# midas NFX 2015 R1

### **Release Note**

### Accurate whenever you Need

Be more efficient by focusing on the right details and get Accurate results

### midas NFX 2015 Release

Midas NFX has been improved once again !

Life of an engineer is not static and FEA software should improve continuously to meet the needs of newer and better tools to solve models which are becoming more and more complex.

Every year, we work hard to provide the best analysis and features that our clients require and you can see on the left the improvement that we did since midas NFX's first release in 2009.

Thank you for staying faithful to our value and believing in us !

**Daeseok Shin** MIDAS IT Technical **Research & Development** Director



#### Past and Future development

Continous Improvement, relentless development. Because we understand the tool that engineers need, and we care

2009

Birth of NFX

2010 Hyper-elastic models Contact Manager High Speed Tetra Mesher Linear Grading Seeding Bearing Load

2011

condition

al Database

**CFD Flow Line** 

Model Simplification

Subcase Combinatio

Nastran Import / Export

Axisymmetric model Spectrum response DB

2012 Topology Optimization Designer / Analyst Auto-update of Design Modes in one interface GUI improvements to Word Report handle models with 1000 Material Database more than 1000 parts Import Personnal Materi-

Creep Material models Implicit Nonlinear **Dynamics Analysis Transient Nonlinear** Heat Stress Analysis Size Optimization Stress linearization Free Body load

2013

3D PDF report Gap Element Cable Element

Mid Surface Extraction Porous Media Fan Models MRF

midas NFX Future **Developments** Meshless Solver Fully Coupled FSI CFD CAED Simulation

Interactive Simulation

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Multi-body Simulation Improvements Nonlinear Elastic Material Multi-lavered PCB Material Compact Thermal Model Joule Heating 1-way FSI Overset Mesh DO Radiation Particle Analysis 1D CFD Flow Analysis Inertia Relief

2015

2014 GPU Computing

**CFD** Radiation

# 1-way FSI (Fluid-Structure Interaction)

This New Fluid-Structure Interface allows the exchange of Data between Fluid Analysis and Structural Analysis.

Analysis Results for Fluid Analysis are directly transferred to the structural analysis model through FSI contact interface.

FSI interface is defined in the same way as a manual contact between 2 parts.

Data such as Pressure, Shear Force, Temperature, Heat Flux and Film coefficient can be transferred automatically from fluid to structural model.



FSI Interface definition window

FSI Interface inside the work tree menu







The developer explains 1-way FSI (Click to watch the video)



1-way FSI step-by Step Tutorial (Click to watch the video)

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# 1-way FSI (Fluid-Structure Interaction)

Analysis Case Setting

FSI Analysis Case is defined to link a Steady Sate CFD Analysis to a Nonlinear Static Analysis, a Nonlinear Steady Heat Transfer Analysis or to a Nonlinear Thermal Stress Analysis.

FSI Analysis Case can also be defined to link a Transient State CFD Analysis to a Nonlinear Quasi-Static, a Nonlinear Implicit Transient, a Nonlinear Transient heat Transfer or a Nonlinear Thermal Stress (Transient) Analysis.



Board\_FSI : Steady State FSI Analysis E CFD : INCR=0001 (TIME=80.1) PRESSURE TOTAL VELOCITY TEMPERATURE PRESSURE TOTAL VELOCITY TEMPERATURE CFD : INCR=0003 (TIME=80.3) PRESSURE TOTAL VELOCITY TEMPERATURE Nonlinear Static (Required) INCR=0 (LOAD=0.000) TOTAL TRANSLATION SOLID STRS VON MISES INCR=1 (LOAD=0.200) TOTAL TRANSLATION SOLID STRS VON MISES incr=2 (LOAD=0.400) TOTAL TRANSLATION SOLID STRS VON MISES TOTAL TRANSLATION SOLID STRS VON MISES

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### **Particle Tracking – DPM (Discrete Phase** Model) Media

This feature creates particles that can create drag in the fluid, collide with the walls and are submitted to gravity. Particles are not interacting between each other.

method The 1-wav creates particles that cannot interact with the fluid. The 2-way method creates particles that interact with the fluid.



**Results of Particle Analysis** (Particle Trajectories)

Particle Analysis Results (Particle Position)





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The developer explains particle Analysis Click to watch the video



Particle Analysis Step-by-step Tutorial Click to watch the video

# **Joule Heating Structural/CFD Analysis**

Used to analyze the heat generated by the flow of current inside a conductor.

Joule Heating can be used in all kind of electric equipment to analyze the influence of heat generated by electric wires



#### Obtained results are very close to the theory







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The developer explains Joule Heating (<u>Click to watch the video</u>)



Step-by-Step Video tutorial about Joule Heating (<u>Click to watch the video</u>)

#### Joule heat Generation Analysis Setting Window

# **Joule Heating Structural/CFD Analysis**

6 new analysis types related to Joule heating have been added along with Electric potential in material data, Electric Load and Potential loads.





Joule heating in sample model with available result types

Analysis Case Setting				
Title				
Solution Type	Linear Static 🔹			
	Nonlinear Steady Heat Transfer         Linear Thermal Stress(Steady State)         Nonlinear Thermal Stress(Steady State)         Nonlinear Thermal Stress(Transient)         Nonlinear Thermal Stress(Transient)         Nonlinear Thermal Stress(Transient)         Nonlinear Static         General Prestressed Analysis         Nonlinear Linglict Transient         Sequential Nonlinear         Direct Frequency Response         Modal Frequency Response         Modal Transient Response         Response Spectrum         Steady State CFD         Transient CFD         Linear Static (MBS)         Nonalinear Explicit Transient (MBS)			
	Nonlinear Steady State Joule Heating Nonlinear Transient Joule Heating Linear Thermal Stress(Steady State Joule Heating) Nonlinear Thermal Stress(Transient Joule Heating) Linear Thermal Stress(Transient Joule Heating) Nonlinear Thermal Stress(Transient Joule Heating)			

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#### Write Results of All Active Mesh Set

Node Results		Element Results	
Applied Load	/lesh Set	📝 Thermal Flux/Gradient	Mesh Set
Temperature	/lesh Set	Electric Flux/Gradient	Mesh Set
Electric Potential	lesh Set		
Constraint Force	lesh Set		
Equation Force	lesh Set		
Output Option	and Text		

**Electric Potential** 

# **Surface Tension – CFD Fluid Material**

Allows for multiphase modelling of free-surface flows with dominant surface tension effects





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Surface tension – "self assemble" experiment

Improvement to free surface fluid flow due to surface tension

## **Surface Tension – CFD Fluid Material**



Surface tension and contact angle during slot coating

id (CFD)				
Fluid Flow				
Model	Incompressible			•
Mass Density	1.003e-006	kg/mm³	None	•
Viscosity	3.8e-006	kg/(mm·sec)	None	•
Molar Mass	1	kg/mol	None	•
Surface Tension	2.5e-005	N/mm	None	•
Compressibility	0	sec²/mm²	None	Ŧ

Surface tension definition window

Wall					
Edge Wall Face Wall					
Name Edge Wall-1 Object					
Type Edge 🔻					
Select Object(s)					
Wall					
Wall Type Wall Distance Applie 🔻					
Wall Distance 0.0008 mm					
Partide Wall Type None					
Motion Control					
Motion None 🐨					
Wall Adhesion					
Contact Angle 18.8 [deg] None					
CFD BC Set CFD Boundary Set-1					

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#### **New Contact Angle option**

# Detailed PCB property (multi layered boards) 2015

PCB model easily simulates the thermal conductivity of laminated PCB board.

ID 5 Name PCB Color	ted tal	Circuit Board Thickness		0.00022	mm
Material 5: PCB   Material CSys Global Rectangular  Moving Reference Frame	stra ater	te(Dielectric) ial	2: CFD	Solid-1 v	
Detailed Definition     Porous Media     Detailed Definition	:es ater	ial (	2: CFD	Solid-1 🔻	t
Printed Circuit Board		Thickness(n	nm)	Coverage(%)	Â
Detailed Definition	1	0.0001	0000	30.00000000	
Radiation Media           Fixed Temperature         0	3	0.0000	1000 1000	50.00000000 50.00000000	Ξ
Overset Mesh	5				
OK Cancel Apply					Ŧ



Temperature result considering copper volume in each PCB layer





#### Multi-layered PCB

Taking into account the effective thermal conductivity of a multilayered PCB used to be a challenging task. See how NFX 2015 makes it easier for you

#### Try it in browser

<u>Click to try the</u> <u>Interactive Tutorial</u>

#### PCB definition window

### **Overset Mesh**

Overset mesh is a new method that allows to create a mesh set on the top of another one. The results will be calculated through the transfer of the data at the boundary of the overlapping mesh sets.

This methods allows to simulate larger displacements of a structural object in a Fluid

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ID 2 Name	Property 2 0	olor 🛛 🛏			
10 2 Nome	Property 2 C				
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			*********		
Materia	2: CFD Fluid-1	▼ (E)			
The centres					
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Material CSvs	Global Rectangular	-			
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Moving Reference	Fidne				
				*********	
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			*********	+++++++++++++++++++++++++++++++++++++++	
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Radiation Media					
The difference in the second s		0 [TT]			
Fixed Lemperature		• [ [ ]			
_					
Overset Mesh					
- over activities in					

#### Overset option and related overlapped meshes



Velocity contour result



Resources



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Step-by-Step Video tutorial about **Overset Mesh** Click to watch the video



#### Overset Mesh

In complex fluid flow problems. not every geometry can be well represented using a single, contiguous mesh, NFX 2015 introduces overset mesh function Try how it works in this example

rv it in browse

**Click to try the Interactive Tutorial** 

### **COMPACT THERMAL MODEL**

CTM is a simplified component model intended to reproduce the thermal behavior of a component in a wide variety of system-level simulations.

This new thermal resistance model allows the calculation of the temperature by inputting directly the Thermal resistance model values  $\theta$ jb, θjc which are reflecting the thermal conductivity in semi-conductor chip 2nd order thermal equipment. resistance model network and resistance model are both supported.



Thermal results using thermal resistance model



Thermal resistance model Scheme



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#### Compact Thermal Model

CTM is a siplified behavioral model which accurately predict temperatures at critical points (i.e.junction) in a electronic systm. It significally reduce the computing time

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### **Compressible Solver Improvement**

The compressible fluid solver has been improved to calculate shock waves in compressible fluid problems.



Peripheral speed of the airfoil transonic zone as interpreted by compressible flow solver

Seneral	Geometry/	Mesh/Connections	Loads/B.C.	Analysis/Results		
	eneral Applicat Ucense Unit Sys Material Material Work Vice Selectio Snap Geomet Element Advance	ion (Structural) (CFD) ww n y	CFD N Compr Compr	faterial essibility Sol.,, essibility Type	Density Based Co Barotropic	Impr
Import C	Configuration	I				
Configura	ation File	Structure			Reset	Reset A

### Density based compressible fluid solver setting window



Shock Wave Analysis in a CDV Nozzle (Compressible Solver)

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# **1D CFD Boundary Conditions**

Using 1D CFD toolbox it is possible to analyze flow, heat, and mass transport in complex pipe networks very easily with great saving of computational time.



midas **NFX** 2015 Media Resources das NFX midas NFX 2015 Release **1D CFD Boundary Conditions** - Using 1D CFD toolbox it is possible to analyze flow, heat, and mass transport in complex pipe networks very easily with great saving of computational time. Watch the explanation in video



#### 1D CFD Analysis

This function helps to analyze flow, heat, and mass transport in complex pipe networks easily with great saving of computational time. Try how to create 1D CFD element and how to connect it with 3D domain

Try it in browser

**Click to try the Interactive Analysis** 

# Pre-processing: Peel Down feature

Media

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Peel Down tool for efficient selection of hidden geometrical entities tw tG





- H H.



**Default geometry view** 



**Peeled geometry - Selected inner faces** 



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#### Peel Down Selection

This tool helps you easily select geometries, which are difficult of access, inside the model.

Try it in browser

**Click to try the interactive tutorial** 

1<sup>st</sup> peeled layer view

# **MBS: Rigid Body Dynamic Improvements**

The first major change is that we were using the finite element method and in particular the penalty method to calculate the multi-body dynamics (MBD) equations. We switched to the recursive calculation method which is usually used in MBD which led to a significant improvement in accuracy and speed of calculation.

In a normal analysis, calculation speed have been improved up to 20 times.



Analysis time comparison for rigid model (12 parts, 10 constrains, 0.01s time interval, 300 steps)





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The developer explains the improvements in MBS (<u>Click to watch the video</u>)



Step-by Step Tutorial about Multi-body Simulation (Click here to watch the video)

### **MBS: Marker**

The Marker is attached to a part and it moves with the part together. Load can be assigned directly to a marker in any point of a rigid body.



Sample Markers, Applied Force

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# Nonlinear elastic material data

With this material model, you can now consider a multi-linear elastic uniaxial material relation.

The nonlinear stress-strain relationship is given by a multilinear curve that is define by a set of points

The behavior is nonlinear but it is elastic









#### Nonlinear Elastic Material

You can simulate nonlinear elastic material in NFX 2015. See how to do it in this example.

Try it in browser

**Click to try the Interactive tutorial** 

# **Enhanced Contact Definition**

The convergence for models with contact discontinuity have been greatly improved by the addition of a smooth surface discretization surface parameter in the contact pairs.





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# **Cyclic Symmetry Constraint**

A structure with a basic unit repeated around an axis can be described as exhibiting cyclic symmetry. This feature remove the need to model all the model which has a cyclic symmetry constraint.

Basic Advanced Cyclic Symmetry	
Name Cyclic Symmetry	
Surface Type 🔻	
Start Boundary	
Type 3D Element Face	
Select Object(s)	
End Boundary	
Type 3D Element Face 💌	
Select Object(s)	
Ref. CSys Global Cylindrical 💌 🔩	
Boundary Set 🛛 Boundary Set-1 🔹 🕵	



Modal analysis result using cyclic symmetry constraints







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### Cyclic Symmetry Boundary Condition

Many structures repeast around an axis (i.e. fans, turbines). For these structures, NFX 2015 can pattern geometries and loads cyclically, so you only need to model one small section to evaluate the behavior of the whole structure

Try it in browser

**Click to try the interactive tutorial** 

Cyclic Symmetry BC definition dialog box

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### **Inertia Relief**

Inertia relief option has been developed to enable the analysis of unconstrained systems such as air vehicles in flight, vehicles in motion, or satellites in space.





External Force F = Acceleration : a Driving force (Reaction)

**Inertia Relief application example** 



#### Inertia Relief

Inertia relief enables the analysis of unsupported systems such as automotives in motion, or satellites in space. It releases the inertia effect and the relative displacements are independent of constraint conditions.



**Click to try the interactive tutorial** 

# **Post Processing: Slice plane Vector**

### **Post-processing**

- Slice Plane Vector





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# **CAD Interface upgrade**

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The CAD model files supported by midas NFX have been extended. The detailed information appears in the table below:

 $\ensuremath{\mathbbmm{X}}$  The support of the latest CAD versions is updated constantly.

CAD format	Supported Versions
SolidWorks	98 - 2015
CATIA V4	4.1.9 - 4.2.4
CATIA V5	R6 – R24
Inventor	V11 – 2015
NX	11 – NX10
Creo (Pro/E)	16 - Creo 3.0
Solid Edge	V18 – ST7
Parasolid	10.0 - 26.0.151
STEP	AP203, AP214
IGES	Up to 5.3
ACIS	R1 – R25

#### < Additional improvements>

- The speed of the node/element selection tool has been improved for big models larger than 10 million mesh elements.
- The performance of the feature for showing or hiding large model elements has been improved.
- Opening speed of model files has been improved.
- The default settings for structural and CFD analysis have been changed. Some feature has been added to change in one click the basic settings for structural or CFD.
- A feature option called "Reload result" has been added to load automatically the results during analysis.

# Watch the Replay of midas NFX 2015 Release Webinar



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Click here to watch the replay of the webinar

# Go to www.midasNFX.com/NFX2015



Get to know the developers



#### Nonlinear Elastic Material

You can simulate nonlinear elastic material in NFX 2015. See how to do it in this example.

Try it in browser



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#### **Overset Mesh**

In complex fluid flow problems, not every geometry can be well represented using a single, contiguous mesh. NFX 2015 introduces overset mesh function. Try how it works in this example

Try it in browser

Try out new features with interactive tutorial

# and More

# Accurate whenever you Need

Be more efficient by focusing on the right details and get Accurate results

#### **Advanced Tools**

Simple interface, with powerful and advanced tools

#### **Professional FEA**

Advanced tools for professional FEA consultants

### **Top-level Solvers**

Midas NFX all-in-one interface is unique

#### **NAFEMS** Verified

Results guaranteed from NAFEMS Benchmarks



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#### Right model from the beginning

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Don't waste your time with over-simplified models

#### **Control your Meshing**

Every Meshing operation is possible

#### Meshing in your own way

Hybrid? Tetra? Manual Meshing? Have it all

#### **Everything Faster**

Multi-core meshing and GPU computation without any added cost.



Midas NFX is growing because of you !

Thank You for your support

