



### **3DExperience Fluid Dynamics Engineer Role**





# Agenda

Fluid Dynamics Engineer – First Look

Key Features and Applications

Conclusion



#### Meet Our Team



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#### Fluid Dynamics Engineer First Look



• Explicit Model Definition

#### Commands

A model and sections have been created.

Create a fluid domain if you do not have a part that represents the fluid volume. All parts must have sections assigned.

#### Model Setup Specifies the f

Specifies the fluid domain and material, mesh parameters, and optionally a bounding box and heat transfer parts.

Fluid Domain

Specifies the fluid regions of the model.

#### Material Palette

Applies materials to regions of your model or modifies material properties.

#### Fluid Section

Applies properties to a region that define an area with continuous fluid media.

#### Solid Section

Applies properties to a region where the material is continuous through the thickness of the part.

#### Porous Section

Applies properties to a region that defines an area with continuous fluid media flowing through a porous solid.

#### VOF Section

-

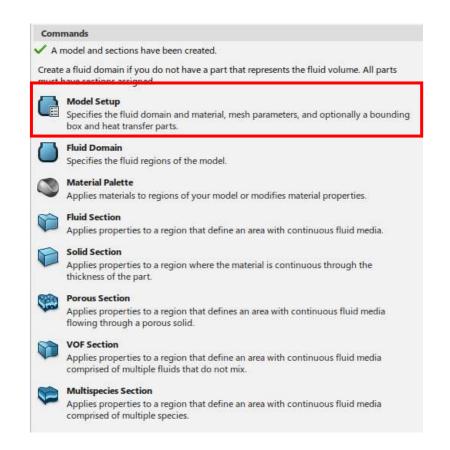
Applies properties to a region that define an area with continuous fluid media comprised of multiple fluids that do not mix.

#### **Multispecies Section**

Applies properties to a region that define an area with continuous fluid media comprised of multiple species.

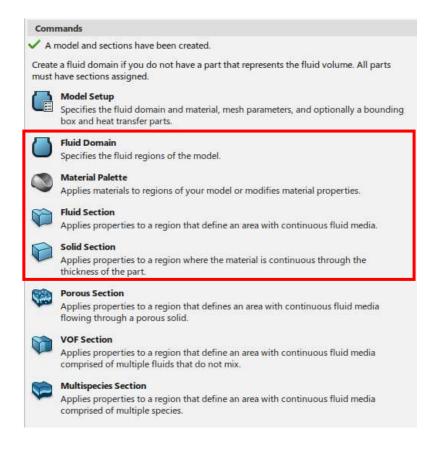
- Explicit Model Definition
  - Explicitly define the computational domain





- Explicit Model Definition
  - Explicitly define the computational domain
  - Subdivide the computational domain





- Explicit Model Definition
  - Explicitly define the computational domain
  - Subdivide the computational domain
  - Multispecies Study, porous media and
     Volume of fluid for liquid-liquid interaction





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- Explicit Model Definition
- Physics:
  - Range of models available
    - SST k-omega for internal/external/thermal
    - Realizable k-epsilon for internal flow
    - Spalart-Allmaras for external aerospace application

Physics					×
Name: Fluid Phys	ics.1				
State: Fluid 💌					
Viscous regime:	Turbulent				•
Turbulence model:	Realizable k-ɛ				•
Turbulence Mo	SST k-ω del Spalart-Allmaras				
Cμ:	Realizable k-ɛ				
Realizable cons	tant (A0):		4		
ok:			1		
ØE:			1.2		
Ce1_min:			0.43		
Cε2:			1.9		
Karman constar	it (κ):		0.41		•
Enable thermal e	ffects				
Enable compress	sible flow				
Enable coupled s	solver				
🗹 Enable gravity					
▼ Gravity Parame	eters				
Gravity (X):		0m_s2			
Gravity (Y):		0m_s2			
Gravity (Z):		-9.81r	n_s2		
Enable particle n	nodeling			ОК	Cancel

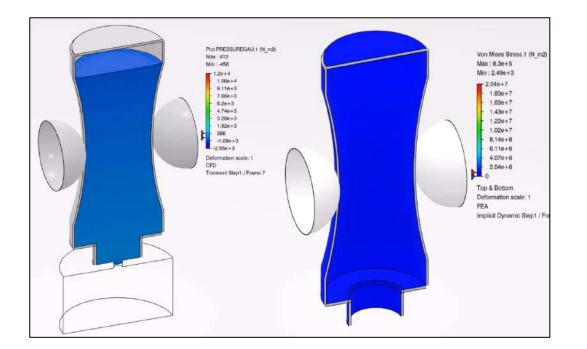


- Explicit Model Definition
- Physics:
  - Range of models available
  - Coupled solver for faster convergence

Name: Fluid Phy	sics.1		
State: Fluid 💌			
Viscous regime:	Turbulent		
Turbulence model:	Realizable k-ɛ	1	13
	SST k-ω		
	odel Spalart-Allma Realizable k-ε		
Сµ:		0.05	
Realizable con	stant (A0):	4	
ok:		1	
OE:		1.2	
Cc1_min:		0.43	
Cε2:		1.9	
Karman consta	ant (κ):	0.41	
Enable thermal	ssible flow		
Enable coupled Enable gravity	i solver		
▼ Gravity Paran	neters		
Gravity (X):		0m_s2	
Gravity (Y):		0m_s2	
Gravity (Z):		-9.81m_s2	
Enable narticle	modeling		



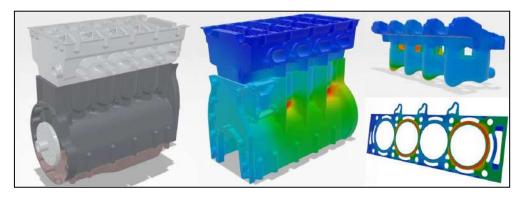
- Explicit Model Definition
- Physics:
  - Range of models available
  - Multiphysics and Fluid Structure Interaction\*



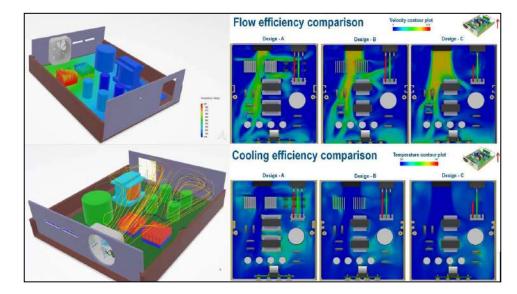
\*Requires system modeling role and coupling role on 3DEXPERIENCE



- Explicit Model Definition
- Physics:
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**Equipment Thermal Performance** 

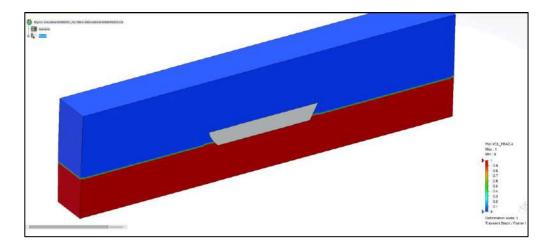


Electronic Device Thermal Performance

\*Requires system modeling role and coupling role on 3DEXPERIENCE

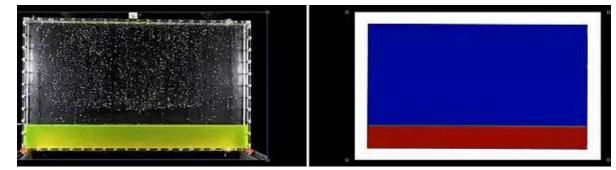


- Explicit Model Definition
- Physics:
  - Range of models available
  - Multiphysics and Fluid Structure Interaction
  - Multiphase, Multispecies, and 2-way particle modeling, Rigid Body





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- Physics:
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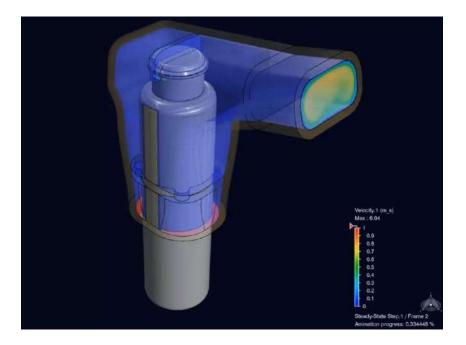




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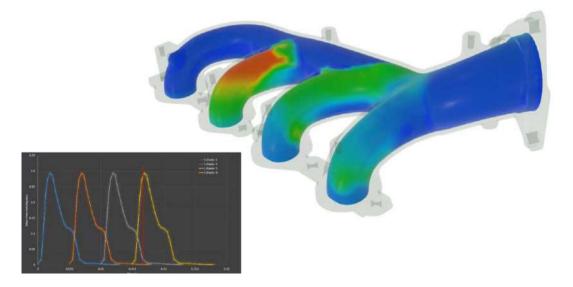


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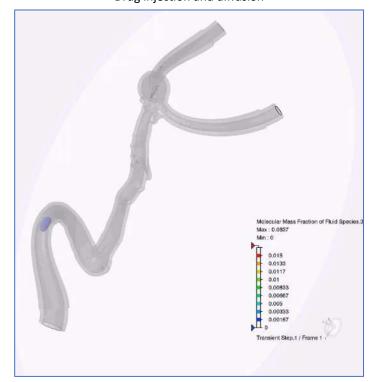


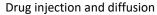
- Explicit Model Definition
- Physics:
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  - Multiphase and Multispecies
  - Transient Simulation





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- Physics:
  - Range of models available
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  - Multiphase and Multispecies
  - Transient Simulation





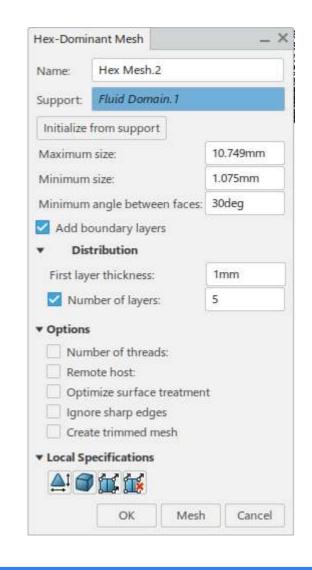


- Explicit Model Definition
- Physics:
  - Range of models available
  - Multiphysics and Fluid Structure Interaction
  - Multiphase and Multispecies
  - Transient Simulation
  - Rotating Region



- Explicit Model Definition
- Physics
- Meshing
  - Hex Dominant Body Fitted Mesh







- Explicit Model Definition
- Physics
- Meshing
  - Hex Dominant Body Fitted Mesh

Control the number of boundary layer mesh

Hex-Domi	nant Mesh			_ ×
Name:	Hex Mesh.2			
Support:	Fluid Domai	n.1		
Initialize	from support			
Maximum	n size:	ĺ	10.749	mm
Minimum	size:	[	1.075m	ım
Minimum	angle betwee	n faces:	30deg	
Nun	nber of layers:		5	
Options     Num     Rem     Opti     Igno     Crea     Local Sp		reatment s		



- Explicit Model Definition
- Physics
- Meshing
  - Hex Dominant Body Fitted Mesh

Offload meshing, automate \_\_\_\_\_ optimization, generate cartesian mesh

Hex-Domi	nant Mesh	-
Name:	Hex Mesh.2	
Support	Fluid Domain.	t
Initialize	from support	
Maximum	i size:	10.749mm
Minimum	size:	1.075mm
Minimum	angle between f	aces: 30deg
	tribution er thickness:	1mm
		1mm
Nun 🗹	nber of layers:	5
<ul> <li>Options</li> </ul>		
Rem     Opti     Igno	iber of threads: ote host: mize surface trea re sharp edges te trimmed mesh	
10.11.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1	ecifications	
	ОК	Mesh Cance

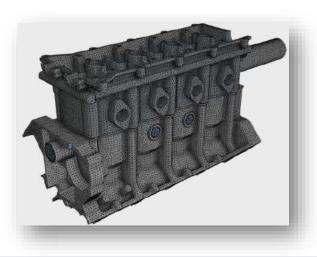


- Explicit Model Definition
- Physics
- Meshing
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	Hex-Domi	nant Mesh	_ ×
	Name:	Hex Mesh.2	
	Support	Fluid Domain.1	
	Initialize	from support	
	Maximum	ı size:	10.749mm
	Minimum	size:	1.075mm
	Minimum	angle between faces:	30deg
esh		oundary layers tribution	
6311	First lay	er thickness:	1mm
	Nun	nber of layers:	5
	Rem	iber of threads: ote host: mize surface treatmen	t
ocal mesh controls in the support	Crea	re sharp edges te trimmed mesh ecifications	
		OK Mesh	Cancel



- Explicit Model Definition
- Physics
- Meshing
  - Hex Dominant Body Fitted Mesh
  - Much more





#### Hex-Dominant Mesh Creates a 3D mesh dominated by hexahedron elements.



#### **Tetrahedron Mesh**

Creates a 3D mesh of tetrahedron elements.



#### Sweep 3D Mesh

Creates a 3D mesh by sweeping a surface mesh through a volume.



#### Surface Triangle Mesh

Creates a surface mesh of triangular elements using saved meshing rules.

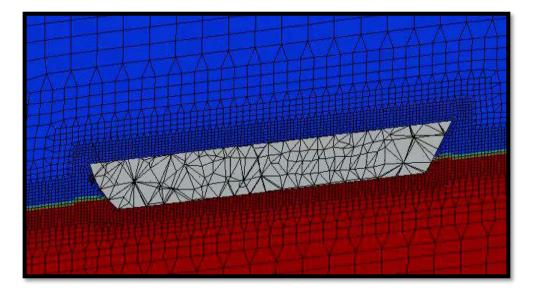


#### Surface Quad Mesh

Creates a surface mesh of quadrilateral elements using saved meshing rules.



- Explicit Model Definition
- Physics
- Meshing
  - Hex Dominant Body Fitted Mesh
  - Much more
  - Morphing mesh for FSI





- Explicit Model Definition
- Physics
- Meshing
- Solver
  - Residual Criteria or patented error criteria for faster convergence

eady-State Step			
Name: Steady-State Step.1			
Maximum iterations:	2000		
Enable auto under-relaxation fo	r all equations		
<ul> <li>Stopping Criteria</li> </ul>	20		
Sampled iterations: 40			
Error Thresholds (%)			
Momentum:	Threshold	1	
🗹 тке:	Threshold	1	
EPS:	Threshold	1	
Species:	Threshold	1	
Residual Thresholds (%)			
Momentum:	Threshold	0.1	
🗹 тке:	Threshold	0.1	
EPS:	Threshold	0.1	
Species:	Threshold	0.1	
Pressure Equation Controls			
Momentum Equation Controls			
Turbulence Equation Controls			
Species Equation Controls			
Expert Numerics Controls			
Expert Cycle Controls			
		ОК	Cancel



- Explicit Model Definition
- Physics
- Meshing
- Solver
  - Residual Criteria or patented error criteria for faster convergence
  - Under relaxation for solver stabilization
    - Related to Courant Number

laximum iterations:		2000
Enable auto under-relaxation f	or all equations	
Stopping Criteria		
Pressure Equation Controls		
Under relaxation factor: 0.2		
Linear solver: AMG-CG 🔻		
Iteration limit:	250	
Convergence check frequency:	2	
Linear convergence limit:	0.01	
AMG cycle type:	V •	
Residual smoother:	ILU 🔻	
Maximum size of coarsest level:	1000	
Maximum number of levels:	10	
Number of pre-smoothing steps:	1	
Number of post-smoothing steps:	1	
Momentum Equation Controls	8	
Turbulence Equation Controls		
Species Equation Controls		
Expert Numerics Controls		
Expert Cycle Controls		

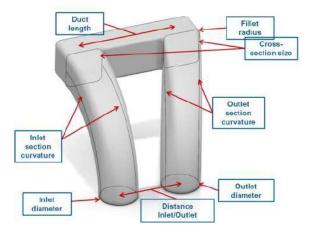


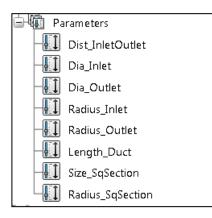
- Explicit Model Definition
- Physics
- Meshing
- Solver
  - Residual Criteria
  - Under Relaxation for solver stabilization
  - Expert Numerical Controls
  - HPC Up to 144 Cores on Cloud

Disable secondary diffusion:	Bad Cells Only	
Disable second order advection:	Bad Cells Only	
Pressure gradient evaluation type:	Conservative	
	Enable pressure dissipation term	
Bad Cells Definition	Enable pressure dissipation term	
Bad Cells Definition		

- Explicit Model Definition
- Physics
- Meshing
- Solver
- Design Automation\*







\*Requires multidisciplinary optimization role on 3DEXPERIENCE



#### \*Requires multidisciplinary optimization role on 3DEXPERIENCE

• Design Automation\*

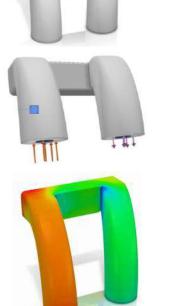
• Physics Meshing

**Key Features** 

- Solver



• Explicit Model Definition





Setup Initial

#### \*Requires multidisciplinary optimization role on 3DEXPERIENCE

 Solver • Design Automation\*

• Explicit Model Definition

**Key Features** 

- Physics

- Meshing





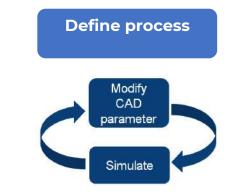




TH.

Setup Initial Simulation

- Explicit Model Definition
- Physics
- Meshing
- Solver
- Design Automation\*



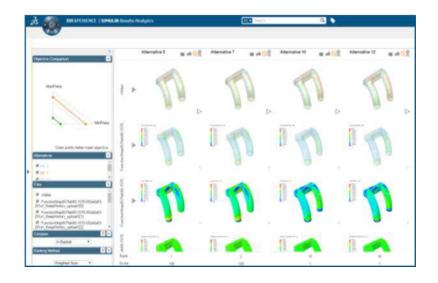


\*Requires multidisciplinary optimization role on 3DEXPERIENCE



- Explicit Model Definition
- Physics
- Meshing
- Solver
- Design Automation\*

Review performance analytics and trade-offs



\*Requires multidisciplinary optimization role on 3DEXPERIENCE



#### Conclusion

- Deeper control on the models and physics
- Wider range of options for physics
- Automated design optimization
- PLM embedded CFD



## Questions?

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#### Stay up to date on upcoming events & webinars!

www.cadmicro.com/events