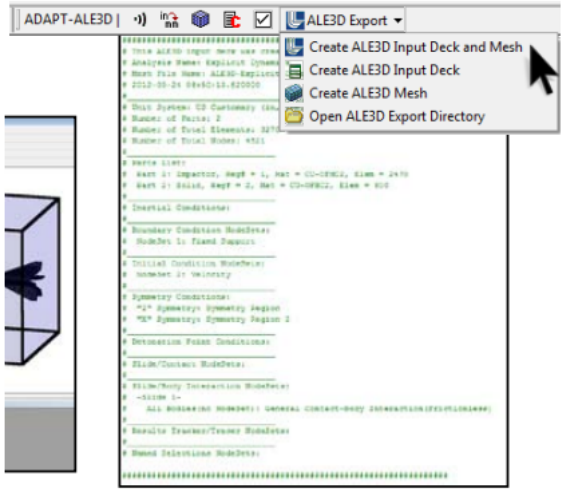
电子

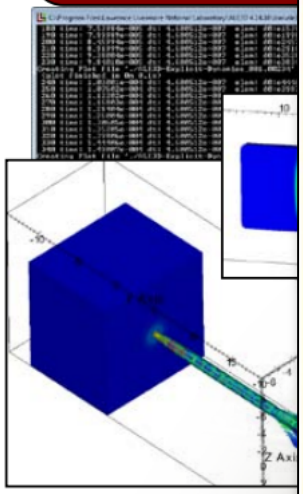
ANSYS HFSS
ANSYS Maxwell
ANSYS Designer
Apache RedHawk

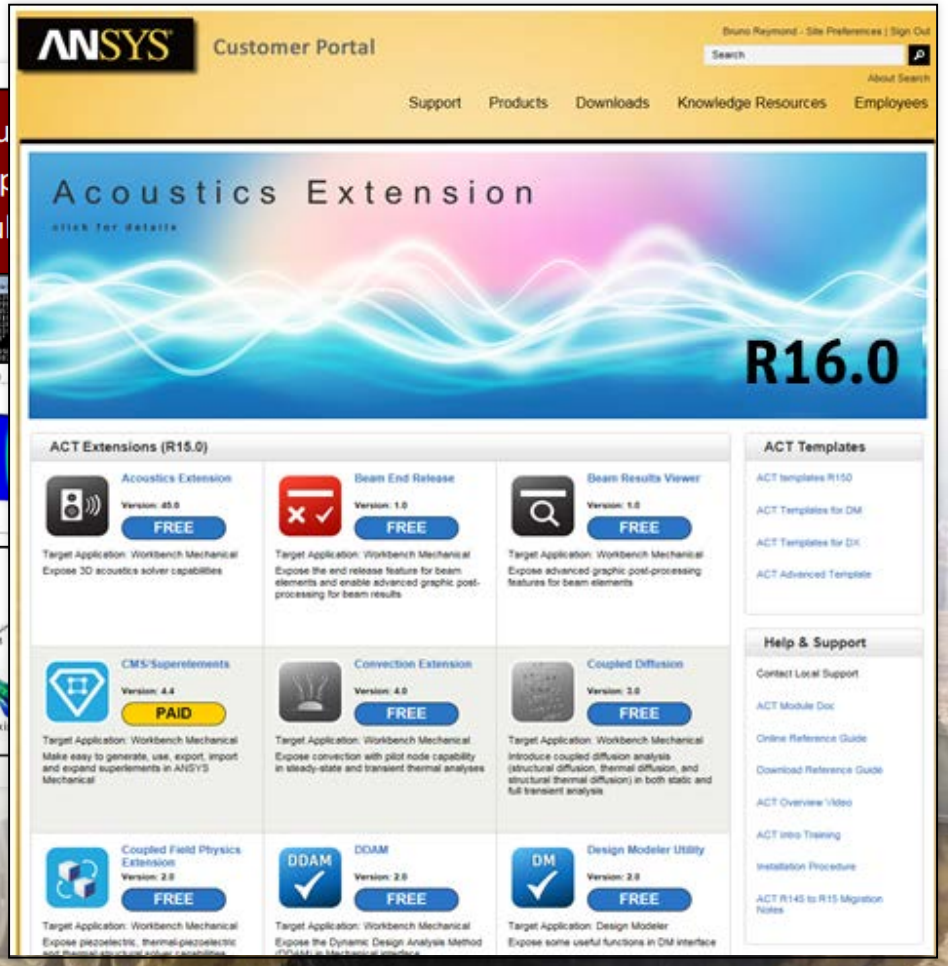
开放的构架与定制化开发

Run the ADAPT-ALE3D ACT extension which exports the ALE3D input deck and mesh file

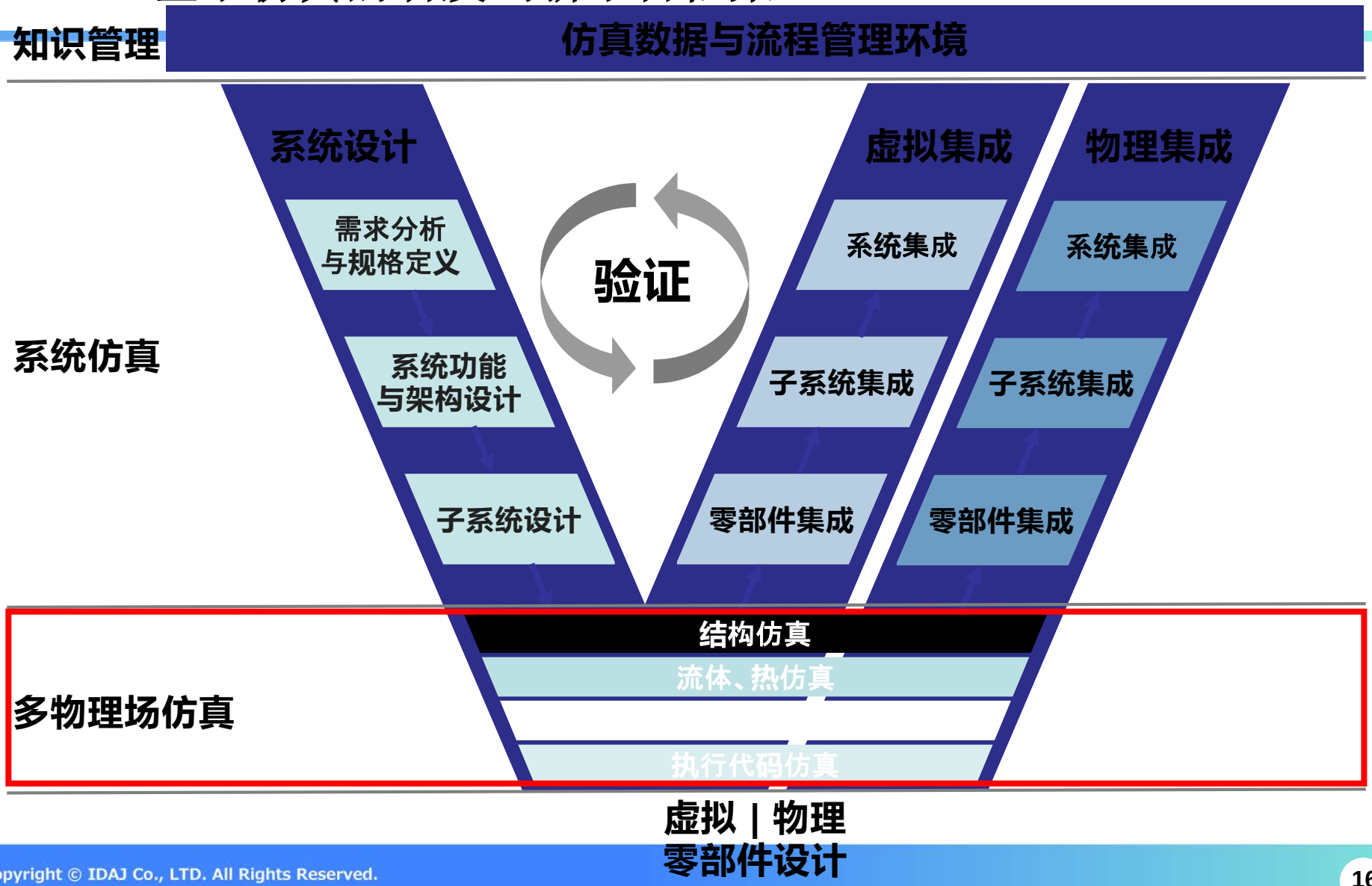
Generate and Ru
ALE3D analysis, p
process the resul



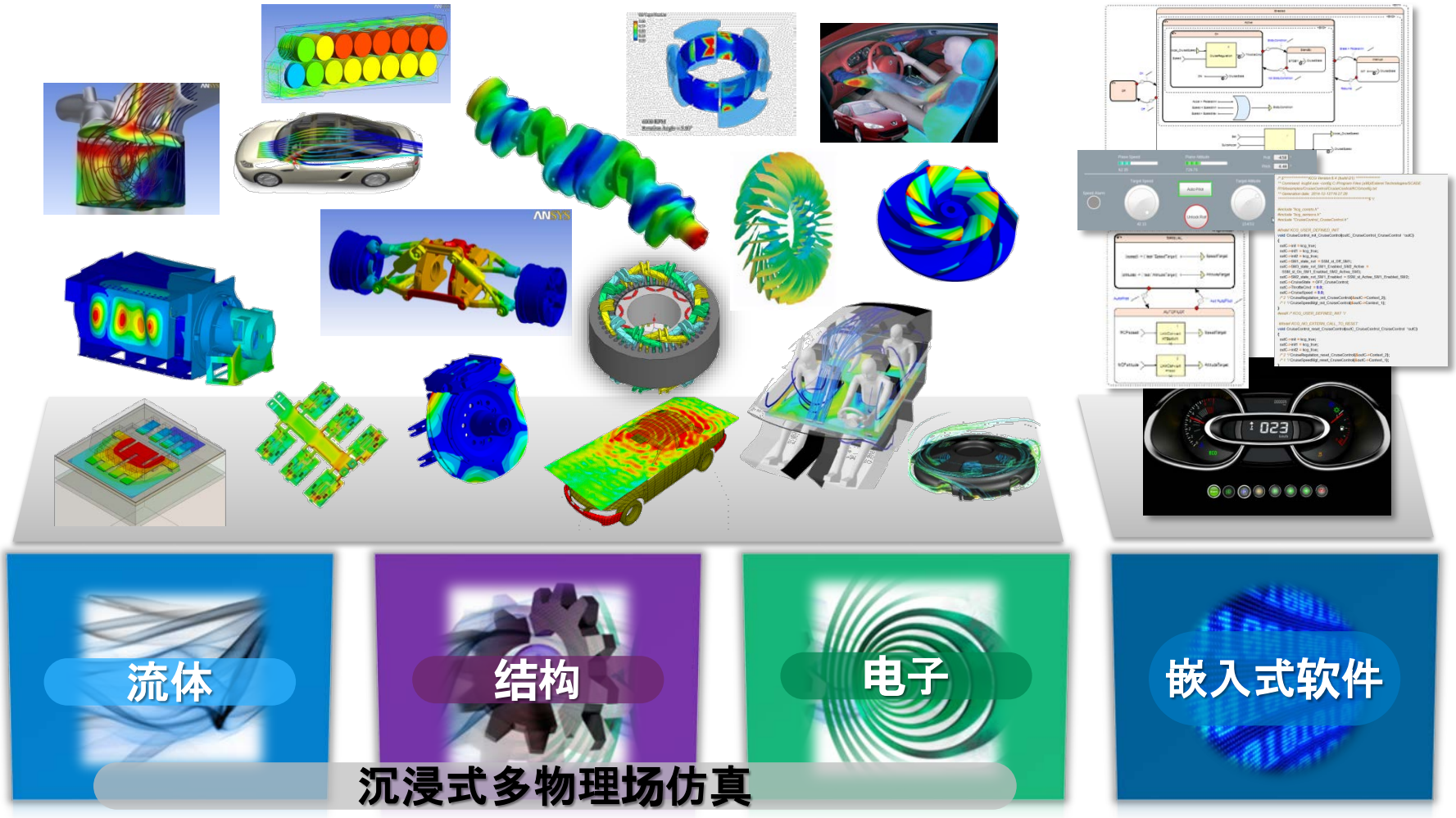




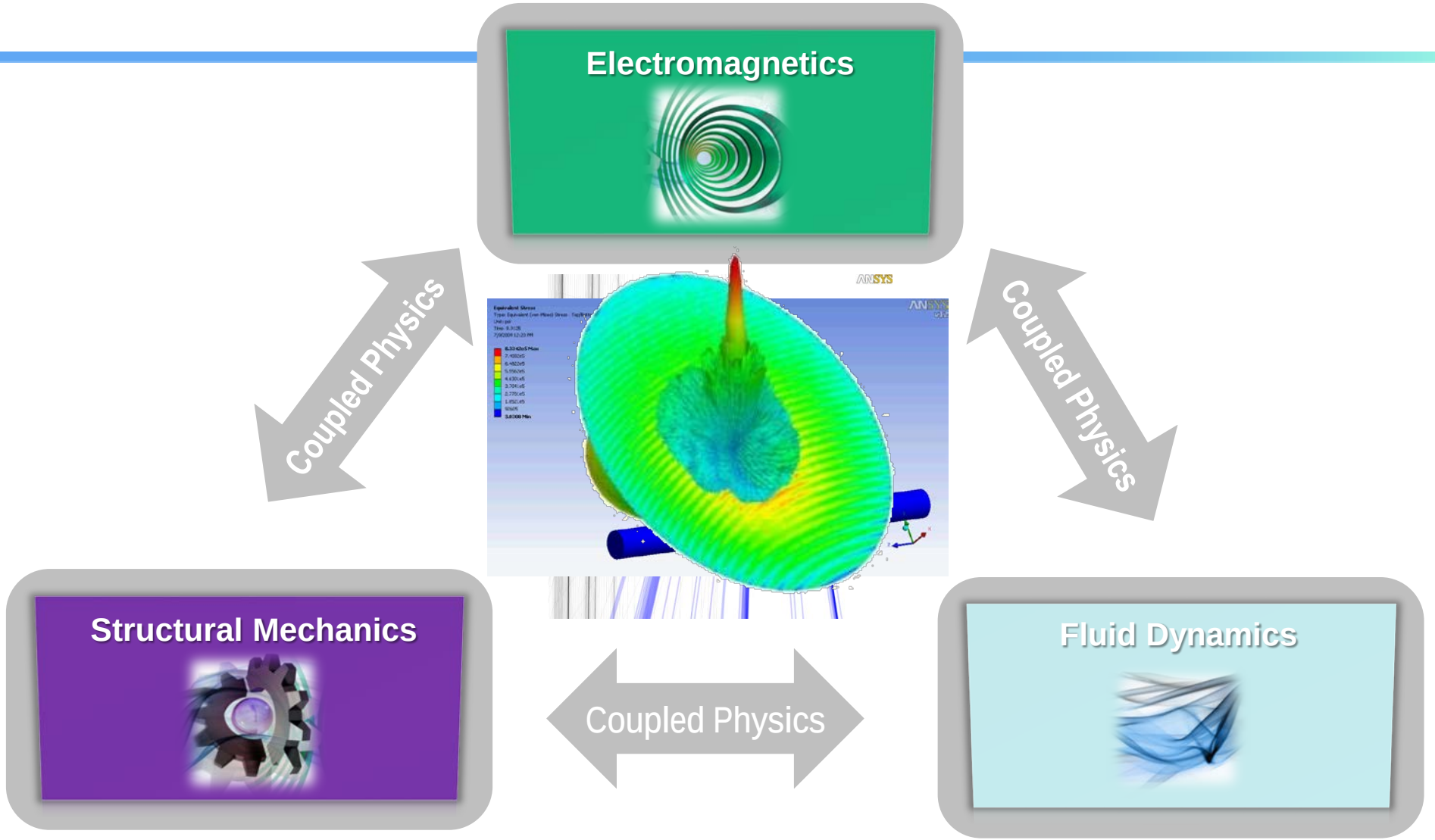
ANSYS 基于仿真的研发创新平台框架



全面的部件级设计

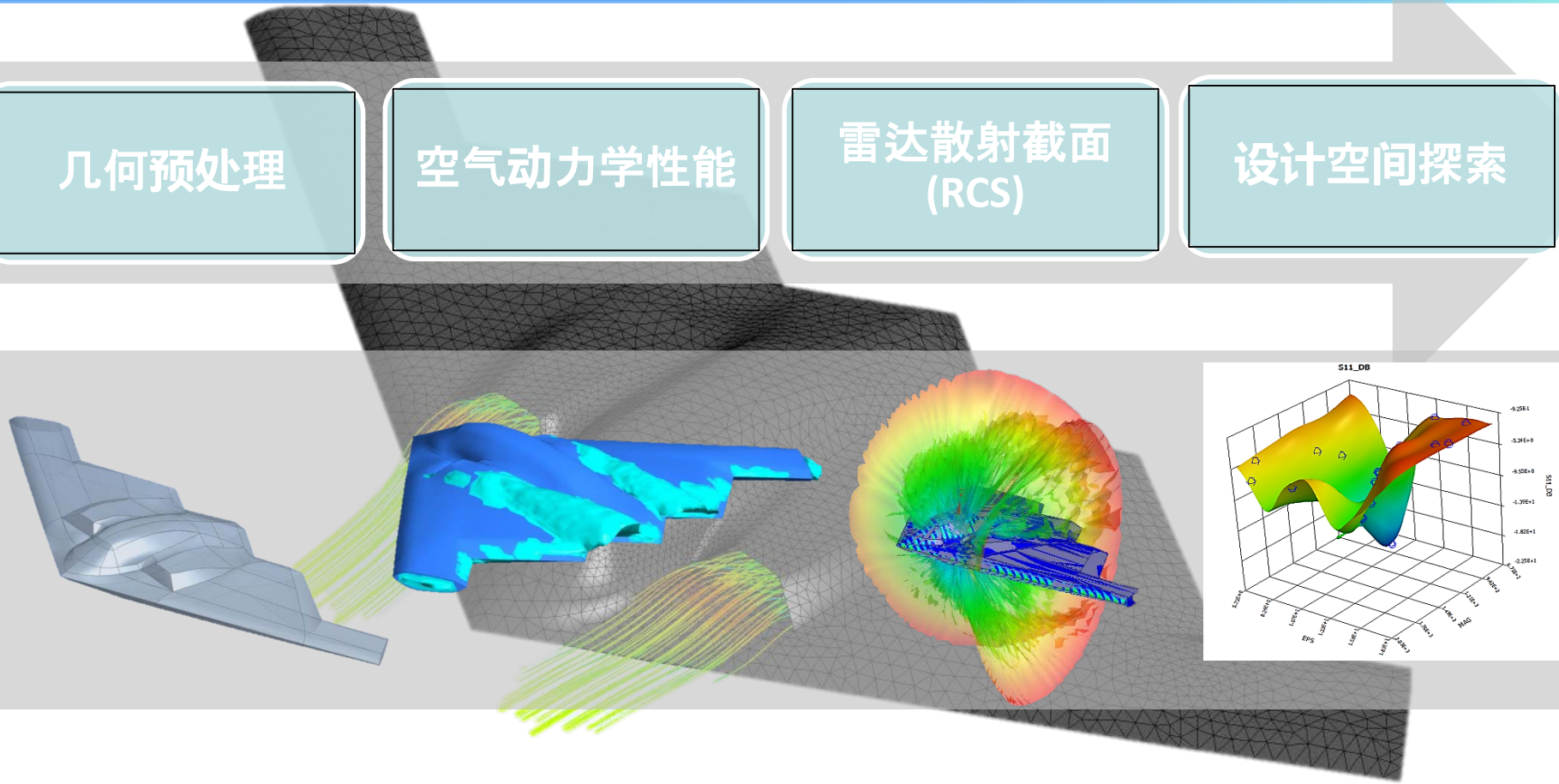


多物理场耦合仿真确保设计质量



多学科设计探索与优化开拓创新思维

几何预处理 → 空气动力学性能 → 雷达散射截面 (RCS) → 设计空间探索



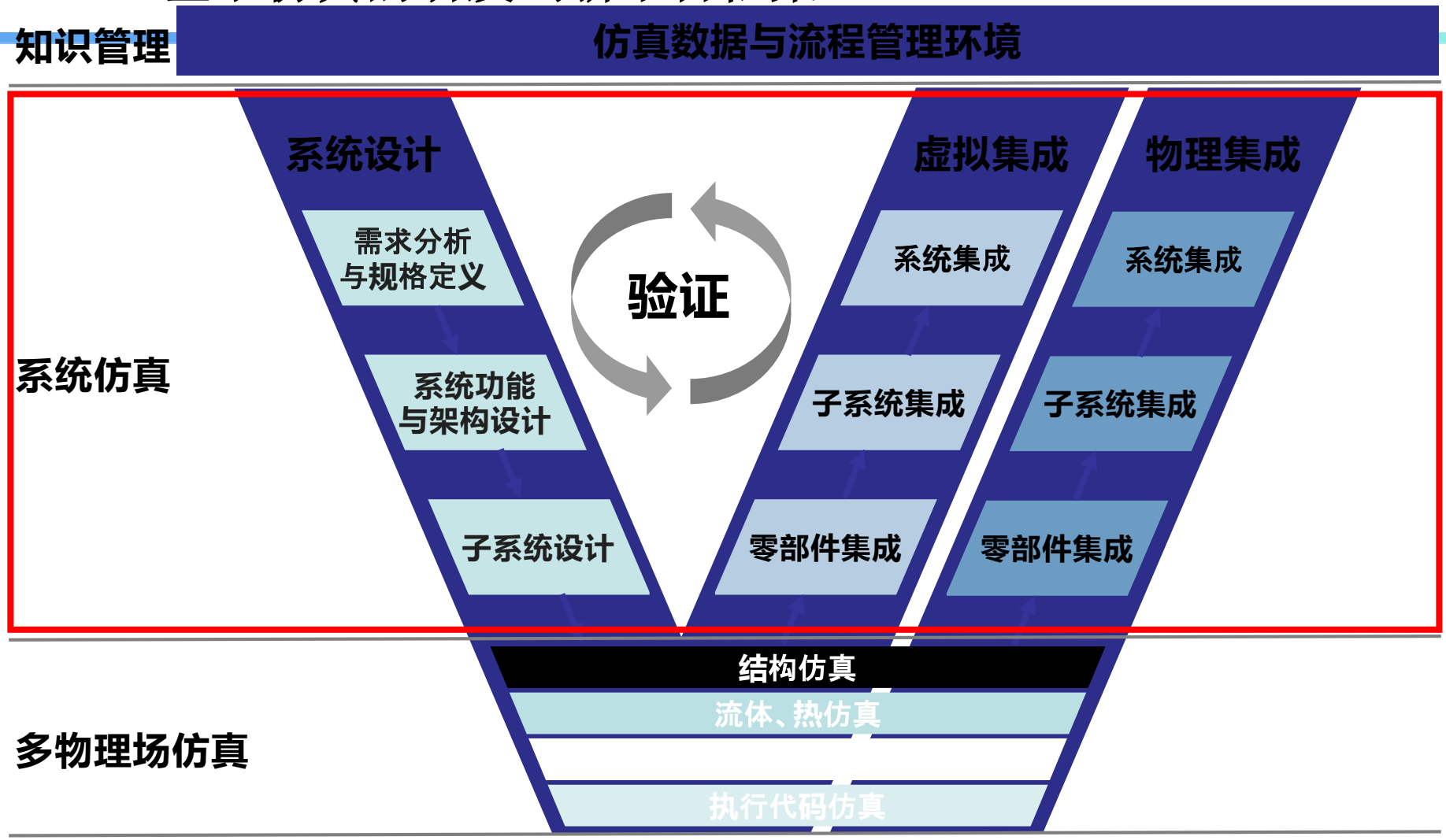
SCDM & DM:
模型简化、修复与参数化

Fluent:
流体动力学仿真

HFSS:
高频电磁场仿真

DesignXplorer:
稳健性设计探索

ANSYS 基于仿真的研发创新平台框架

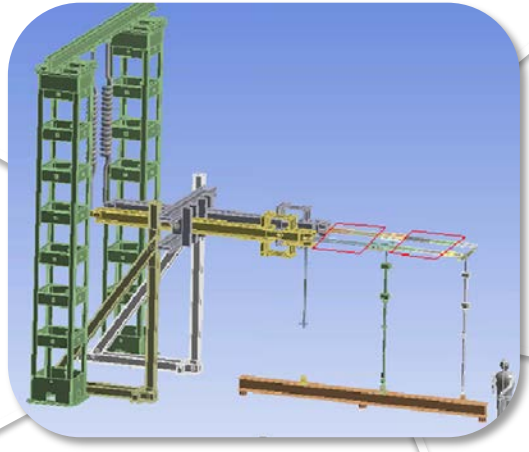


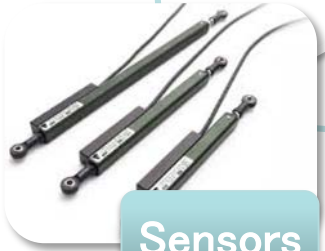
…with Complex Interactions

Simplorer

Electronic Control

Actuators



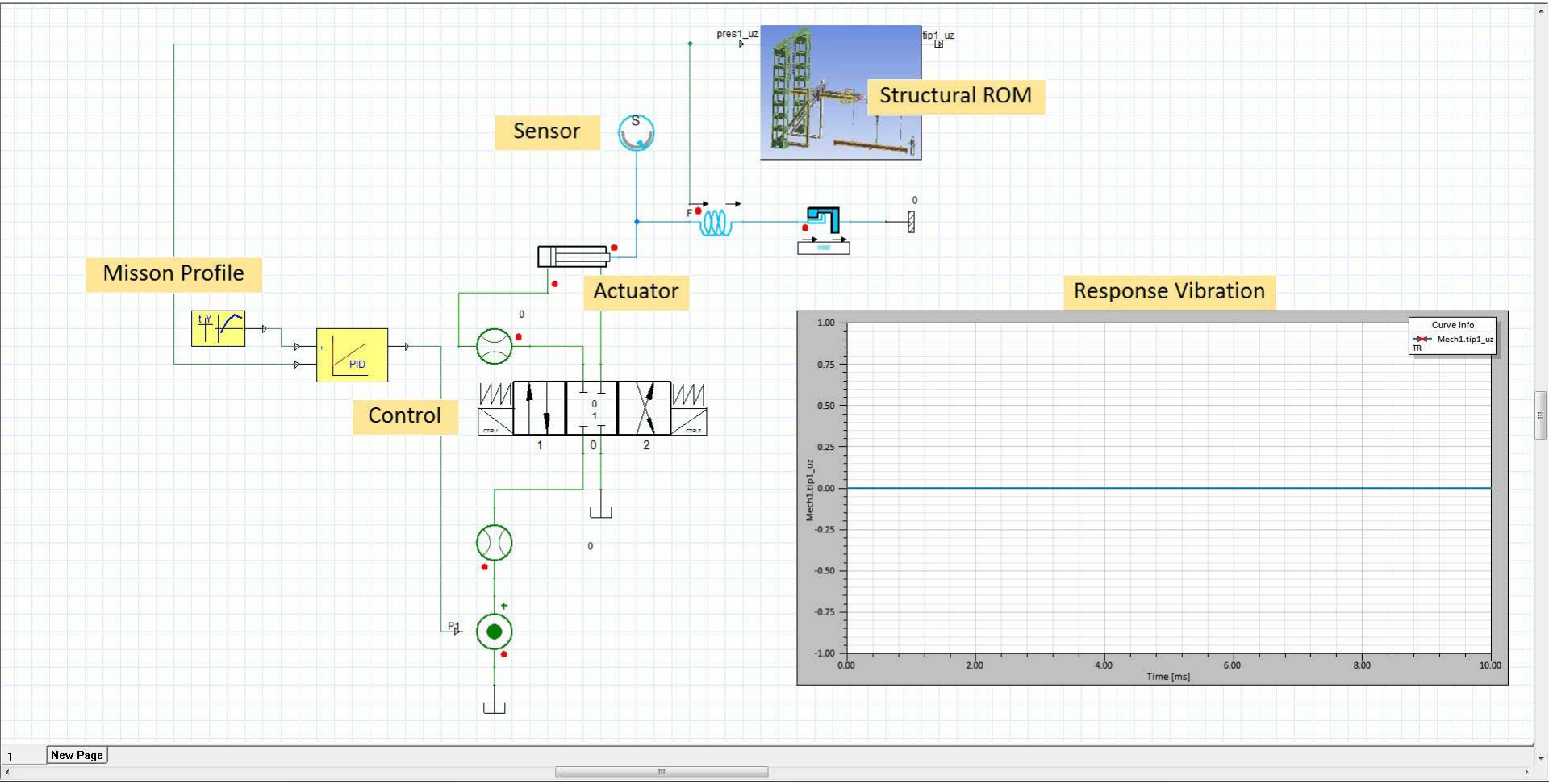


Sensors

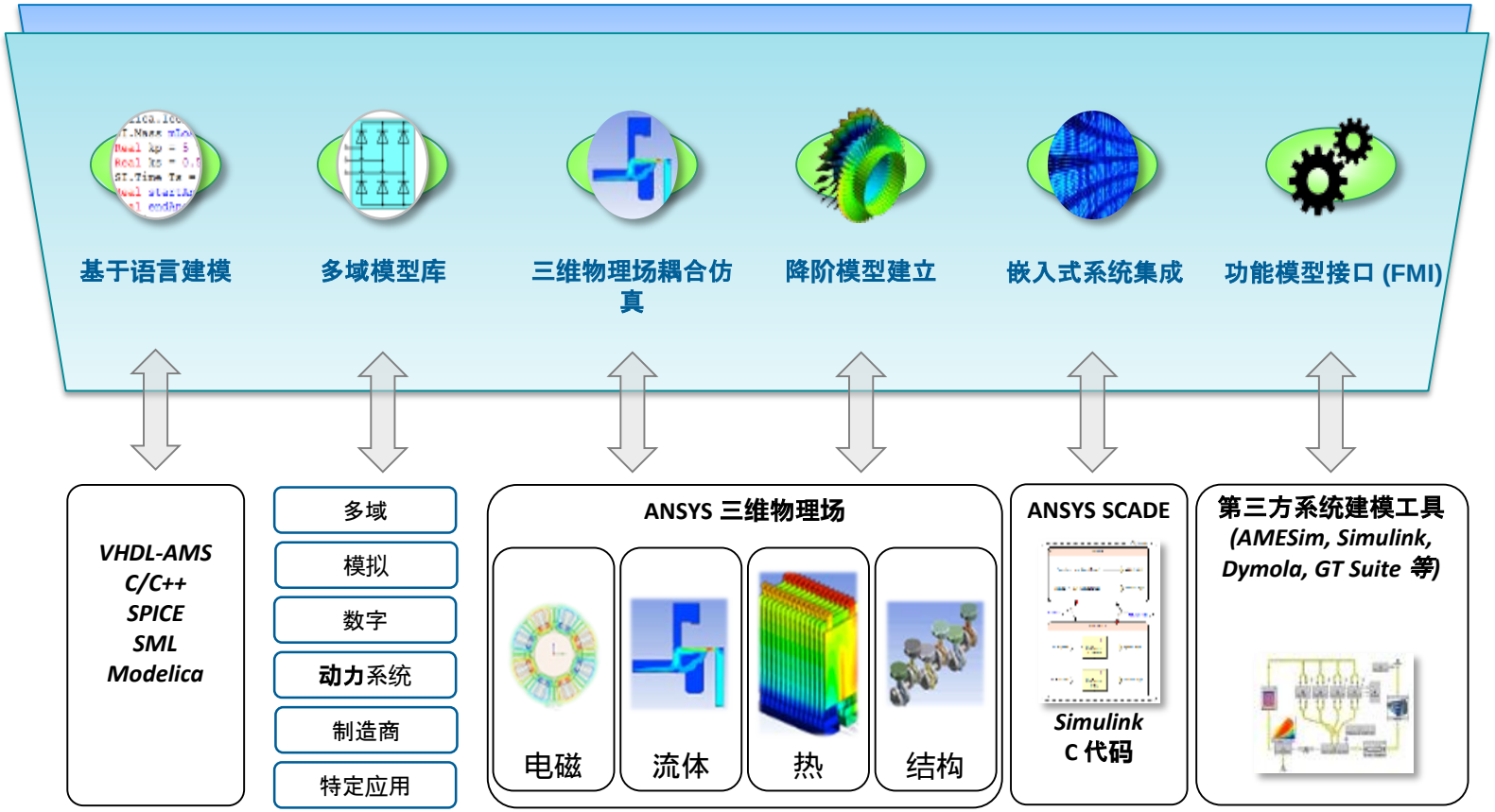
Operating Conditions

Mission Profiles

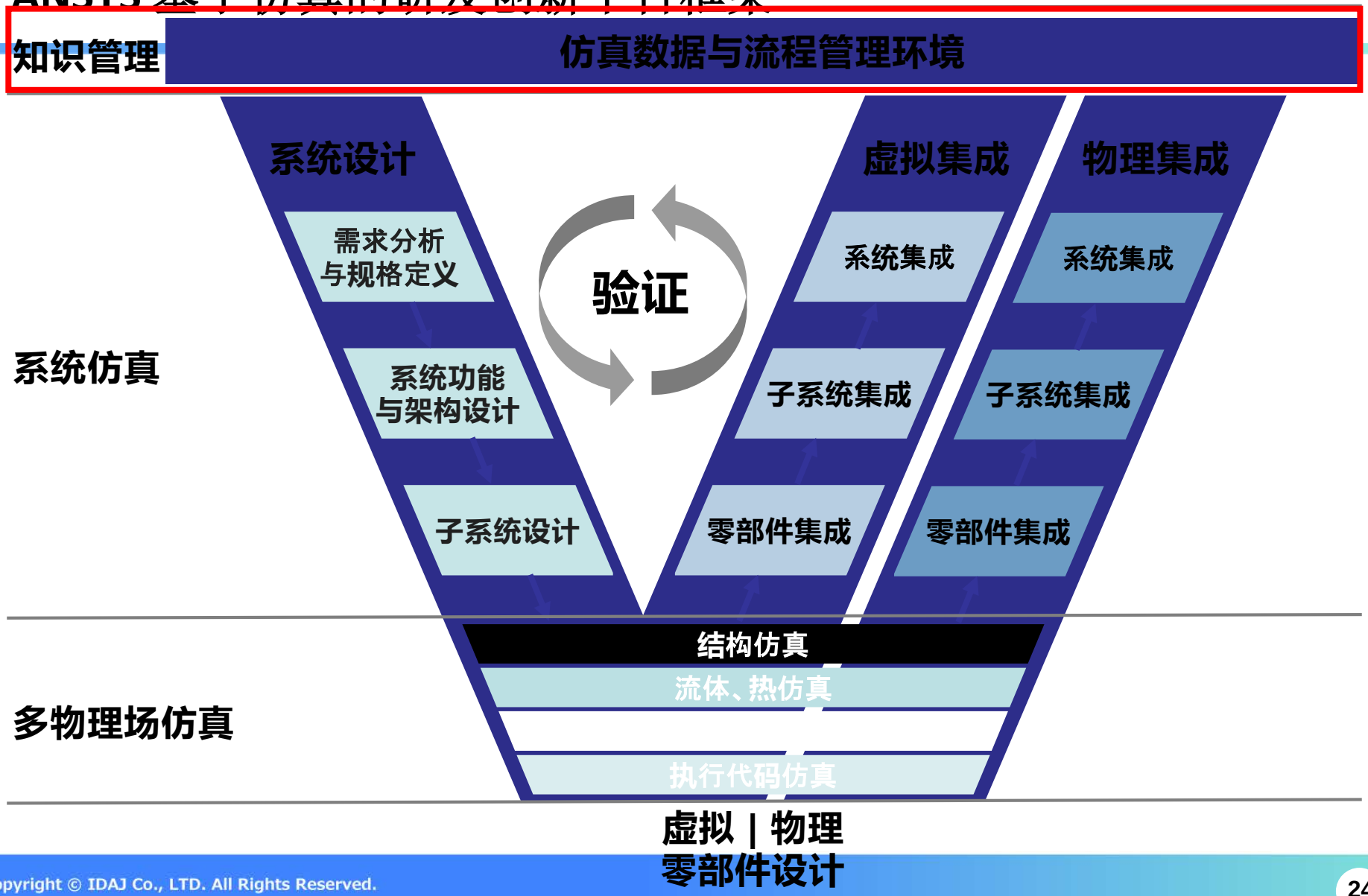
Simplorer: Simulate System Interactions



全系统建模

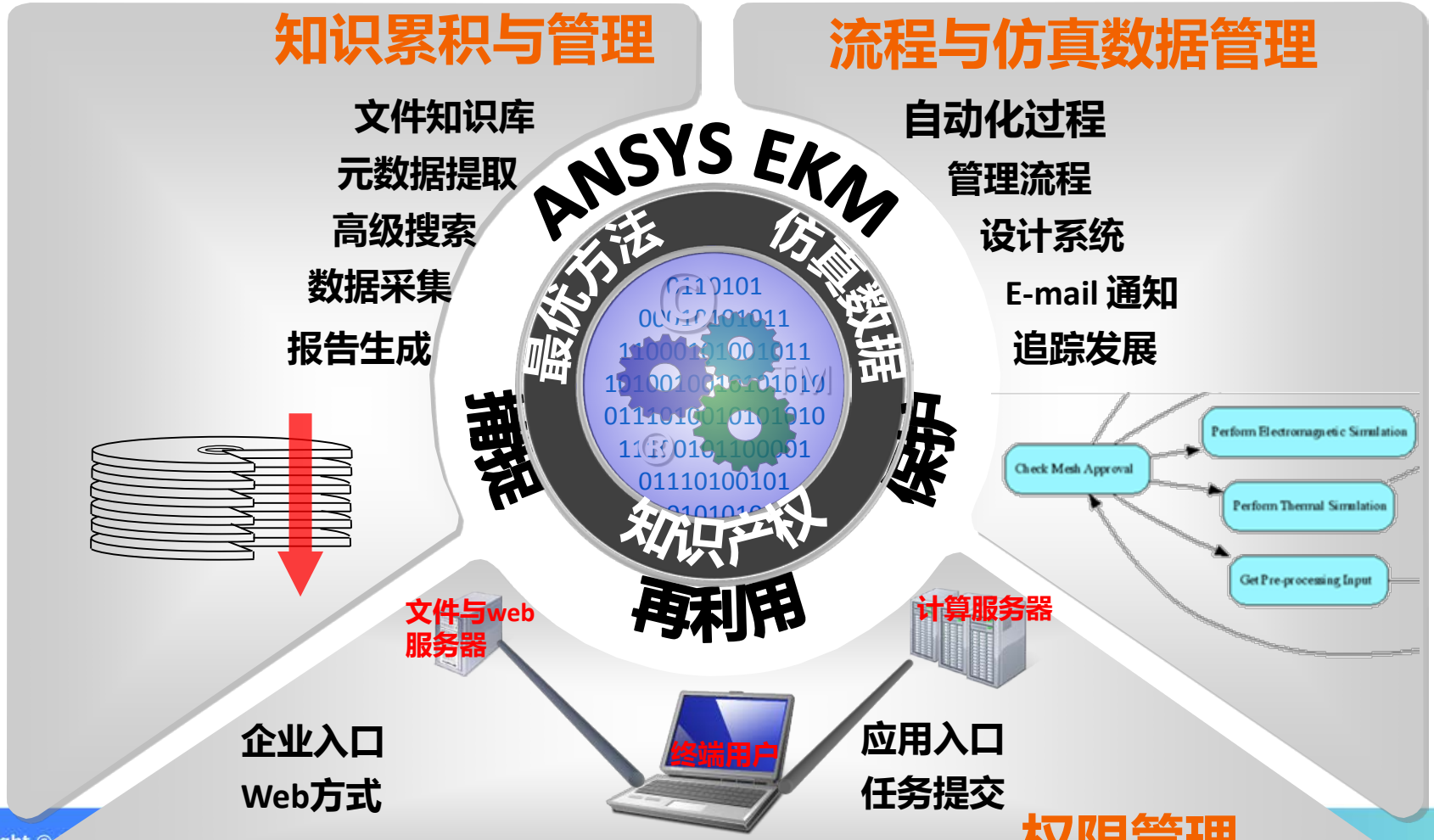


ANSYS 基于仿真的研发创新平台框架

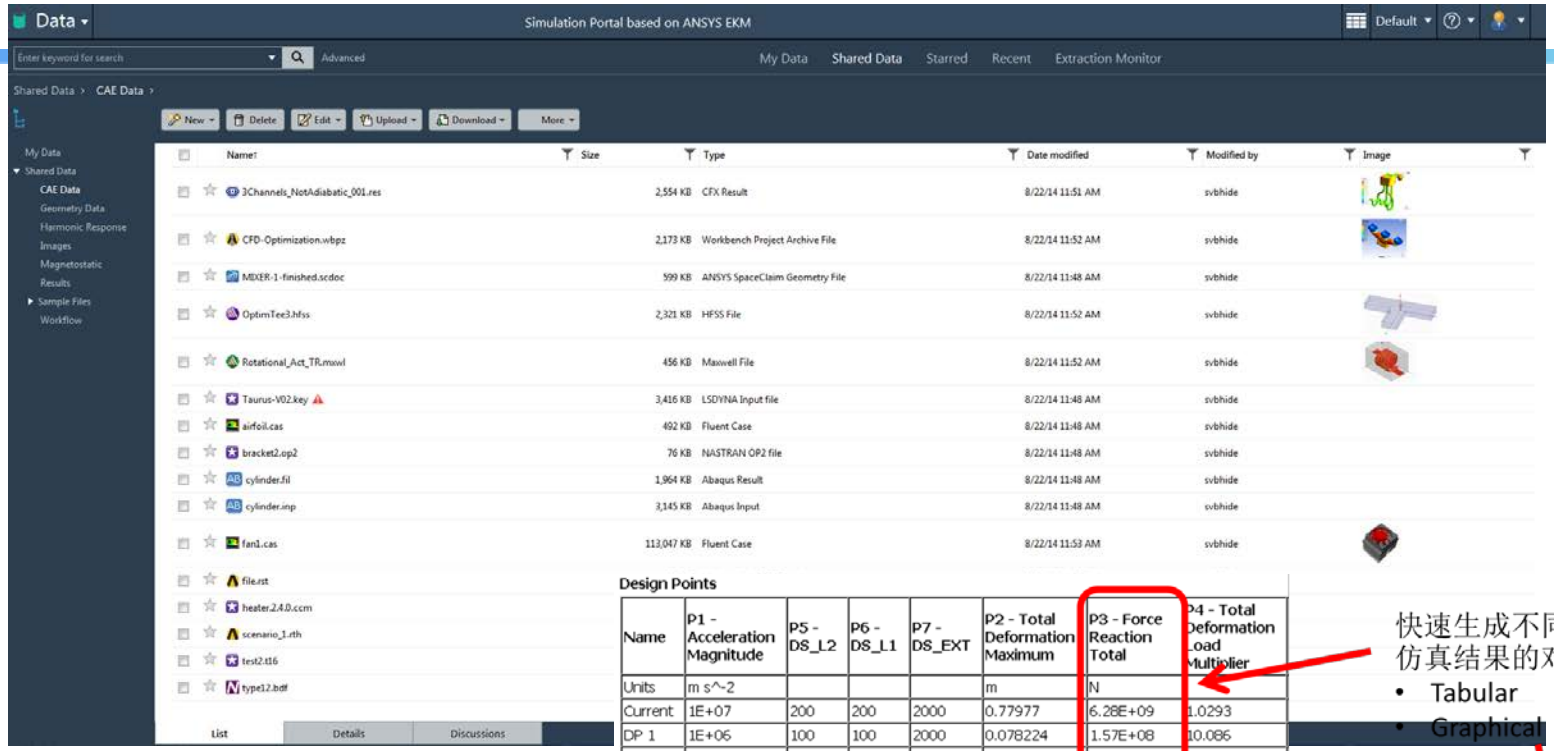


仿真知识管理系统

仿真设计方案的分类、归类整理和有序管理与复用
设计数据、仿真结果和设计经验的数据备份和归档



仿真数据库、模板库定制与管理



Design Points

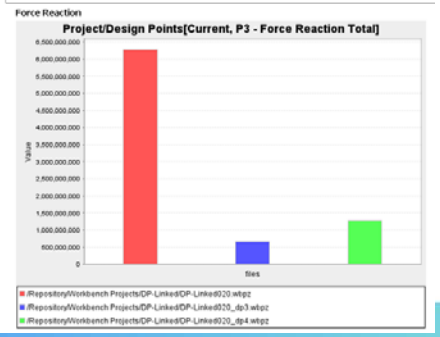
Name	P1 - Acceleration Magnitude	P5 - DS_L2	P6 - DS_L1	P7 - DS_EXT	P2 - Total Deformation Maximum	P3 - Force Reaction Total	P4 - Total Deformation Load Multiplier
Units	m s^-2				m	N	
Current	1E+07	200	200	2000	0.77977	6.28E+09	1.0293
DP 1	1E+06	100	100	2000	0.078224	1.57E+08	10.086
DP 2	1.5E+07	400	400	4000	4.6786	7.536E+10	0.34311
DP 3	2.5E+07	300	300	3000	4.3862	5.2988E+10	0.27449

快速生成不同设计和仿真结果的对比报告

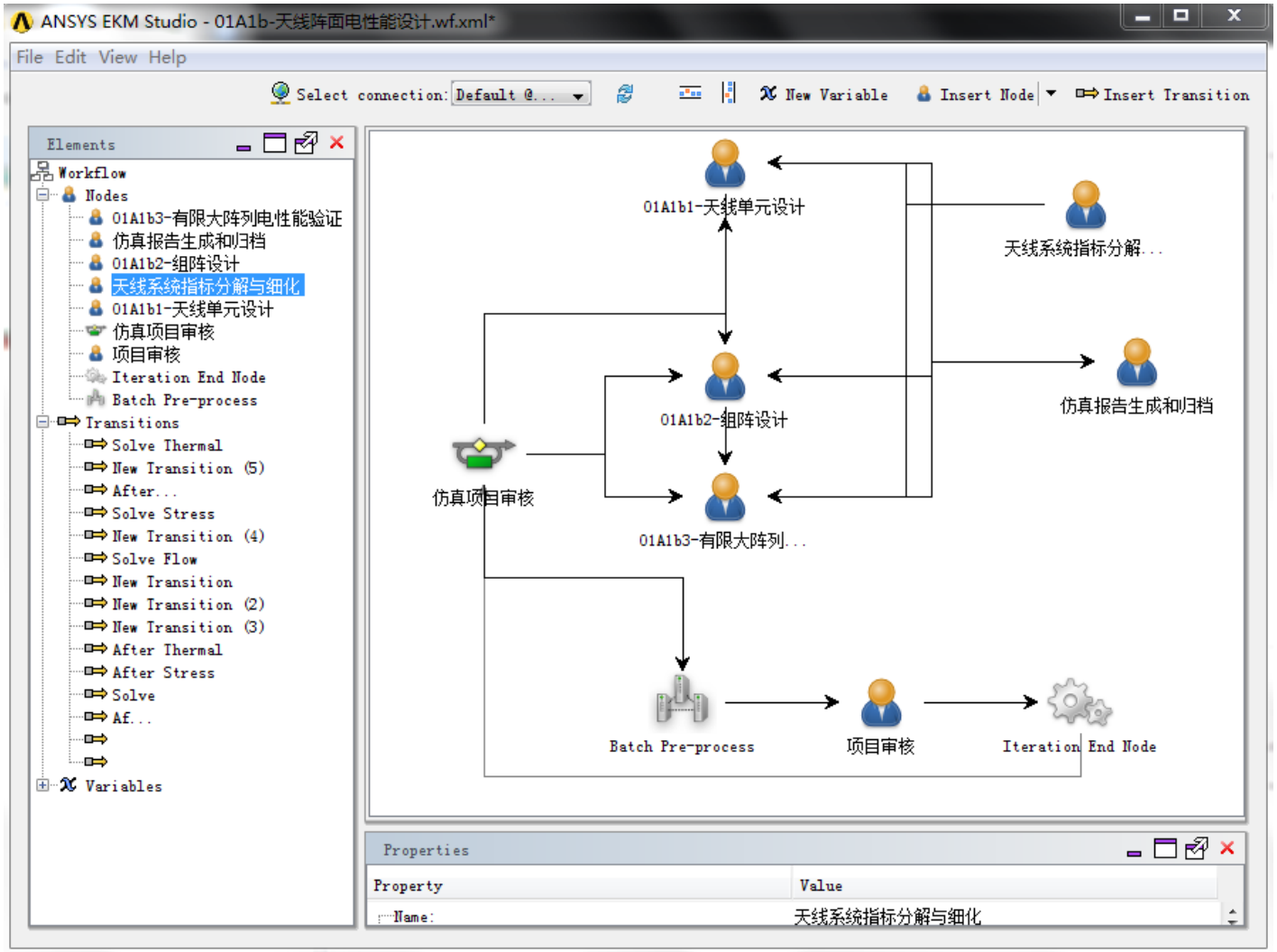
- Tabular
- Graphical

Outline of All Parameters

ID	Parameter Name	Value	Unit
Input Parameters			
Static Structural (ANSYS)			
P1	Acceleration Magnitude	1E+07	m s^-2
P5	DS_L2	200	
P6	DS_L1	200	
P7	DS_EXT	2000	
Output Parameters			
Static Structural (ANSYS)			
P2	Total Deformation Maximum	0.77977	m
P3	Force Reaction Total	6.28E+09	N
Linear Buckling (ANSYS)			
P4	Total Deformation Load Multiplier	1.0293	



仿真工作流程定制与管理



ANSYS CFD新功能

Fluent

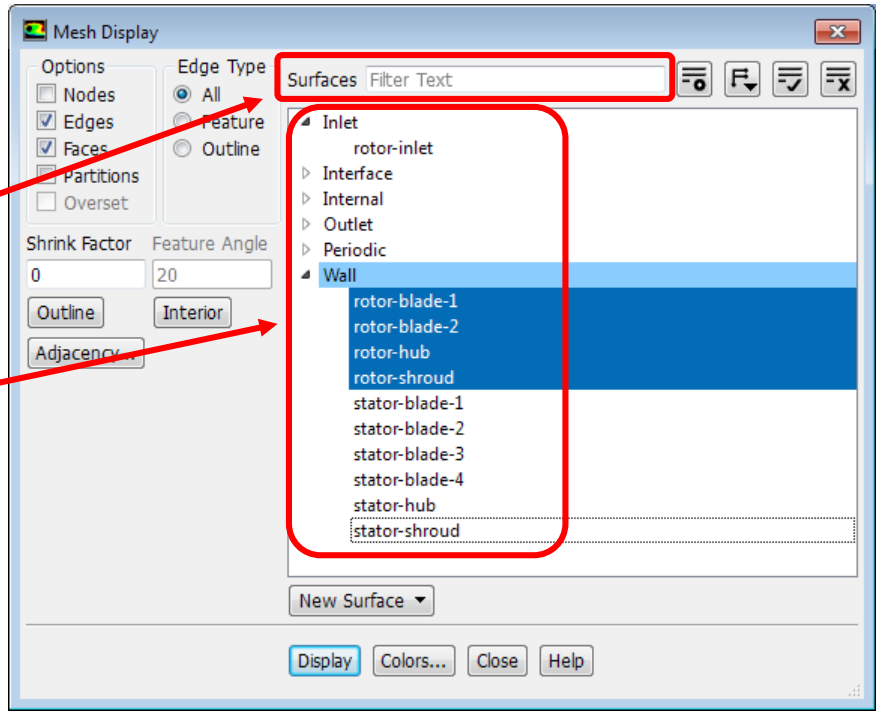
长列表的工作流程改进

添加过滤器

- Field variable lists
- Surface lists

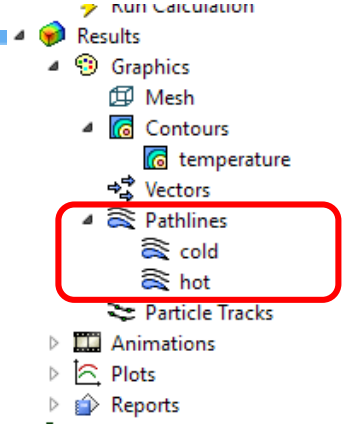
.项目分组

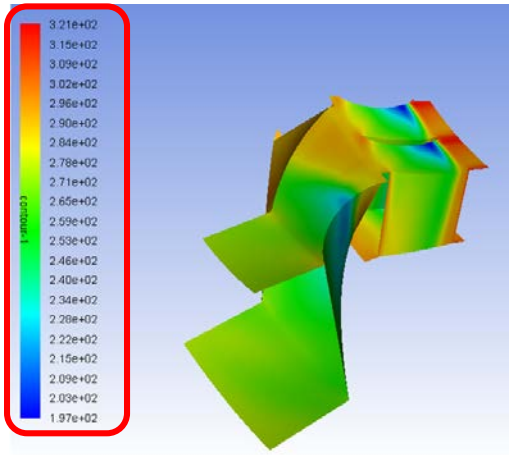
- Surface/Zone type
- Name



更强的后处理显示功能

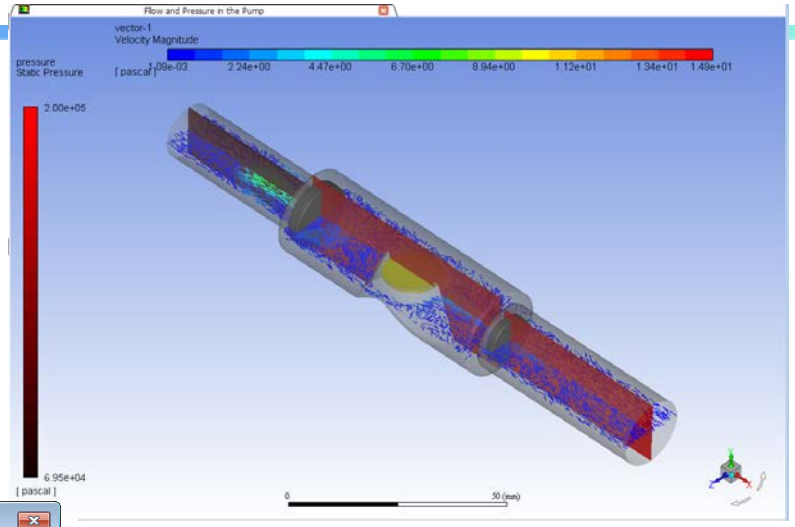
- New Persistent Graphics Object types
  - Mesh
  - Pathline
  - Particle Track
  - Plot
- Pathlines can now be plotted on arbitrary Eulerian phases.
- Smooth contour option in addition to default banded
- Legend for contours/vectors can be interactively resized and moved

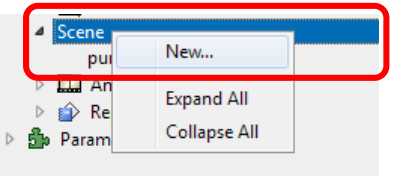


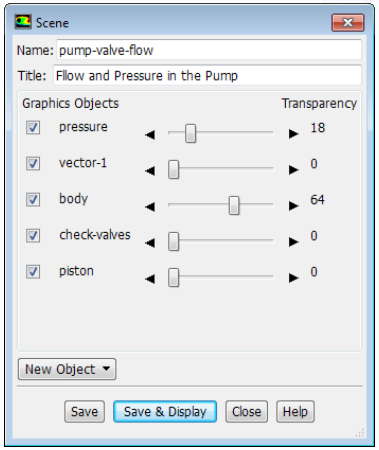


更轻松的构建复合图形显示

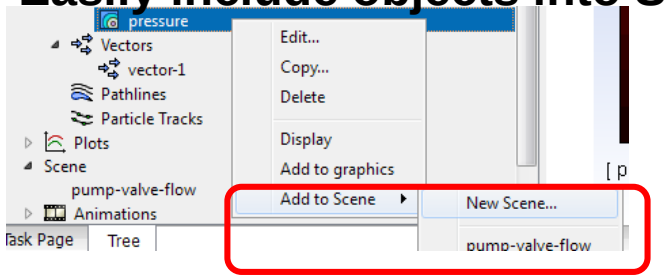
- Easily display multiple types of graphics (mesh, contours, or vectors) without complex overlay workflow
- Easily apply / adjust transparency
- Support for multiple colormaps for different solution quantities
- Built on the concept of Graphics Objects.







Easily include objects into Scene



在求解过程中诊断并标记问题网格单元

Easily identify problematic cells during solution iteration

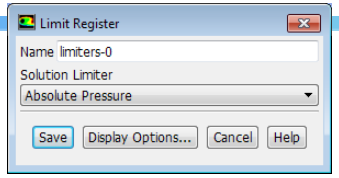
Use Cell Registers to mark cells according to solution criteria:

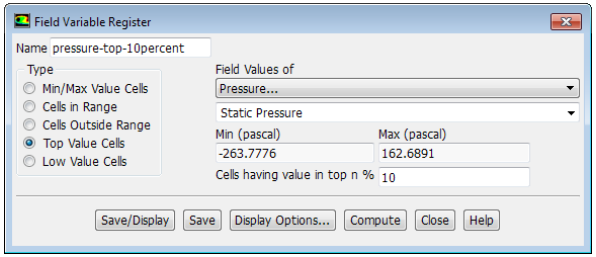
- Variable Limiter: Mark cells where selected solution variable has been limited by the solver
- Field Variable
  - Min- and Max-value cells
  - Cells with value inside or outside a range
  - Top / Bottom value cells (Cells whose value is > or < X% of the Min/Max)
- Residual: Mark cells where a given equation residual is above a threshold percentage of the maximum residual in the domain.

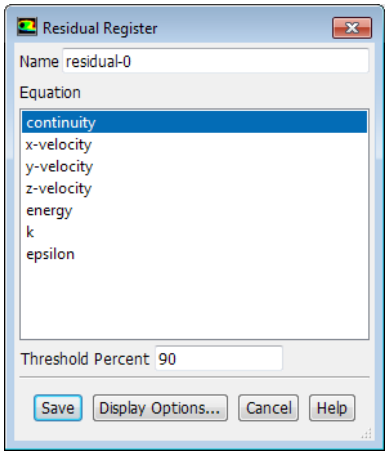
Registers are updated during solution and definitions are saved with case file

Registers are named objects in the tree and can be displayed, adapted, selected for poor-mesh numerics

- Display settings (color, symbol, etc.) are register-specific and persistent



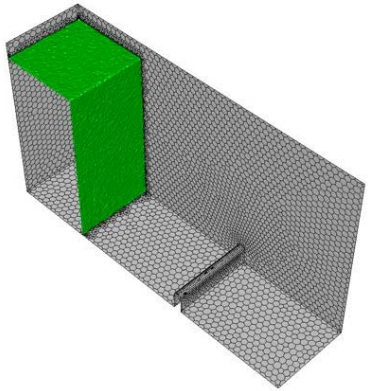




多面体网格自适应(BETA)

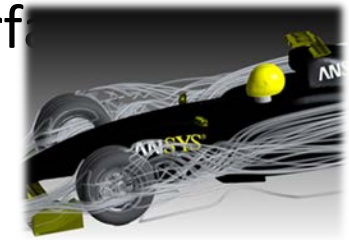
- Polyhedral Unstructured Mesh Adaption (PUMA) method
- Compatible with all cell types
- Refinement and coarsening supported

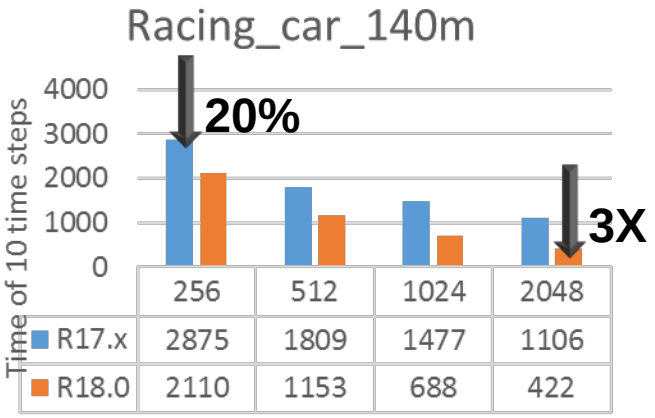
```
> /adapt/set/method
Adaption method (0 = Hanging-                                    MA 3D) [2] 2
```



滑移交界面并行计算能力加强

- Large scalability improvements for sliding interf
- Results
  - Test case
    - **140 million hex-core cells**
    - **F1 car with 4 wheels as SI**
  - Close to 3X speedup at 2048 cores

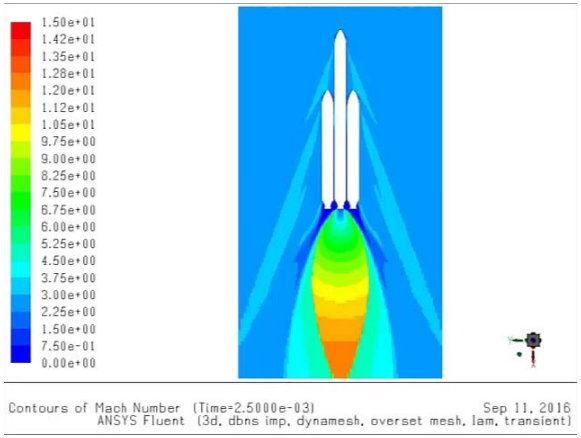




Run on CRAY XE6

重叠网格功能扩展

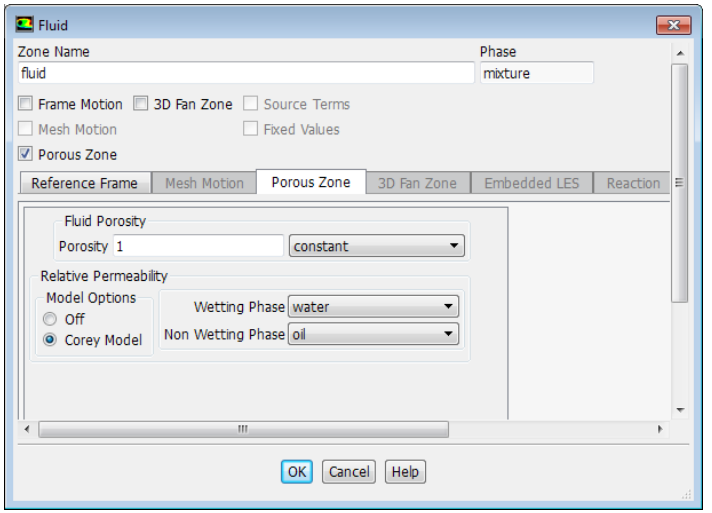
- Compatibility with density-based solver
  - Suitable for high Ma compressible flows
- Full support for compressible flow if using density-based solver
- 2nd order in time for stationary mesh zones
- Moving mesh zone compatibility (previously beta)
  - 1st order in time only
- Hybrid Initialization
  - Use Hybrid method by default in same scenarios as for non-overset cases
  - No longer necessary to set rpvar for interpolation method as in 17.2
- Performance improvements, particularly in parallel



Booster Separation with Ma=14 Engine Plume (Density-Based Solver)

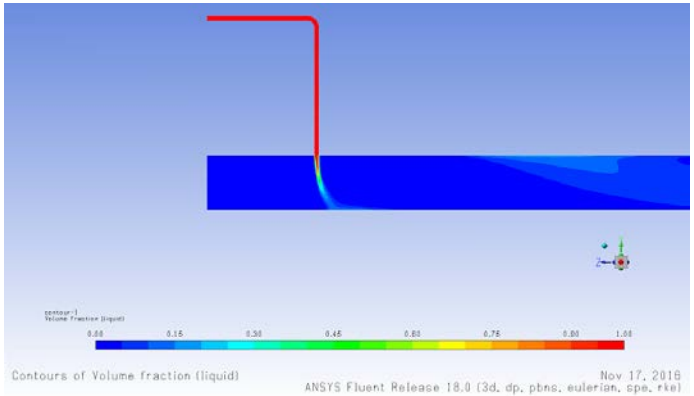
多孔介质中两相相对渗透率

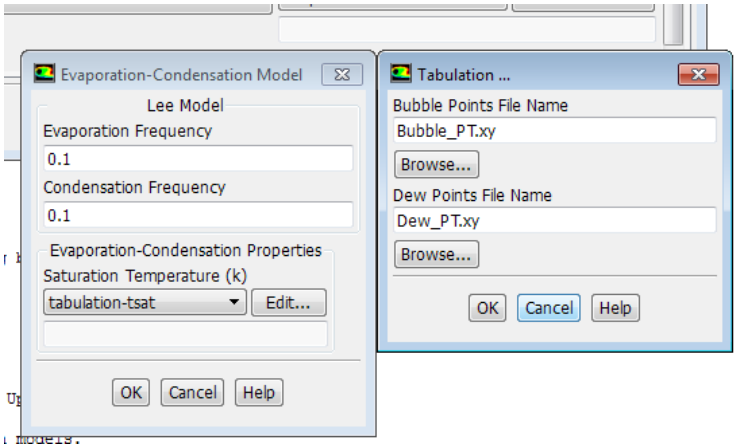
- Corey model for 2-phase relative permeability (previously Beta)
- Any pair of phases may be chosen as wetting and non-wetting
- Other phases may be present but are not included in the formulation
- Target application: accurate simulation of water-oil displacement in reservoir production.



基于饱和线插值表的两相流相变 (Beta)

- For flashing and similar applications it is important to consider the composition-dependent bubble / dew point curves in the mass transfer model
- Previously this required UDFs. New option permits import of tabulated saturation curves for single components or binary mixtures



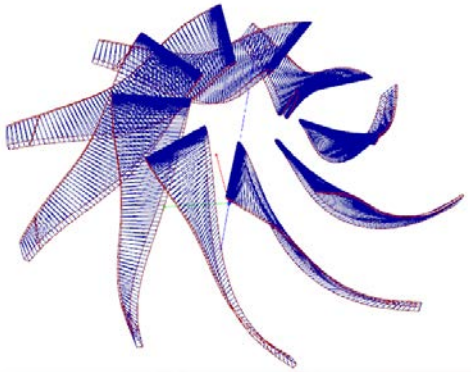


化学反应

- Up to 20% speed-up for PDF combustion using real gas model
- Surface reactions can now be computed using the Chemkin-CFD solver in Fluent
- Limit list of species for boundary specification, and residual monitoring

ANSYS CFD新功能
CFX

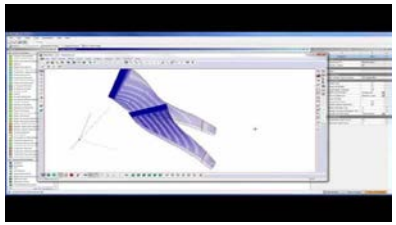
切削加工的叶片模型



New Flank Milled mode added to BladeModeler with controls for blade ruling line distributions

Introduced consistent geometry representation between tools for flank milled blades (design, aerodynamic analysis, mechanical analysis and manufacturing)

Customer impact: primarily automotive turbocharger and industrial compressor manufacturers



TurboGrid CAD Support

Available in 18.0

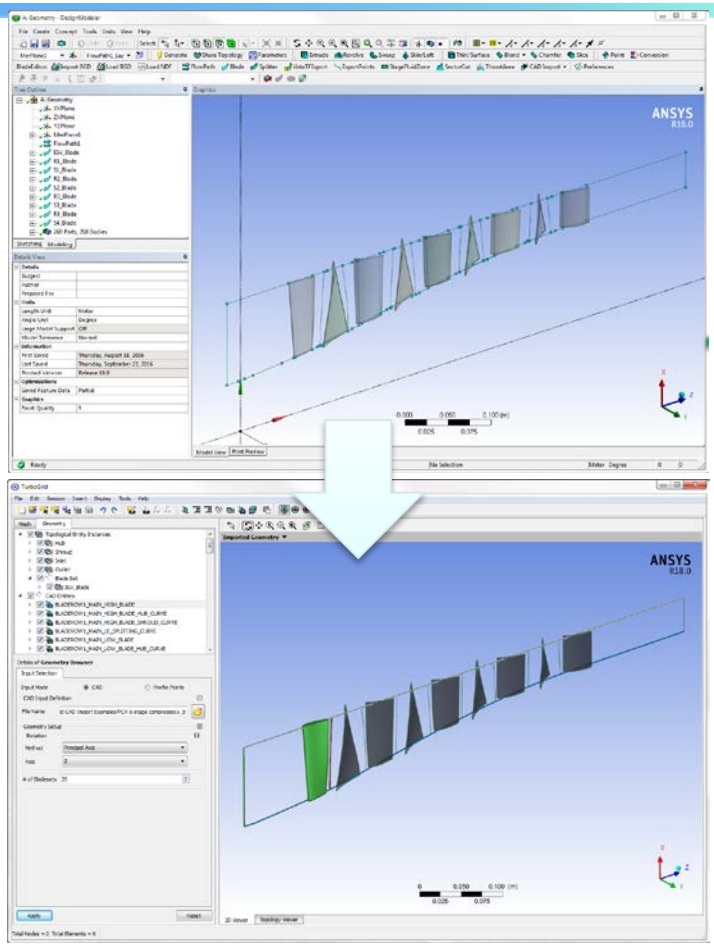
Improved fidelity and robustness by importing CAD models directly into TurboGrid

- BladeRow

R18.0 Capabilities

- Transfer via workbench schematic
  - BladeEditor (DM) exports underlying, native blade surfaces from and meridional flowpath in Parasolids format
  - Blade modifications via general DM features such as fillets are not currently transferred via schematic
  - BladeGen to TurboGrid connection still uses blade profile points
- Direct import
  - Supports Parasolids (x_b, x_t) and ICEM CFD Tetin (.tin)
  - User must assign faces and curves to appropriate turbo topology
  - Further refinements to come throughout 2017

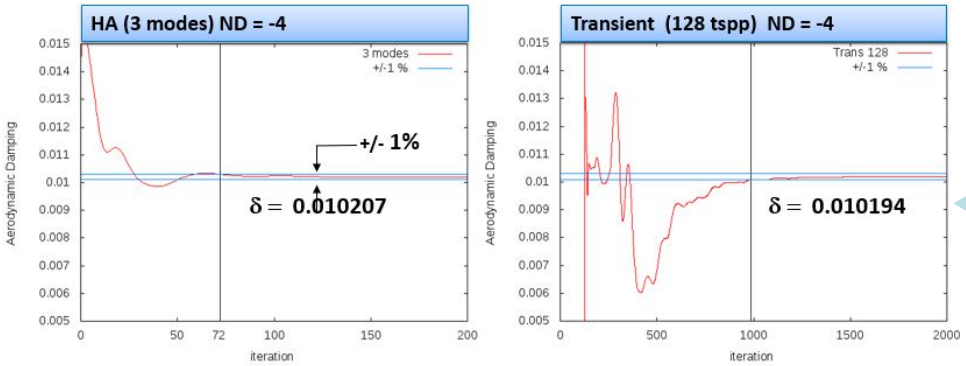
Customer impact: all BladeEditor/TurboGrid users



CFX Harmonic Analysis (HA)

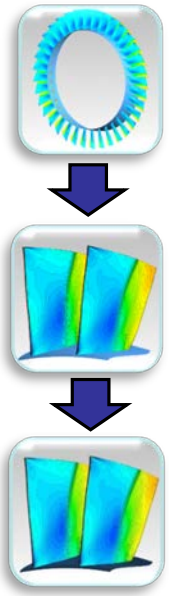
Release focus: Aeromechanics of blades

- Blade Flutter (1st use case under HA method)
- Fast solution to transient periodic flow 10x to 100x faster than transient time integration



Transient simulation can take between 15 to 30 vibration cycle to converge

Aerodamping/Flutter



Transient
Full-wheel
R14.5

Transient
Reduced geometry
FT-method
Fast solution
R14.5

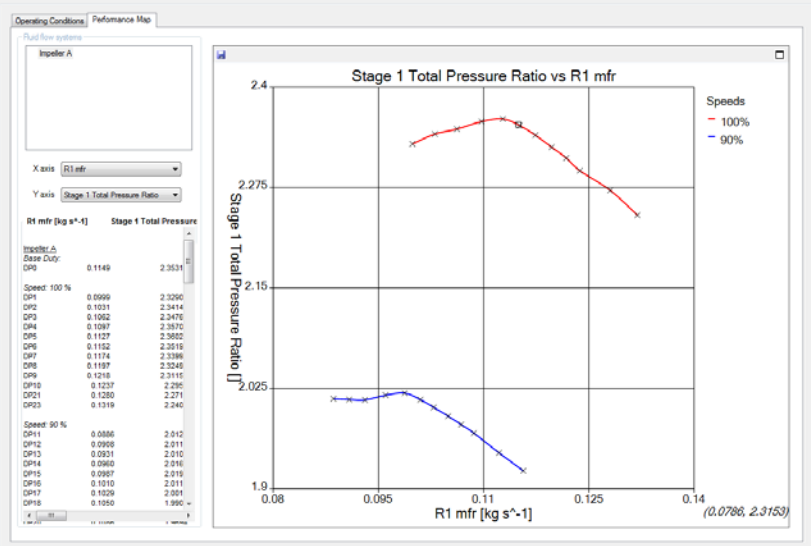
Harmonic Analysis
Reduced geometry
FT-method
Faster solution
R18.0

Turbo Performance Maps in Workbench

Provide easy setup for running turbo performance maps (multiple operating points)

Provide simple charting tool for viewing and comparing performance maps

Leverage Workbench DPs to automate concurrent solution of operating points



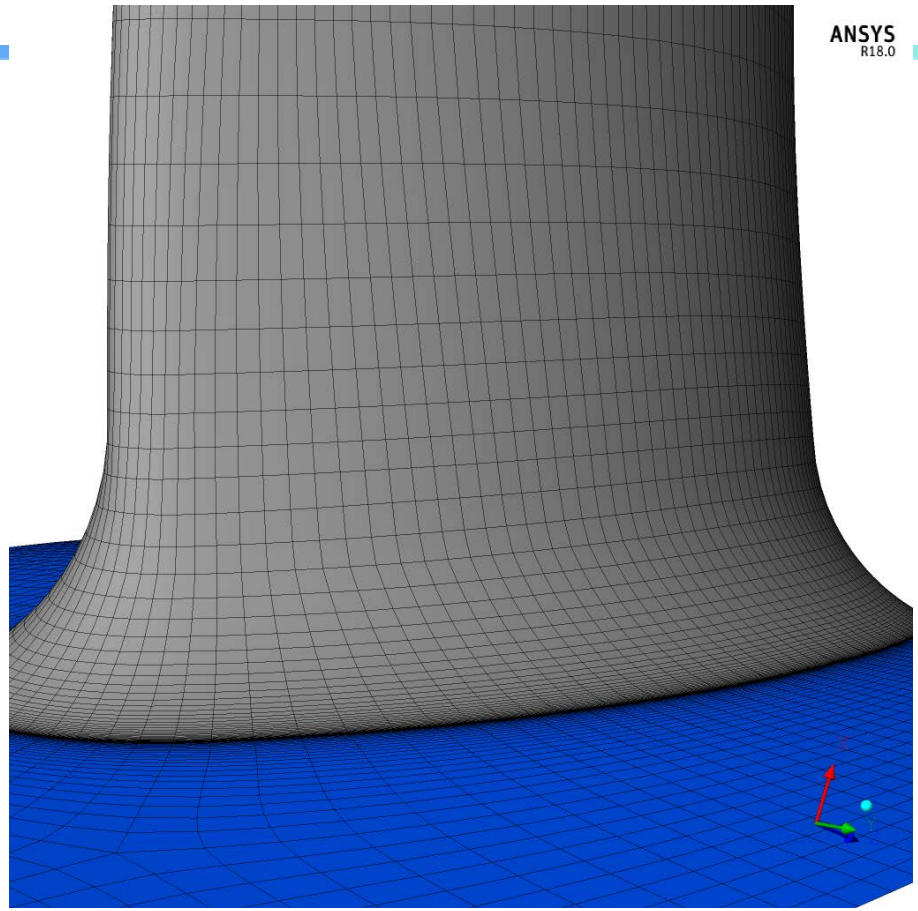
Fillets from CAD import

CAD surface imported and assigned to topology

Exact representation

High quality parameterization

High quality mesh



感谢聆听！