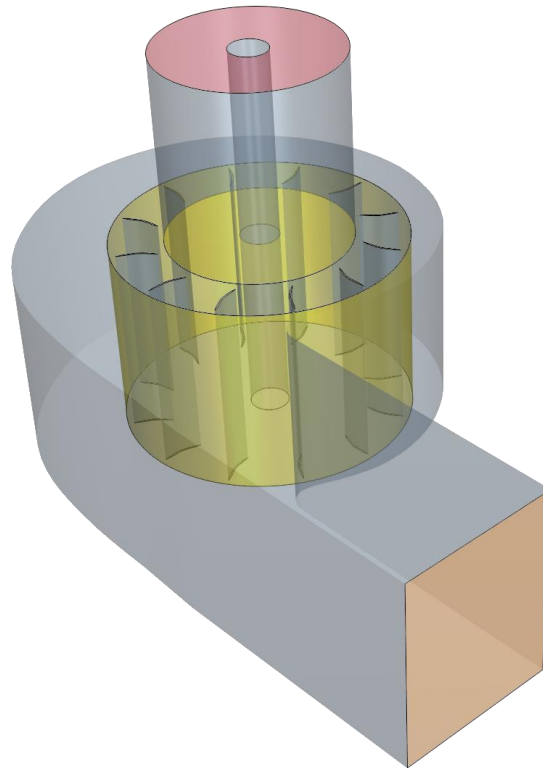


CFD applied to Turbomachinery

Francesco Romanò

francesco.romano@ensam.eu

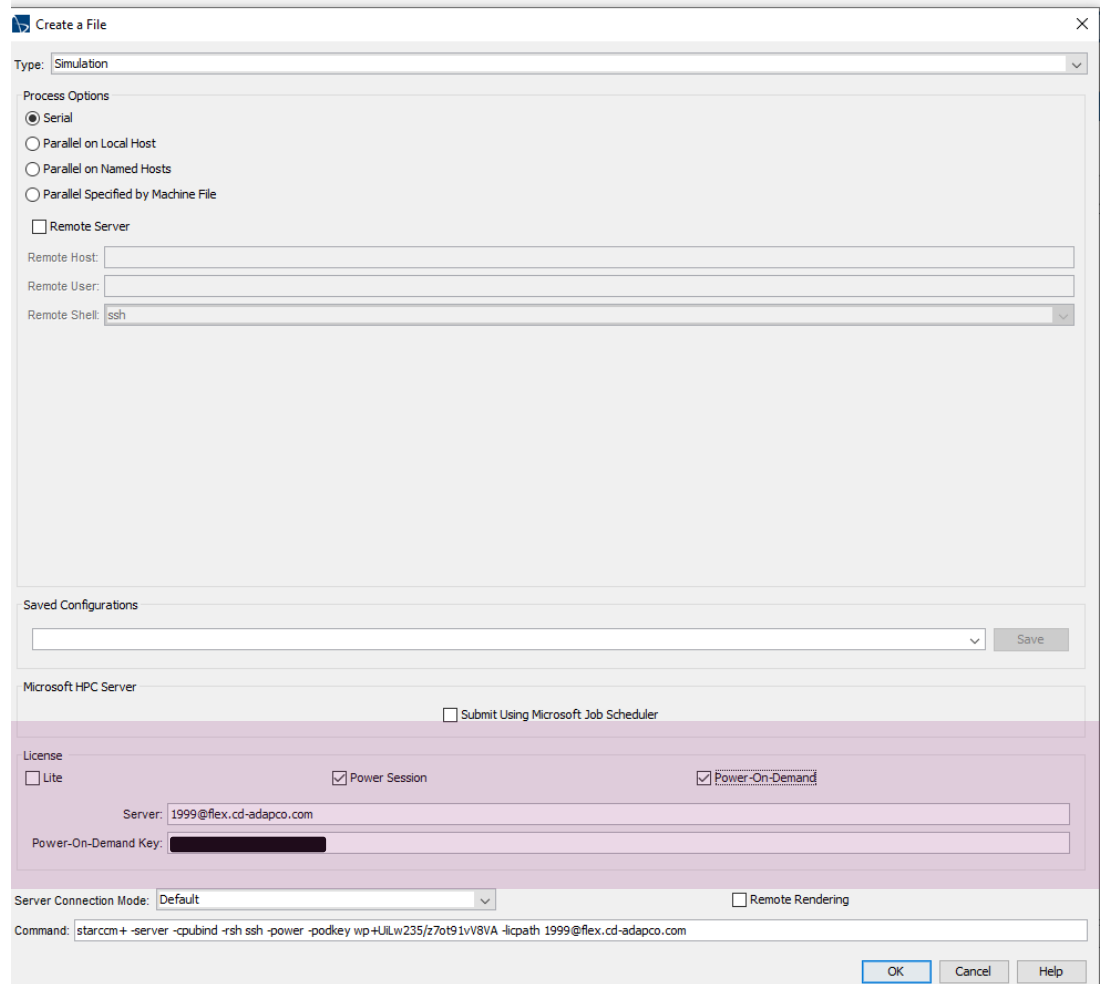
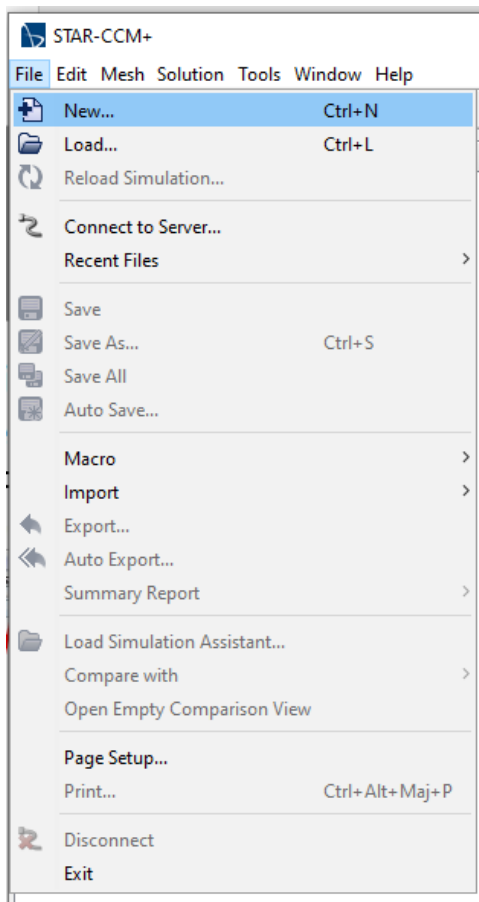
Laboratoire de Mécanique des Fluides Lille, Arts et Métiers Institute of Technology, 59800, Lille, France



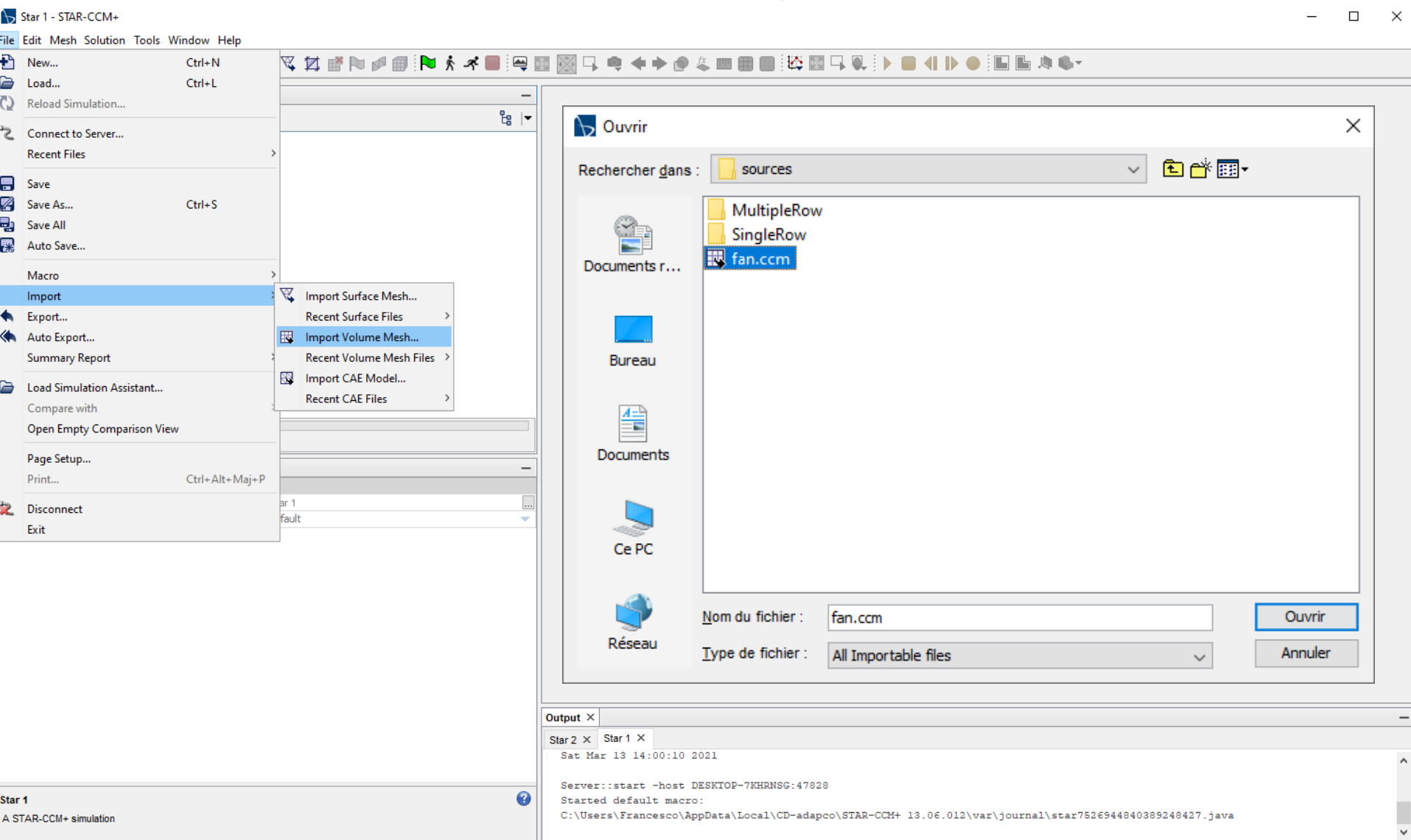
March 18, 2021, International Master of Turbulence



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+

The screenshot displays the Star-CCM+ software interface. The **File** menu is open, showing options like New..., Load..., Save, and Save As... (Ctrl+S). The **Enregistrer** (Save) dialog box is active, showing the file name **MovingReferenceFrame_CentrifugalFan** and the file type **Simulation Database (*.sim)**. The dialog also lists several simulation files in the **sources** folder, including **2DMeshConnectivityAirfoil.sim**, **HarmonicBalanceSingleRow_RotorBlade.sim**, **MeshAirfoil.sim**, **MovingReferenceFrame_CentrifugalFan.sim**, **SteadySingleRow_RotorBlade.sim**, **SteadyStateRotorBlade.sim**, and **SteadyStateRotorStatorBlade.sim**. The **Output - Star 2** console at the bottom shows simulation progress with volume change metrics.

File Edit Mesh Solution Tools Window Help

New... Ctrl+N
Load... Ctrl+L
Reload Simulation...
Connect to Server...
Recent Files
Save
Save As... Ctrl+S
Save All
Auto Save...
Macro
Import
Export...
Auto Export...
Summary Report
Load Simulation Assistant...
Compare with
Open Empty Comparison View
Page Setup...
Print... Ctrl+Alt+Maj+P
Disconnect
Exit

Enregistrer

Enregistrer dans : CourseTurbulence

sources

- 2DMeshConnectivityAirfoil.sim
- HarmonicBalanceSingleRow_RotorBlade.sim
- MeshAirfoil.sim
- MovingReferenceFrame_CentrifugalFan.sim
- SteadySingleRow_RotorBlade.sim
- SteadyStateRotorBlade.sim
- SteadyStateRotorStatorBlade.sim

Nom du fichier : MovingReferenceFrame_CentrifugalFan

Type de fichier : Simulation Database (*.sim)

Enregistrer
Annuler

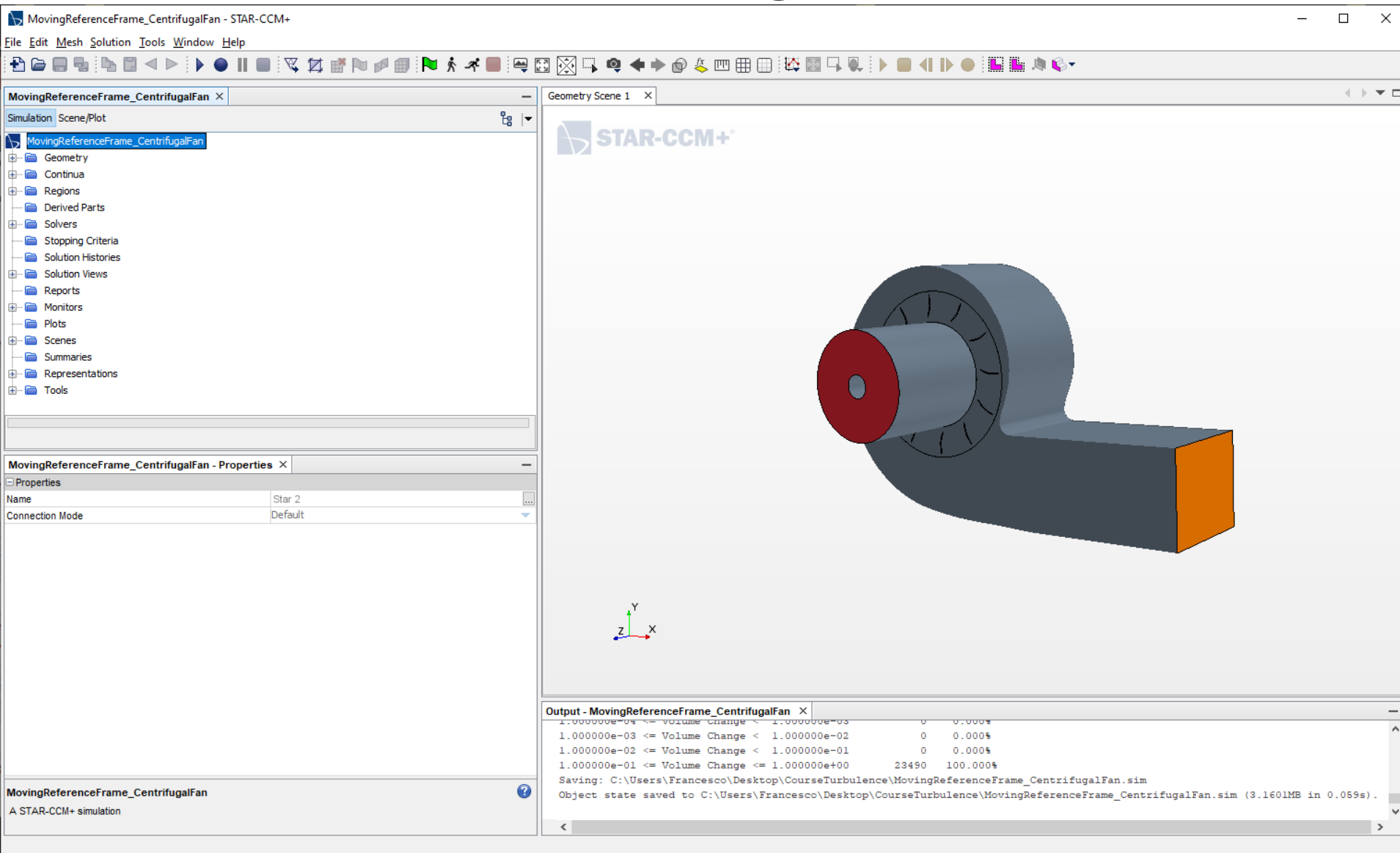
Output - Star 2

Volume Change	Volume Change	Volume Change	Volume Change
1.000000e-06	<= Volume Change < 1.000000e-05	0	0.000%
1.000000e-05	<= Volume Change < 1.000000e-04	0	0.000%
1.000000e-04	<= Volume Change < 1.000000e-03	0	0.000%
1.000000e-03	<= Volume Change < 1.000000e-02	0	0.000%
1.000000e-02	<= Volume Change < 1.000000e-01	0	0.000%
1.000000e-01	<= Volume Change <= 1.000000e+00	23490	100.000%

Star 2
A STAR-CCM+ simulation



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+

The screenshot displays the StarCCM+ software interface for a MovingReferenceFrame_CentrifugalFan simulation. The main window shows a 3D model of a centrifugal fan with a magenta housing and a grey impeller. The impeller is labeled "Stationary". The interface includes a menu bar (File, Edit, Mesh, Solution, Tools, Window, Help), a toolbar, and a left sidebar with a tree view of the simulation hierarchy. The "Stationary - Properties" panel is open, showing properties for a fluid region. The "Output" window at the bottom displays simulation progress and saving information.

Simulation Hierarchy:

- MovingReferenceFrame_CentrifugalFan
 - Geometry
 - Continua
 - Regions
 - Rotating
 - Stationary**
 - Derived Parts
 - Solvers
 - Stopping Criteria
 - Solution Histories
 - Solution Views
 - Reports
 - Monitors
 - Plots
 - Scenes
 - Summaries
 - Representations

Stationary - Properties

Properties	
Index	0
Mesh Continuum	None
Physics Continuum	Physics 1
Parts	
Type	Fluid Region
Tags	
Expert	
Allow Per-Part Values	☐

Output - MovingReferenceFrame_CentrifugalFan

```
1.000000e-04 <= Volume Change < 1.000000e-03 0 0.000%
1.000000e-03 <= Volume Change < 1.000000e-02 0 0.000%
1.000000e-02 <= Volume Change < 1.000000e-01 0 0.000%
1.000000e-01 <= Volume Change <= 1.000000e+00 23490 100.000%

Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.1601MB in 0.059s).
```



MRF Simulation Centrifugal Fan in StarCCM+

MovingReferenceFrame_CentrifugalFan - STAR-CCM+

File Edit Mesh Solution Tools Window Help

Simulation Scene/Plot

MovingReferenceFrame_CentrifugalFan

- Geometry
- Continua
- Regions
 - Rotating
 - Stationary
- Derived Parts
- Solvers
- Stopping Criteria
- Solution Histories
- Solution Views
- Reports
- Monitors
- Plots
- Scenes
- Summaries
- Representations

Update View: Finished

Rotating - Properties

Properties

Index	1
Mesh Continuum	None
Physics Continuum	Physics 1
Parts	
Type	Fluid Region
Tags	

Expert

Allow Per-Part Values

Rotating

A Region

Geometry Scene 1

STAR-CCM+

Rotating

Output - MovingReferenceFrame_CentrifugalFan

```
1.000000e-04 <= Volume Change < 1.000000e-03 0 0.000%
1.000000e-03 <= Volume Change < 1.000000e-02 0 0.000%
1.000000e-02 <= Volume Change < 1.000000e-01 0 0.000%
1.000000e-01 <= Volume Change <= 1.000000e+00 23490 100.000%
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.1601MB in 0.059s).
```



MRF Simulation Centrifugal Fan in StarCCM+

MovingReferenceFrame_CentrifugalFan - STAR-CCM+

File Edit Mesh Solution Tools Window Help

MovingReferenceFrame_CentrifugalFan x

Simulation Scene/Plot

MovingReferenceFrame_CentrifugalFan

- Geometry
- Continua
- Regions
 - Rotating
 - Boundaries
 - Physics Conditions
 - Physics Values
- Station
- Bou
- Phy
- Phy
- Derived Par
- Solvers
- Stopping Cr
- Solution His
- Solution Vie

Multiple Objects

- Properties
- Index
- Mesh Continuum
- Physics Continuum
- Parts
- Type
- Tags
- Expert
- Allow Per-Part Valu

Highlight

Edit...

Set New Tag...

Combine...

Boolean

Split by Surface Topology

Split Non-Contiguous...

Split by Function...

Remove Invalid Cells...

Transform

- Scale...
- Translate...
- Rotate...
- Reflect...

Reorder Mesh

Replace Mesh...

Solution

Create Interface

Compare

Copy Ctrl+C

Paste Ctrl+V

Delete Supprimer

Rename...

Geometry Scene 1 x

STAR-CCM+

Scale Regions

Scale Regions

☒ Scale all dimensions uniformly

Scale Factor

X 0.001

Y 0.001

Z 0.001

Coordinate System

Laboratory

Apply Close Help

Output - MovingReferenceFrame_CentrifugalFan x

```
1.000000e-04 <= Volume Change < 1.000000e-03 0 0.000%
1.000000e-03 <= Volume Change < 1.000000e-02 0 0.000%
1.000000e-02 <= Volume Change < 1.000000e-01 0 0.000%
1.000000e-01 <= Volume Change <= 1.000000e+00 23490 100.000%
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.1601MB in 0.059s).
```

Multiple objects selected

Multiple objects selected (2)



MRF Simulation Centrifugal Fan in StarCCM+

The screenshot displays the StarCCM+ software interface for a simulation titled "MovingReferenceFrame_CentrifugalFan". The main window shows the "Physics 1 Model Selection" dialog box, which is used to configure the physics models for the simulation. The dialog is divided into two main sections: "Optional Models" and "Enabled Models".

Optional Models:

- ☐ Segregated Fluid Enthalpy
- ☐ Co-Simulation
- ☐ Electromagnetism
- ☐ Passive Scalar
- ☐ Conservative Interpolation
- ☐ Turbulence Suppression
- ☐ Fluid Film
- ☐ Mesh Deformation
- ☐ Dispersed Multiphase
- ☐ Virtual Disk
- ☐ Porous Media
- ☐ Gravity
- ☐ Turbulent Viscosity User Scaling
- ☐ Cell Quality Remediation
- ☐ Radiation
- ☐ Lagrangian Multiphase
- ☐ Aeroacoustics
- ☐ Boussinesq Model
- ☐ Segregated Fluid Isothermal
- ☐ Vorticity Confinement Model
- ☐ Electrochemistry
- ☐ Plasma
- ☐ Segregated Fluid Temperature

Enabled Models:

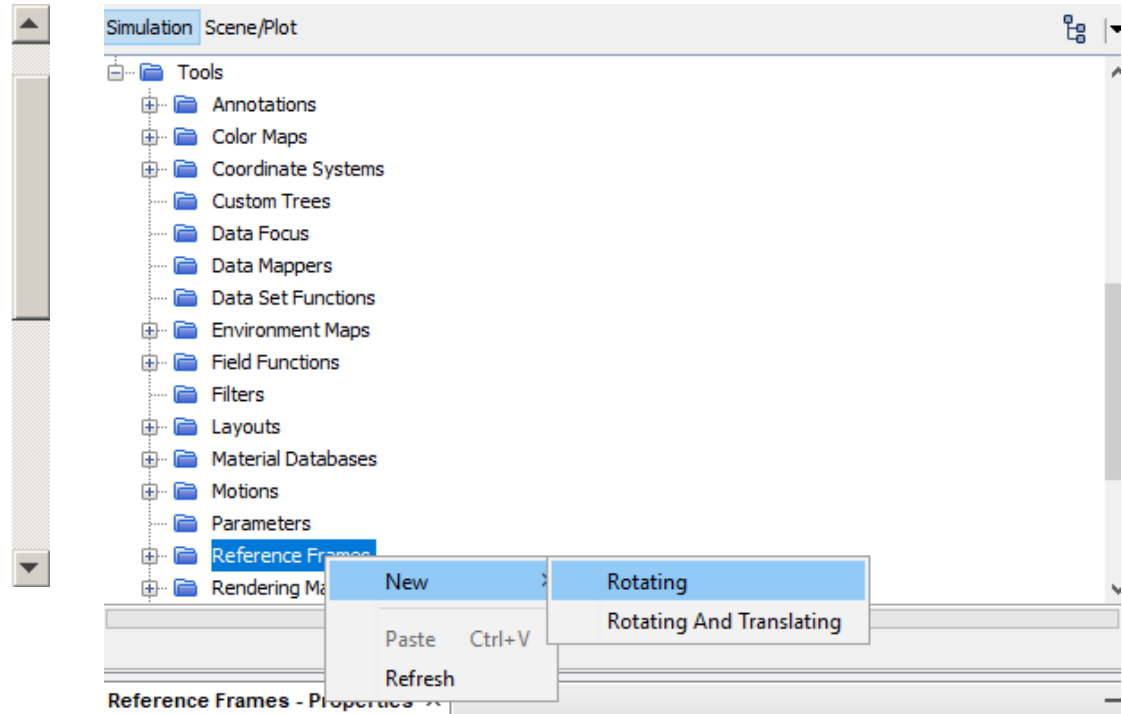
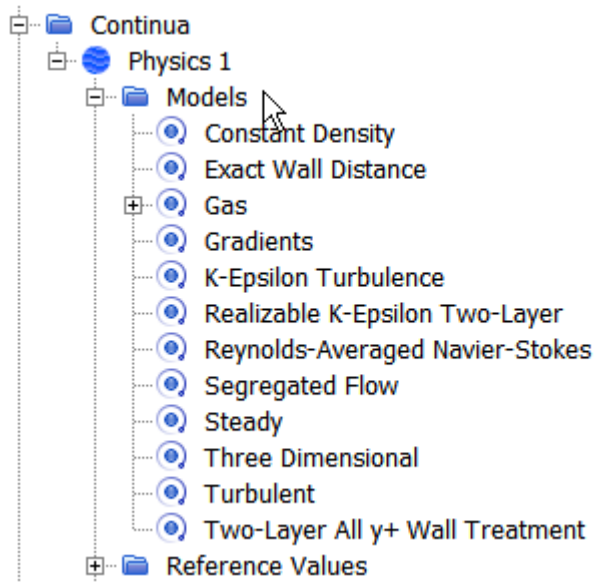
- ☒ Two-Layer All y+ Wall Treatment
- ☒ Exact Wall Distance
- ☒ Realizable K-Epsilon Two-Layer
- ☒ K-Epsilon Turbulence
- ☒ Reynolds-Averaged Navier-Stokes
- ☒ Turbulent
- ☒ Constant Density
- ☒ Gradients
- ☒ Segregated Flow
- ☒ Gas
- ☒ Steady
- ☒ Three Dimensional

At the bottom of the dialog, there is a checkbox for "Auto-select recommended models" which is checked. The "Close" and "Help" buttons are located at the bottom right.

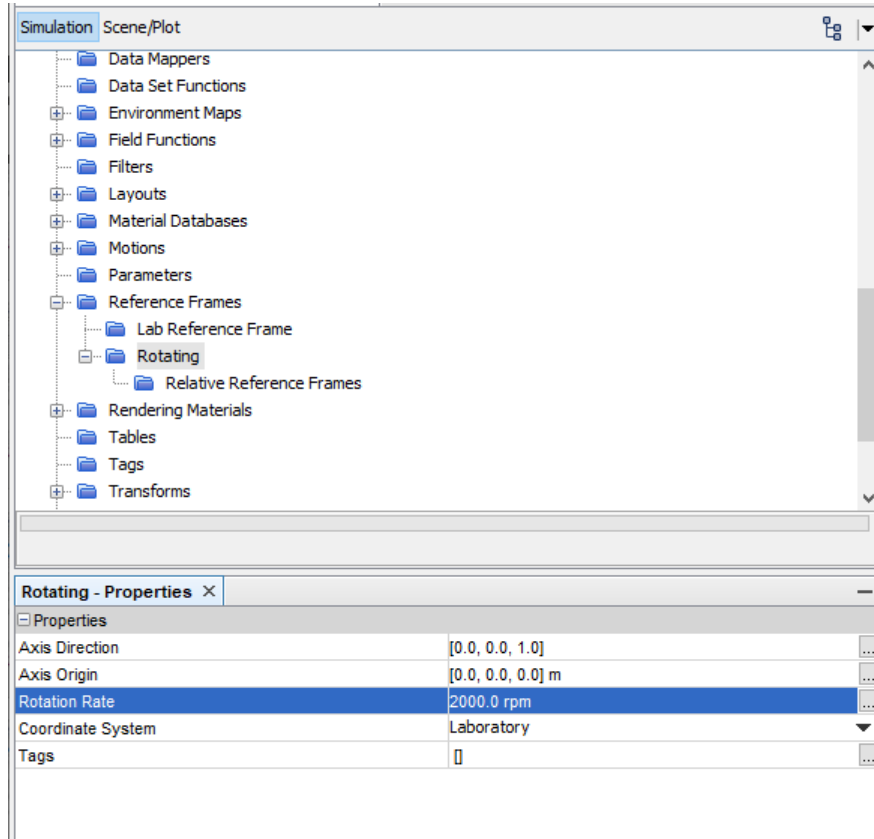
The background interface shows the "MovingReferenceFrame_CentrifugalFan" project tree on the left, with the "Physics" folder expanded. The "Physics 1 - Properties" panel is visible below the tree, showing the "Regions" property set to "[Stationary, Rotating]". The "Output - MovingReferenceFrame" panel at the bottom shows the coordinates of the scene point p2: d(X) = 0,10571 (m), d(Y) = 0,26961 (m), d(Z) = -0,035938 (m).



MRF Simulation Centrifugal Fan in StarCCM+

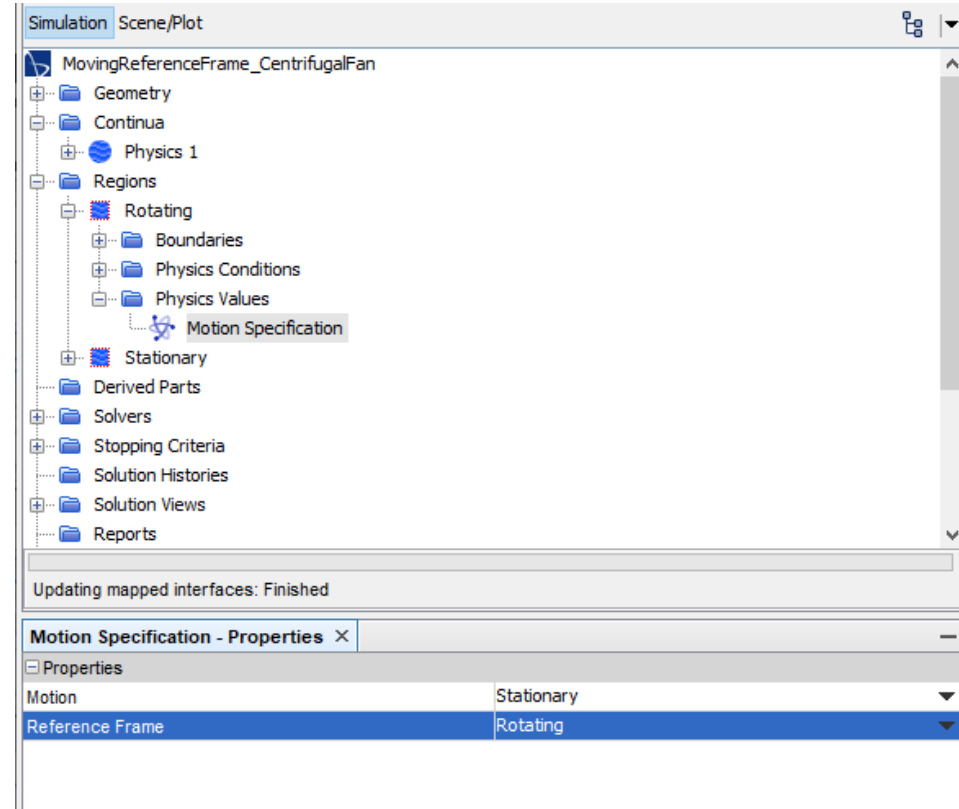


MRF Simulation Centrifugal Fan in StarCCM+



The left screenshot shows the StarCCM+ interface. The 'Simulation' tree on the left lists various components, with 'Rotating' selected under 'Reference Frames'. The 'Rotating - Properties' panel is open at the bottom, showing the following settings:

Rotating - Properties	
Properties	
Axis Direction	[0.0, 0.0, 1.0]
Axis Origin	[0.0, 0.0, 0.0] m
Rotation Rate	2000.0 rpm
Coordinate System	Laboratory
Tags	[]



The right screenshot shows the StarCCM+ interface with the 'MovingReferenceFrame_CentrifugalFan' selected in the 'Simulation' tree. The 'Motion Specification' is highlighted under 'Physics Values'. The 'Motion Specification - Properties' panel is open at the bottom, showing the following settings:

Motion Specification - Properties	
Properties	
Motion	Stationary
Reference Frame	Rotating



MRF Simulation Centrifugal Fan in StarCCM+

The image displays the StarCCM+ software interface for setting up a Moving Reference Frame (MRF) simulation of a centrifugal fan. The interface is divided into three main panes: a tree view on the left, a properties pane on the right, and a detailed properties pane at the bottom.

Tree View (Left Pane):

- MovingReferenceFrame_CentrifugalFan
 - Geometry
 - Continua
 - Physics 1
 - Models
 - Reference Values
 - Initial Conditions
 - Pressure
 - Turbulence Specification
 - Turbulent Dissipation Rate
 - Turbulent Kinetic Energy
 - Velocity
 - Regions
 - Rotating
 - Boundaries
 - Physics Conditions
 - Physics Values

Properties Pane (Right Pane):

Turbulent Dissipation Rate - Properties

Properties	
Method	Constant
Value	150.0 m ² /s ³
	Length ² /Time ³

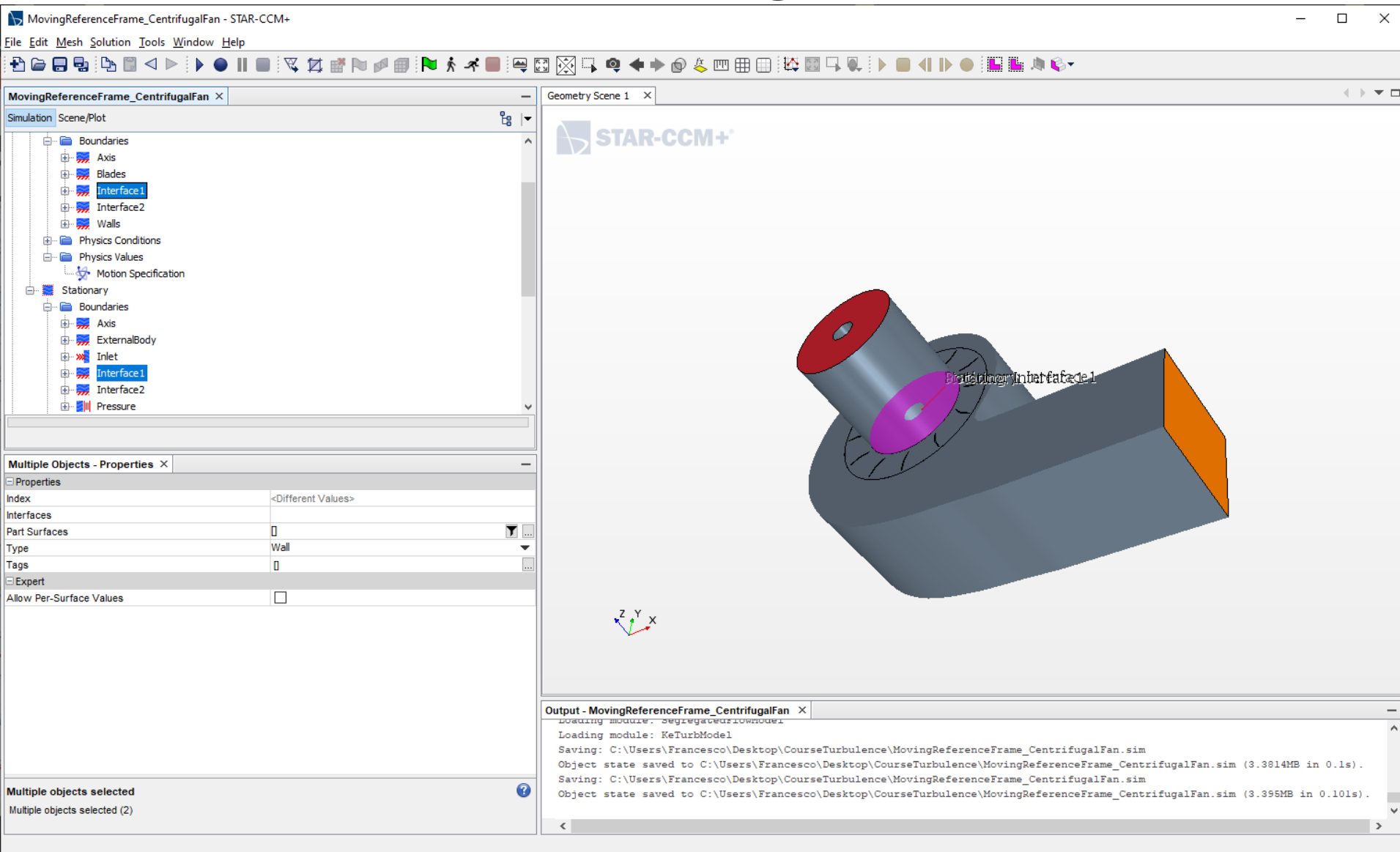
Detailed Properties Pane (Bottom):

Turbulent Kinetic Energy - Properties

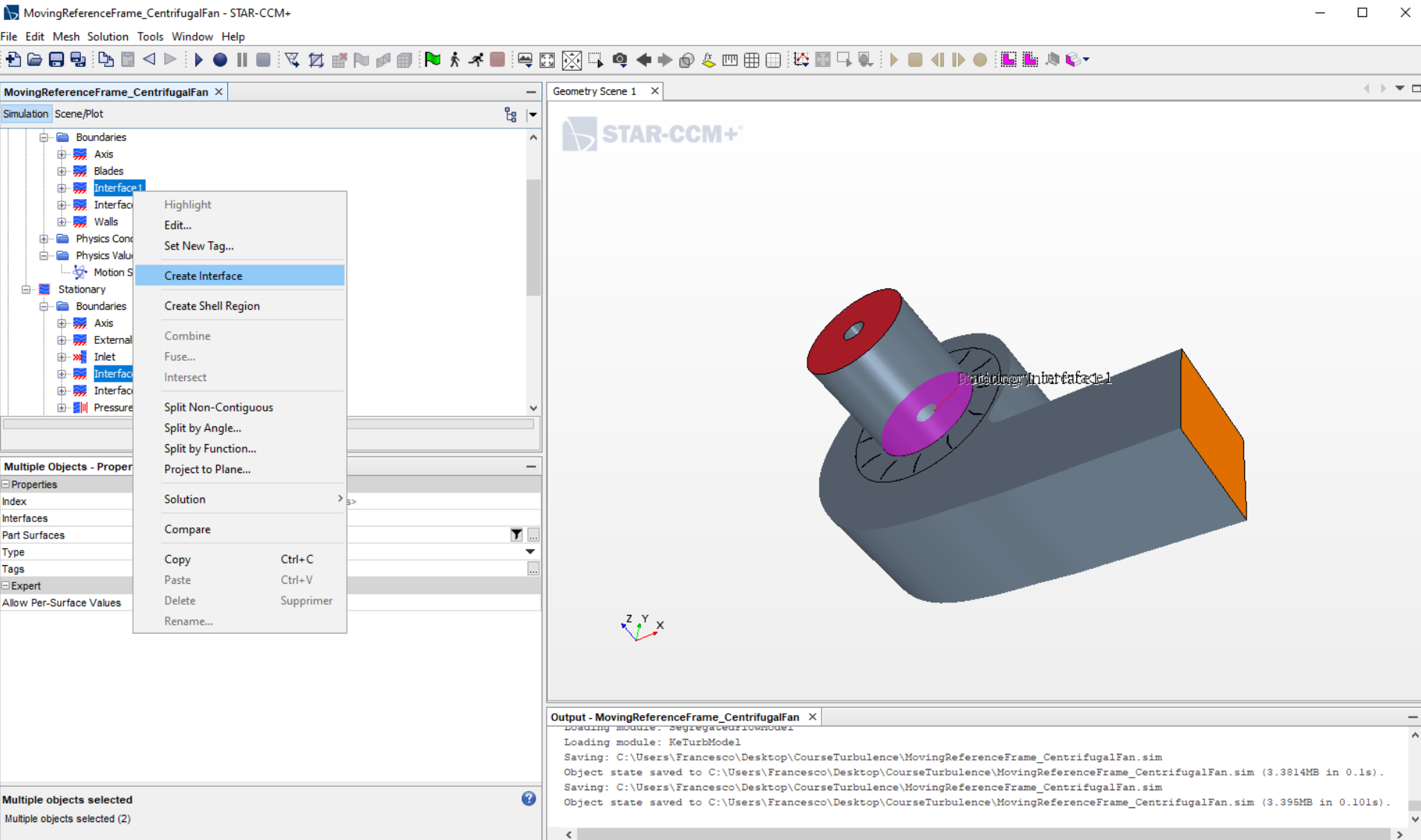
Properties	
Method	Constant
Value	1.5 J/kg
Dimensions	Length ² /Time ²

Physical dimensions

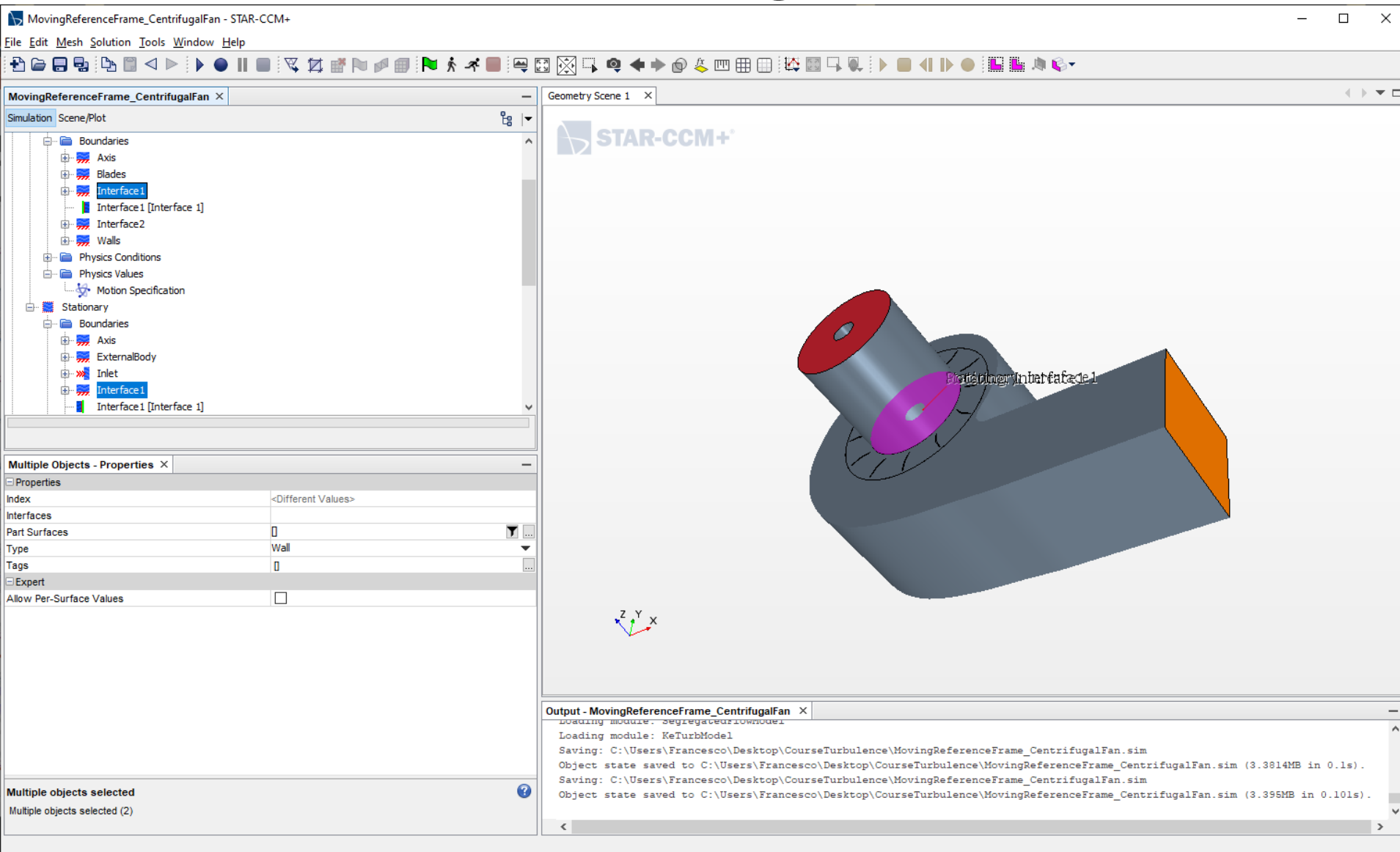
MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+



Repeat it with « Interface 2 »

CFD applied to Turbomachinery



MRF Simulation Centrifugal Fan in StarCCM+

MovingReferenceFrame_CentrifugalFan - STAR-CCM+

File Edit Mesh Solution Tools Window Help

Simulation Scene/Plot

- Interface1
 - Interface1 [Interface 1]
 - Interface2
 - Interface2 [Interface 2]
- Walls
- Physics Conditions
- Physics Values
 - Motion Specification
- Stationary
 - Boundaries
 - Axis
 - ExternalBody
 - Inlet
 - Interface1
 - Interface1 [Interface 1]
 - Interface2
 - Interface2 [Interface 2]

Computing metrics: Finished

Multiple Objects - Properties

Properties

Index	<Different Values>
Interfaces	
Part Surfaces	
Type	Wall
Tags	

Expert

Allow Per-Surface Values

Multiple objects selected

Multiple objects selected (2)

Geometry Scene 1

STAR-CCM+

Rotating: Interface2

Stationary: Interface2

Output - MovingReferenceFrame_CentrifugalFan

```
Loading module: segregatedFlowModel
Loading module: KeTurbModel
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.3814MB in 0.1s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.395MB in 0.101s).
```



MRF Simulation Centrifugal Fan in StarCCM+

MovingReferenceFrame_CentrifugalFan - STAR-CCM+

File Edit Mesh Solution Tools Window Help

Simulation Scene/Plot

MovingReferenceFrame_CentrifugalFan

- Geometry
- Continua
- Regions
 - Rotating
 - Stationary
 - Boundaries
 - Axis
 - ExternalBody
 - Inlet
 - Physics Conditions
 - Physics Values
 - Turbulence Intensity
 - Turbulent Viscosity Ratio
 - Velocity Magnitude

- Interface 1
- Interface 1 [Interface 1]

Velocity Magnitude - Properties

Properties

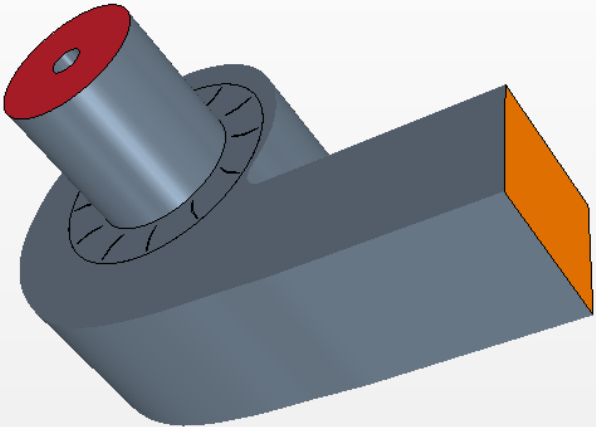
Method	Constant
Value	5.0 m/s
Dimensions	Velocity

Velocity Magnitude

Velocity magnitude profile

Geometry Scene 1

STAR-CCM+



Output - MovingReferenceFrame_CentrifugalFan

```
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.3814MB in 0.1s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.395MB in 0.101s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.4158MB in 0.108s).
```



MRF Simulation Centrifugal Fan in StarCCM+

MovingReferenceFrame_CentrifugalFan - STAR-CCM+

File Edit Mesh Solution Tools Window Help

Simulation Scene/Plot

MovingReferenceFrame_CentrifugalFan

- Geometry
- Continua
- Regions
 - Rotating
 - Stationary
 - Boundaries
 - Axis
 - Physics Conditions
 - Reference Frame Specification
 - Shear Stress Specification
 - Tangential Velocity Specification
 - Wall Surface Specification
 - Physics Values
 - Blended Wall Function
 - Wall Relative Rotation
 - ExternalBody

Tangential Velocity Specification - Properties

Properties

Method Rotation Rate

Method

Wall tangential velocity specification method

Geometry Scene 1

STAR-CCM+

Output - MovingReferenceFrame_CentrifugalFan

```
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.3814MB in 0.1s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.395MB in 0.101s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.4158MB in 0.108s).
```



MRF Simulation Centrifugal Fan in StarCCM+

MovingReferenceFrame_CentrifugalFan - STAR-CCM+

File Edit Mesh Solution Tools Window Help

Simulation Scene/Plot

MovingReferenceFrame_CentrifugalFan

- Geometry
- Continua
- Regions
 - Rotating
 - Stationary
 - Boundaries
 - Axis
 - Physics Conditions
 - Reference Frame Specification
 - Shear Stress Specification
 - Tangential Velocity Specification
 - Wall Surface Specification
 - Physics Values
 - Blended Wall Function
 - Wall Relative Rotation
 - ExternalBody

Wall Relative Rotation - Properties

Properties

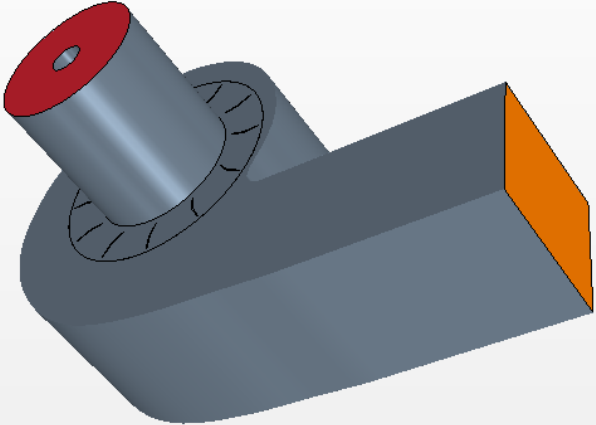
Method	Constant
Value	2000.0 rpm
Dimensions	Angular Velocity

Wall Relative Rotation

Wall relative rotation profile

Geometry Scene 1

STAR-CCM+

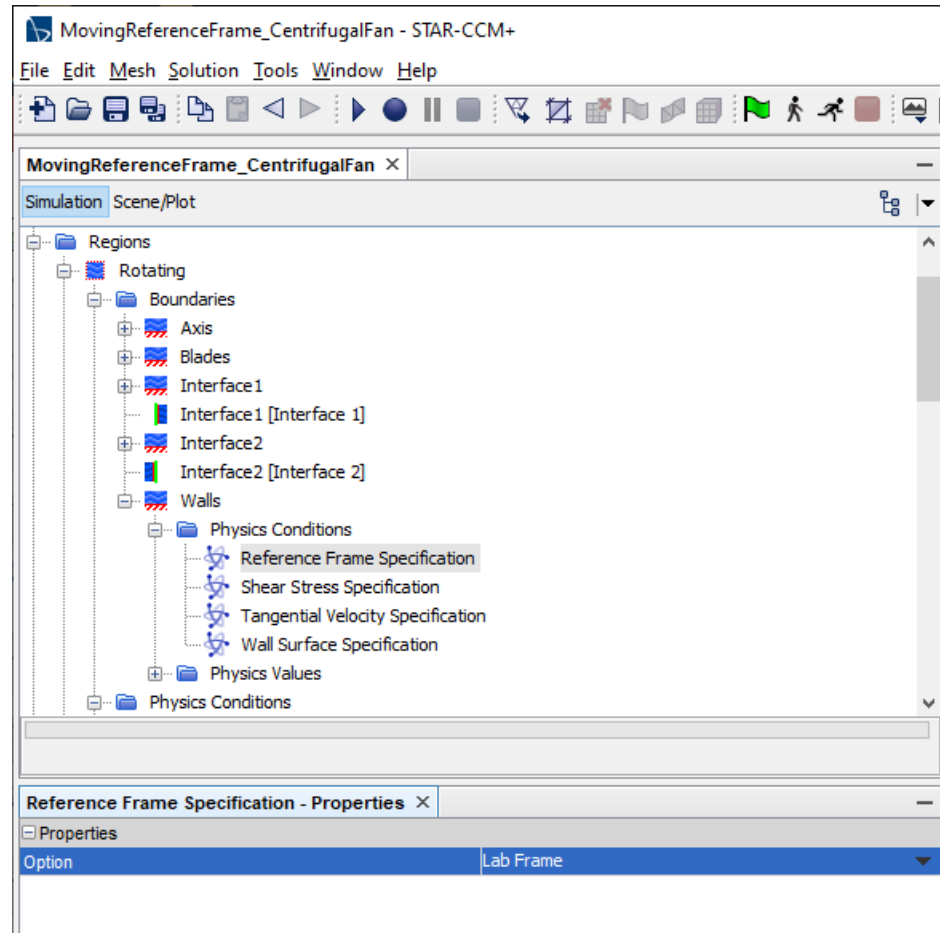
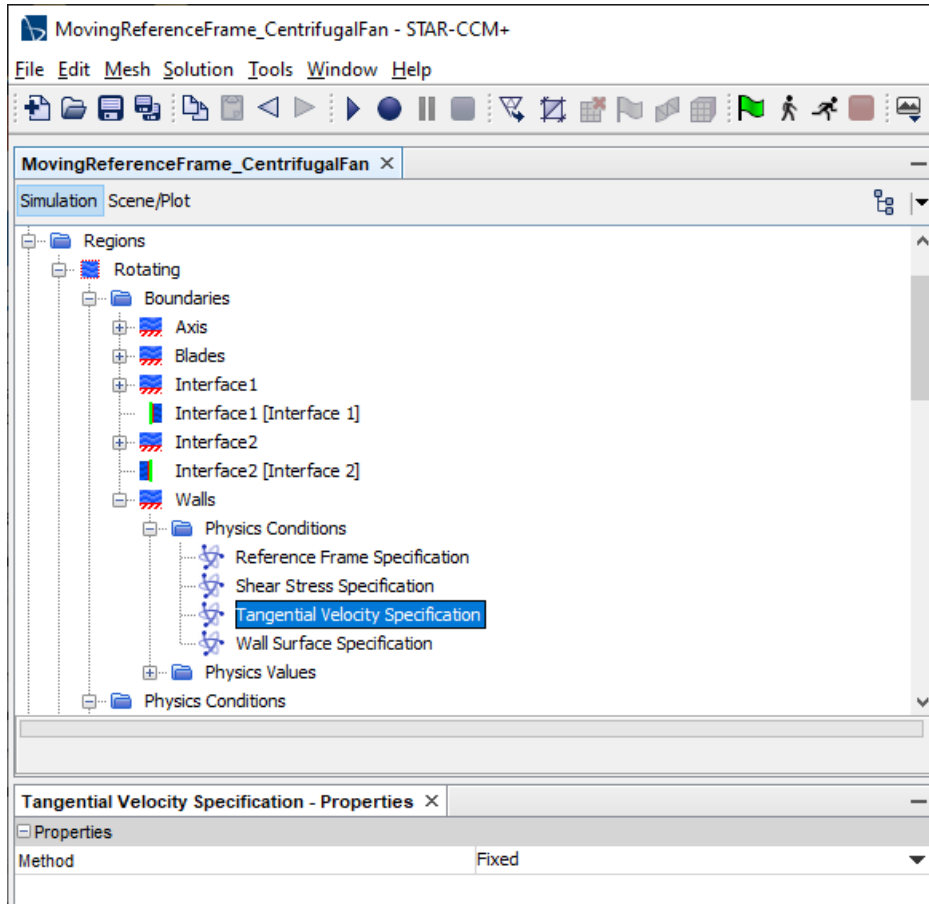


Output - MovingReferenceFrame_CentrifugalFan

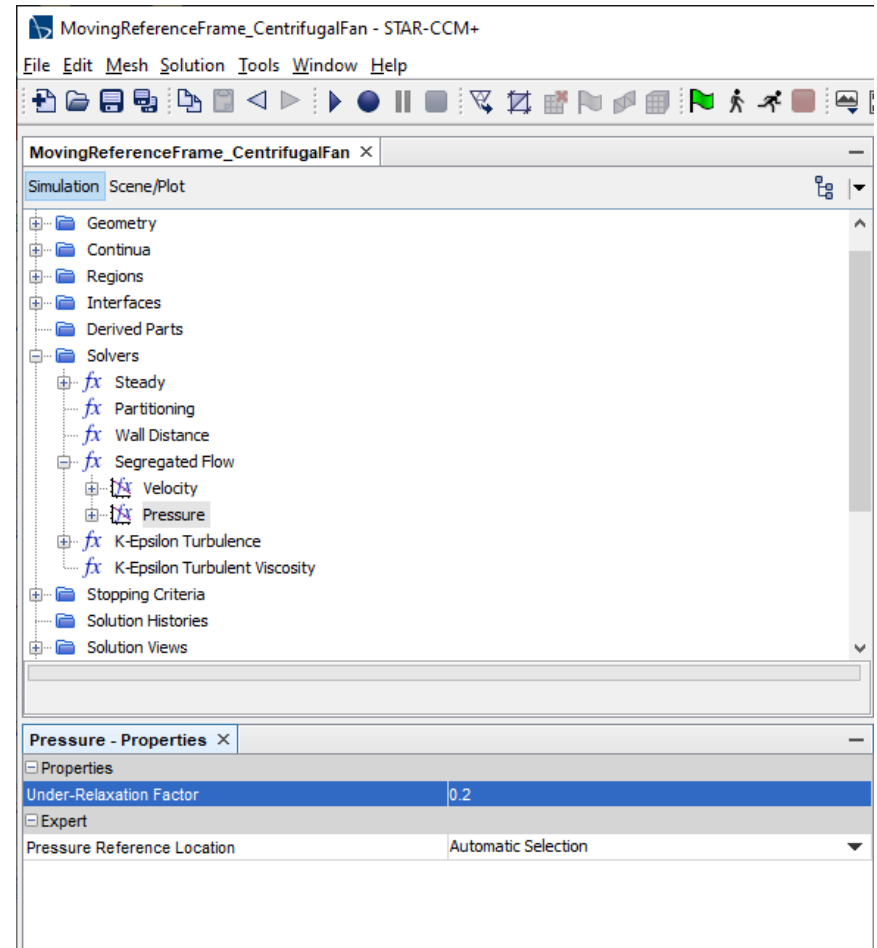
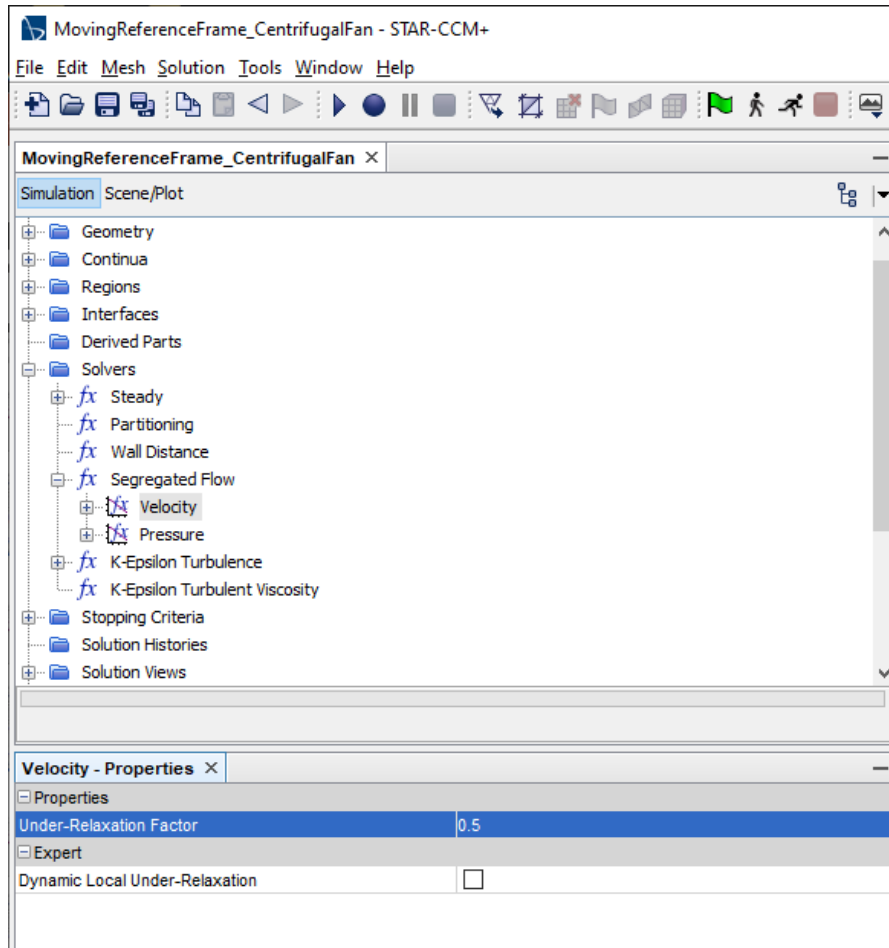
```
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.3914MB in 0.1s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.395MB in 0.101s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.4158MB in 0.108s).
```



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+

MovingReferenceFrame_CentrifugalFan - STAR-CCM+

File Edit Mesh Solution Tools Window Help

Simulation Scene/Plot

- Geometry
- Continua
- Regions
- Interfaces
- Derived Parts
- Solvers
- Stopping Criteria
 - Maximum Steps
 - Stop File
- Solution Histories
- Solution Views
- Reports
- Monitors
- Plots
- Scenes
 - Geometry Scene 1
- Summaries

Maximum Steps - Properties

Properties

Enabled	☒
Maximum Steps	600
Logical Rule	Or
Criterion Satisfied	☐
Tags	

Maximum Steps

Maximum number of steps. Range: [1 .. ∞)

Geometry Scene 1

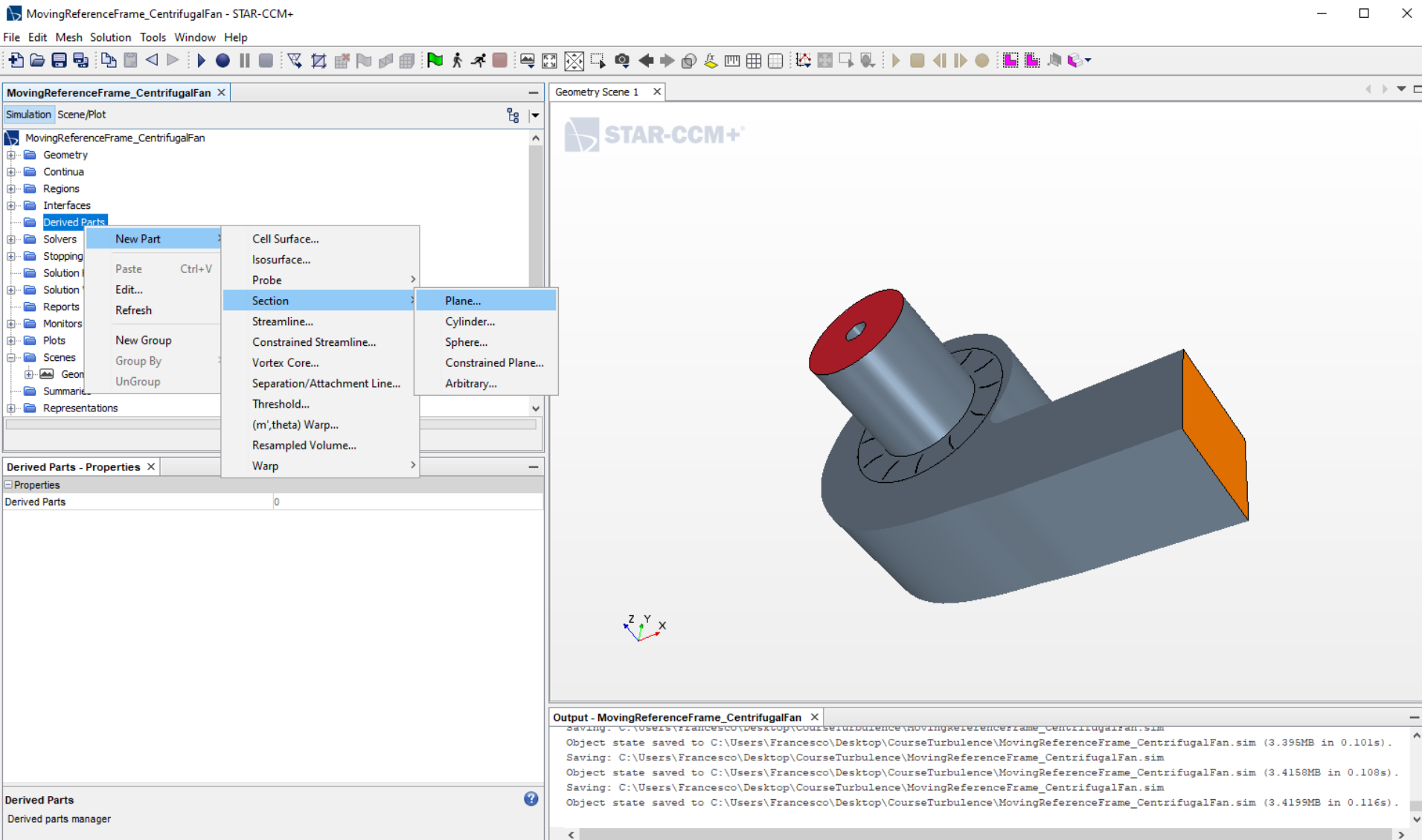
STAR-CCM+

Output - MovingReferenceFrame_CentrifugalFan

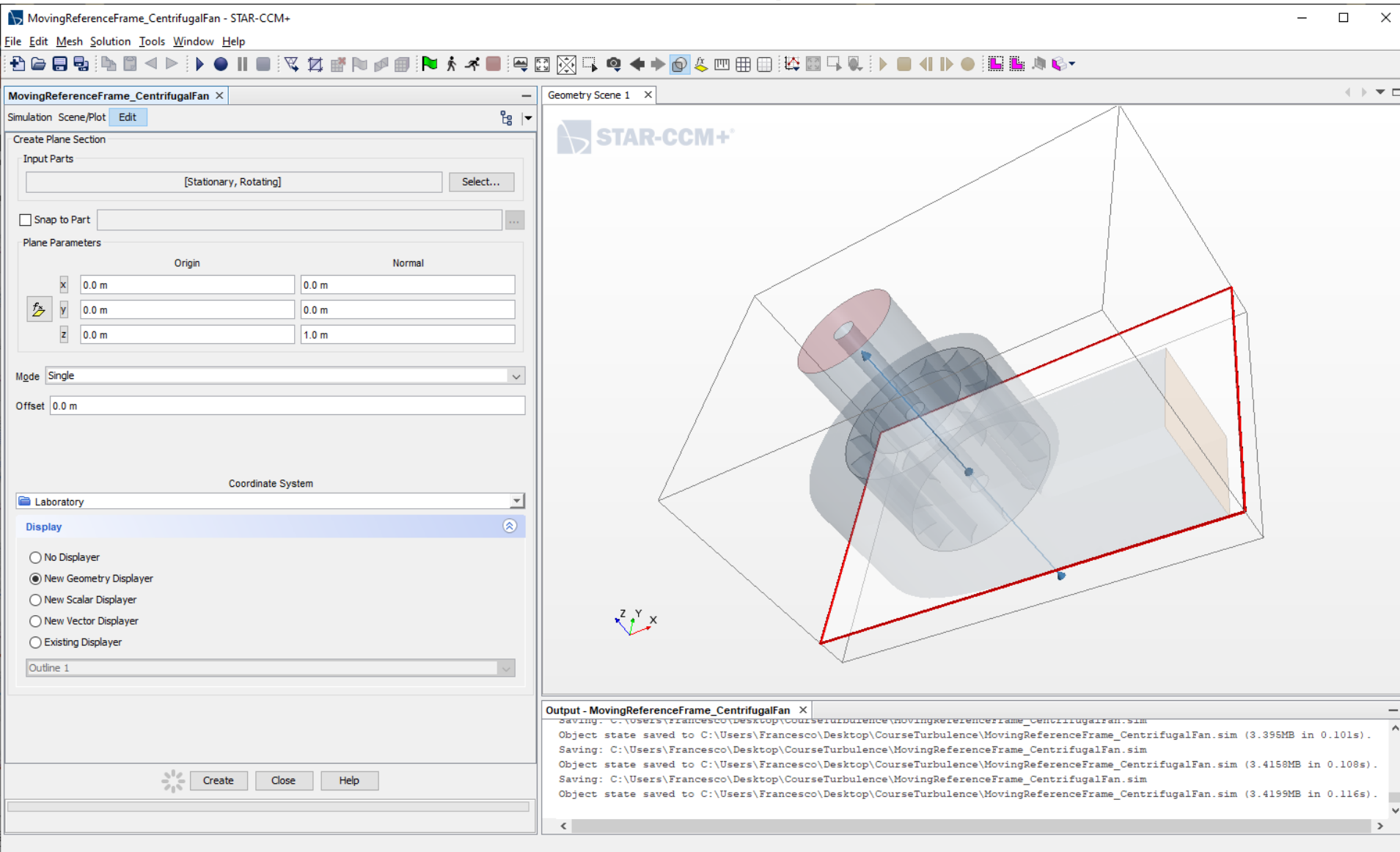
```
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.395MB in 0.101s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.4158MB in 0.108s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.4199MB in 0.116s).
```



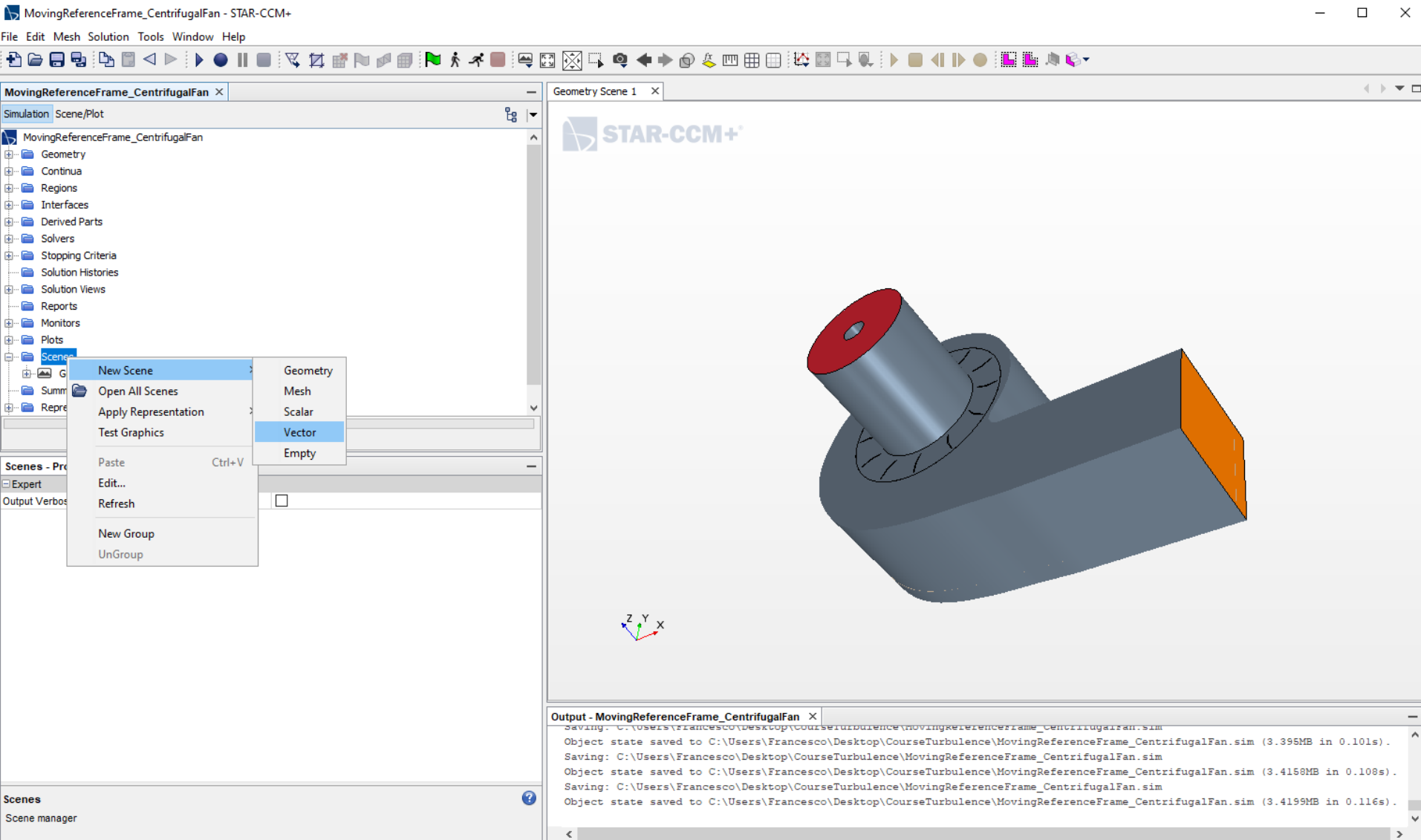
MRF Simulation Centrifugal Fan in StarCCM+



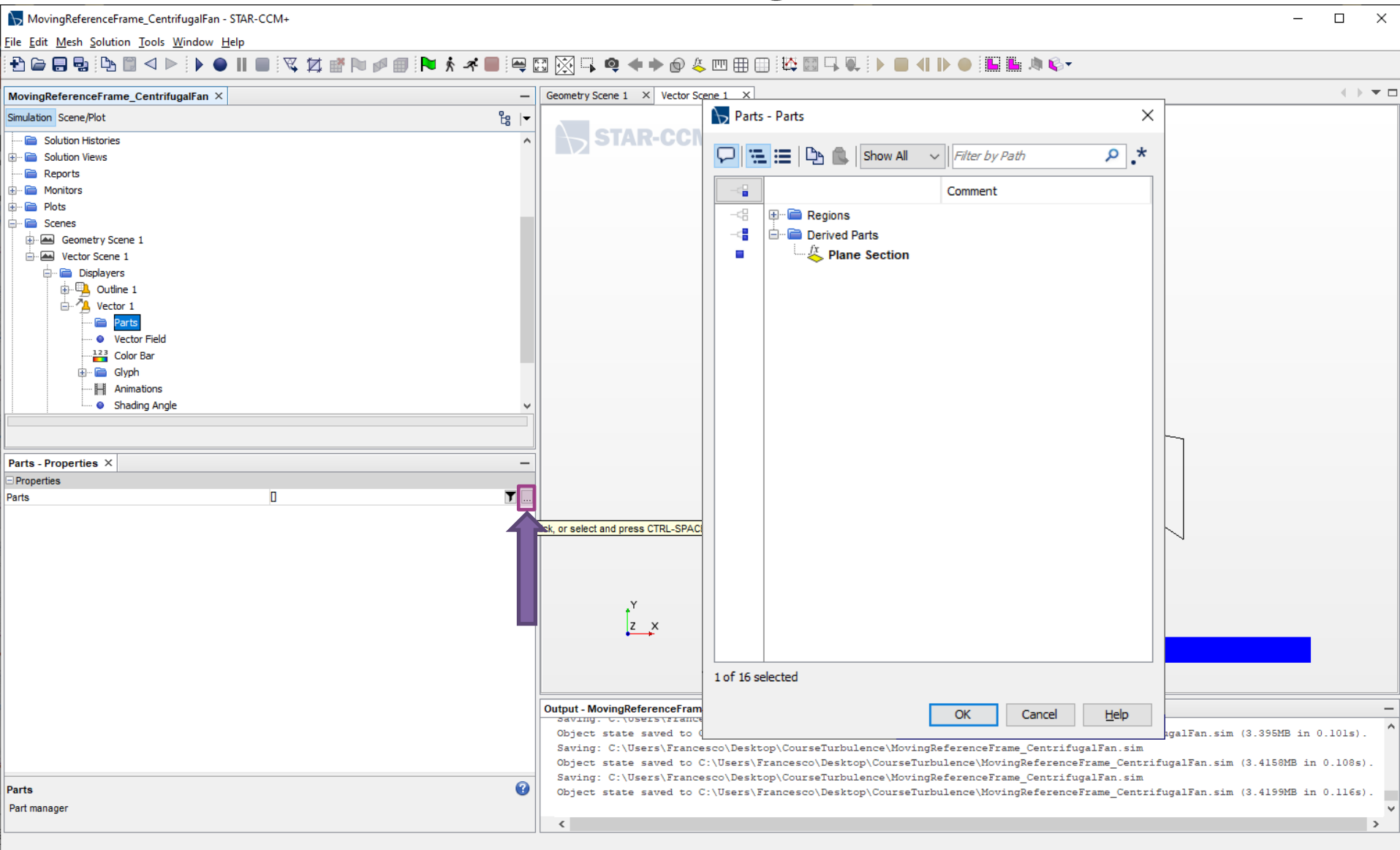
MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+

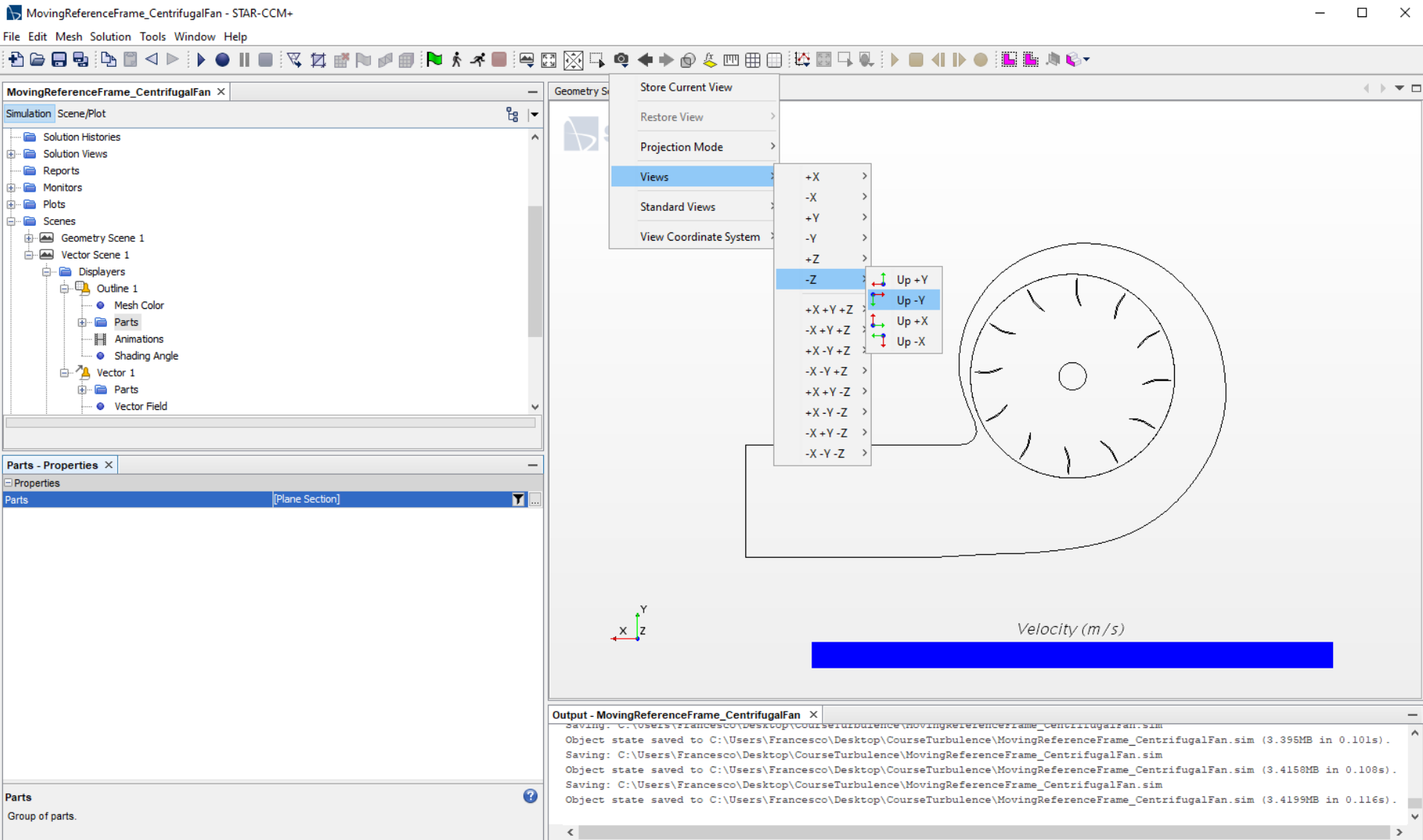


Repeat it with « Outline »

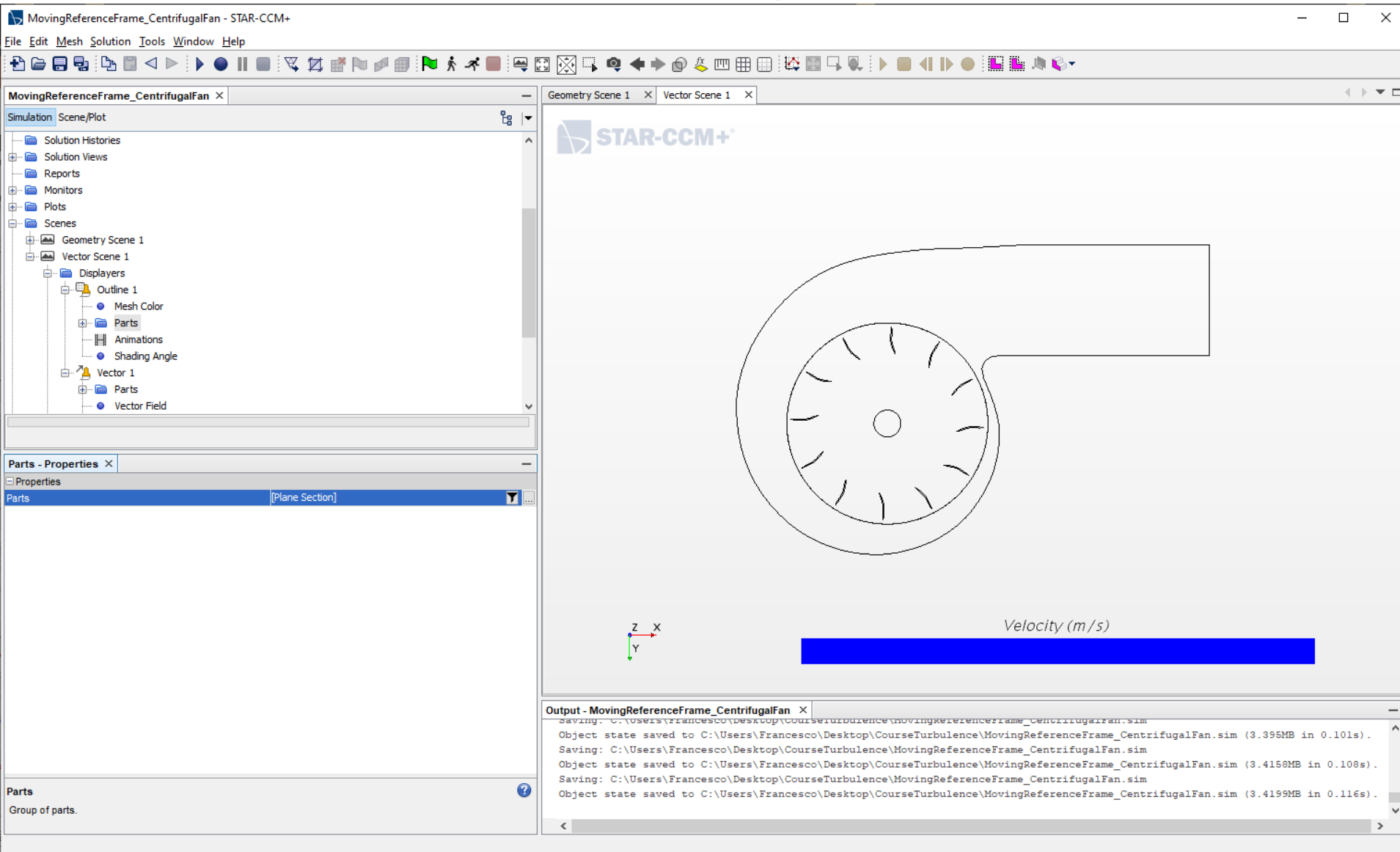
CFD applied to Turbomachinery



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+

MovingReferenceFrame_CentrifugalFan - STAR-CCM+

File Edit Mesh Solution Tools Window Help

Simulation Scene/Plot

Solution Histories
Solution Views

New Report
Run all reports
Apply Representation
Paste Ctrl+V
Edit...
Refresh
New Group
Group By
UnGroup

Parts
Vector Field

Reports - Properties

Properties
Reports

Element Count
Expression
Force
Force Coefficient
Frontal Area
Line Integral
Mass Averaged
Mass Flow
Mass Flow Averaged
Maximum
Maximum Memory Report
Minimum
Moment
Moment Coefficient
Monitor Integral Report
Overset Surface Integral
Overset Volume Integral
Physics Continuum Iteration
Pressure Correction
Pressure Drop
Solver Iteration CPU Time
Solver Iteration Elapsed Time
Statistics Report
Sum
Surface Average
Surface Integral
Surface Standard Deviation
Surface Uniformity
Thrust
Total Solver CPU Time
Total Solver Elapsed Time
Tumble/Swirl Ratio
Uniformity Deviation

Geometry Scene 1 Vector Scene 1

STAR-CCM+

Velocity (m/s)

Output - MovingReferenceFrame_CentrifugalFan

```
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.4168MB in 0.108s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.4199MB in 0.116s).
Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.4584MB in 0.111s).
```



MRF Simulation Centrifugal Fan in StarCCM+

The screenshot shows the StarCCM+ software interface for a Moving Reference Frame (MRF) simulation of a centrifugal fan. The main window displays the 'MovingReferenceFrame_CentrifugalFan - STAR-CCM+' title bar and a menu bar with File, Edit, Mesh, Solution, Tools, Window, and Help. The 'Surface Average 1 - Properties' panel is open, showing the 'Field Function' dropdown menu. A purple arrow points to the dropdown button. The 'Field Function' list includes various physical quantities, with 'Pressure' selected. The 'Output - MovingReferenceFrame' panel at the bottom shows simulation progress and file saving status.

Surface Average 1 - Properties

Property	Value
Units	
Field Function	<Select Function>
Parts	
Tags	
Expert	
Representation	Volume Mesh
Smooth Values	☐

Field Function

Field function report is based on

Surface Average 1 - Field Function

Field Functions

- ☐ Connected Cells
- ☐ Density
- ☐ Dynamic Viscosity
- ☐ Effective Viscosity
- ☐ Effective Volume
- ☐ Element Type
- ☐ Face Index
- ☐ Face Part Surface Index
- ☐ Face Type
- ☐ Face Validity
- ☒ Flow Direction
- ☐ Gauss/LSQ gradient blending factor
- ☐ Grid Flux
- ☐ Helicity
- ☐ Interface Parent Boundary Index
- ☐ Interface Parent Face Index
- ☐ Iteration
- ☐ Lamb Vector
- ☐ Lambda 2 criterion
- ☐ Least Squares Quality
- ☐ Mapped Facet Area Match
- ☐ Mapped Facet Count
- ☐ Mass Flow Rate
- ☐ Mass Flux
- ☐ Mass Imbalance
- ☐ Non-Conformal Interface Faces
- ☐ Normal
- ☐ Part Surface Contact Index
- ☐ Partition
- ☐ Periodic Index
- ☐ Position
- ☒ Pressure
- ☐ Pressure Coefficient
- ☐ Prism Layer Cells

1 of 130 selected

OK Cancel Help



MRF Simulation Centrifugal Fan in StarCCM+

The screenshot displays the StarCCM+ software interface for a MovingReferenceFrame_CentrifugalFan simulation. The main window shows the 'Geometry Scene 1' with a 3D model of the fan. The 'Surface Average 1 - Properties' dialog is open, showing the 'Field Function' dropdown menu. A purple arrow points to the 'Field Function' dropdown menu, which is currently set to '<Select Function>'. The 'Parts' list shows the 'Volume Mesh' part. The 'Output - MovingReferenceFrame_CentrifugalFan' window at the bottom shows the simulation progress, indicating '1 of 16 selected'.

Surface Average 1 - Properties

Property	Value
Units	
Field Function	<Select Function>
Parts	
Tags	
Expert	
Representation	Volume Mesh
Smooth Values	☐

Field Function

Field function report is based on

Output - MovingReferenceFrame_CentrifugalFan

1 of 16 selected

OK Cancel Help



MRF Simulation Centrifugal Fan in StarCCM+

MovingReferenceFrame_CentrifugalFan - STAR-CCM+

File Edit Mesh Solution Tools Window Help

Geometry Scene 1 Vector Scene 1

STAR-CCM+

Surface Average 1

- Run Report
- Highlight
- Edit...
- Set New Tag...
- Create Monitor and Plot from Report
- Create Monitor from Report
- Create Annotation from Report
- Copy Ctrl+C
- Paste Ctrl+V
- Delete Supprimer
- Rename...
- Error Log

Surface Average 1 - Properties

Units	Pa
Field Function	Pressure
Parts	[Stationary: Inlet]
Tags	
Expert	
Representation	Volume Mesh
Smooth Values	☐

Surface Average 1

Surface average report

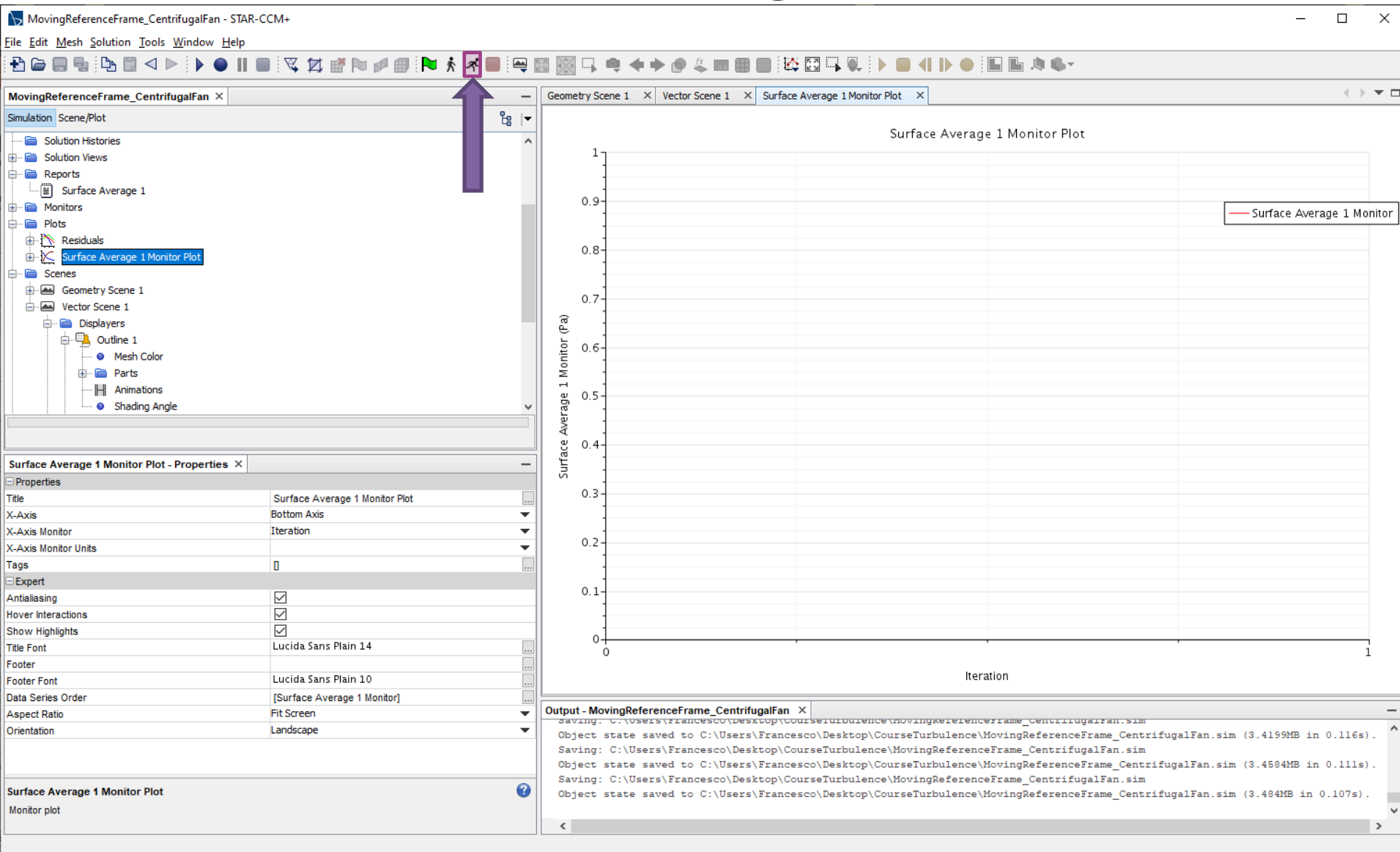
Velocity (m/s)

Output - MovingReferenceFrame_CentrifugalFan

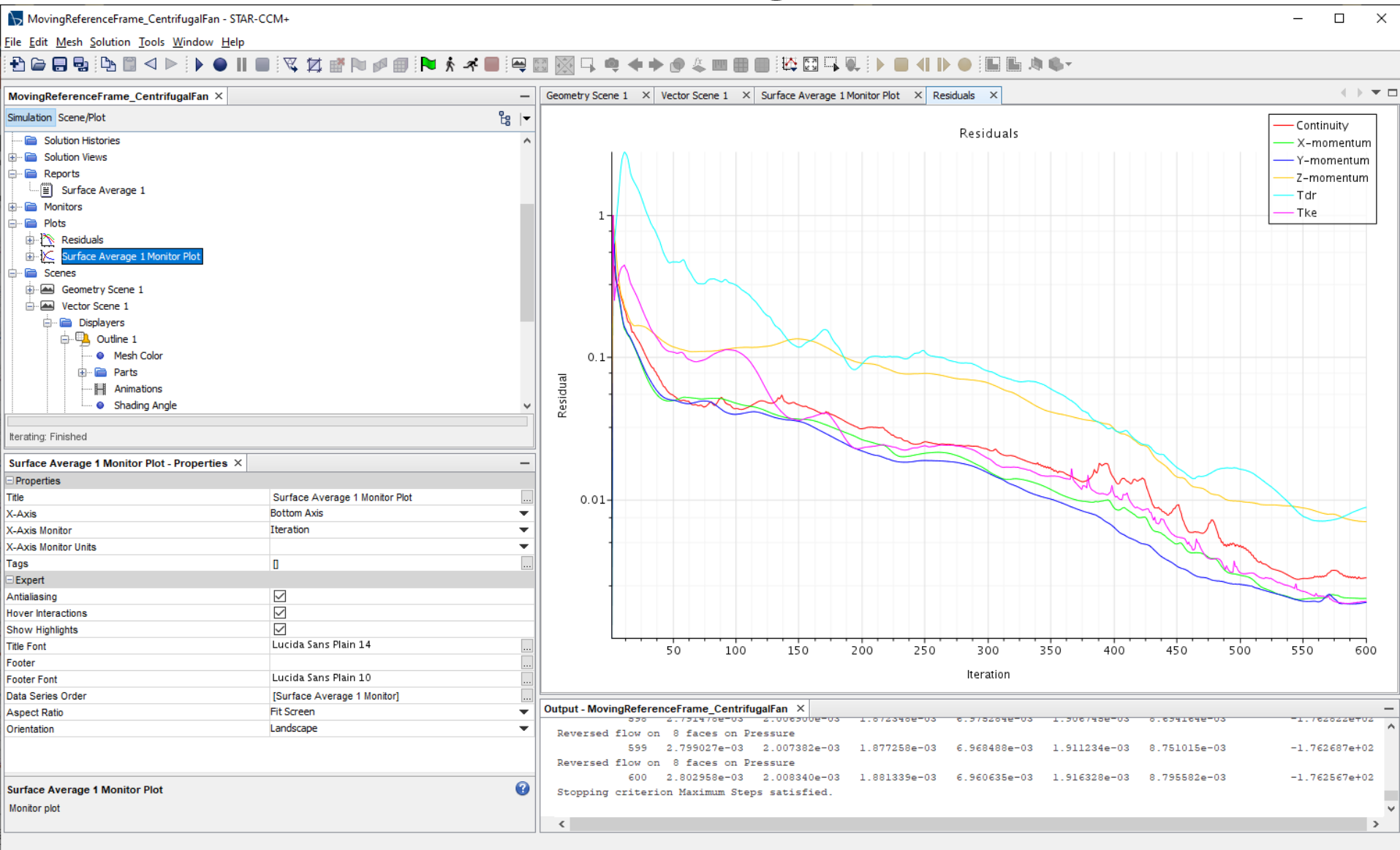
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Saving: C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim
Object state saved to C:\Users\Francesco\Desktop\CourseTurbulence\MovingReferenceFrame_CentrifugalFan.sim (3.4158MB in 0.108s).
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```



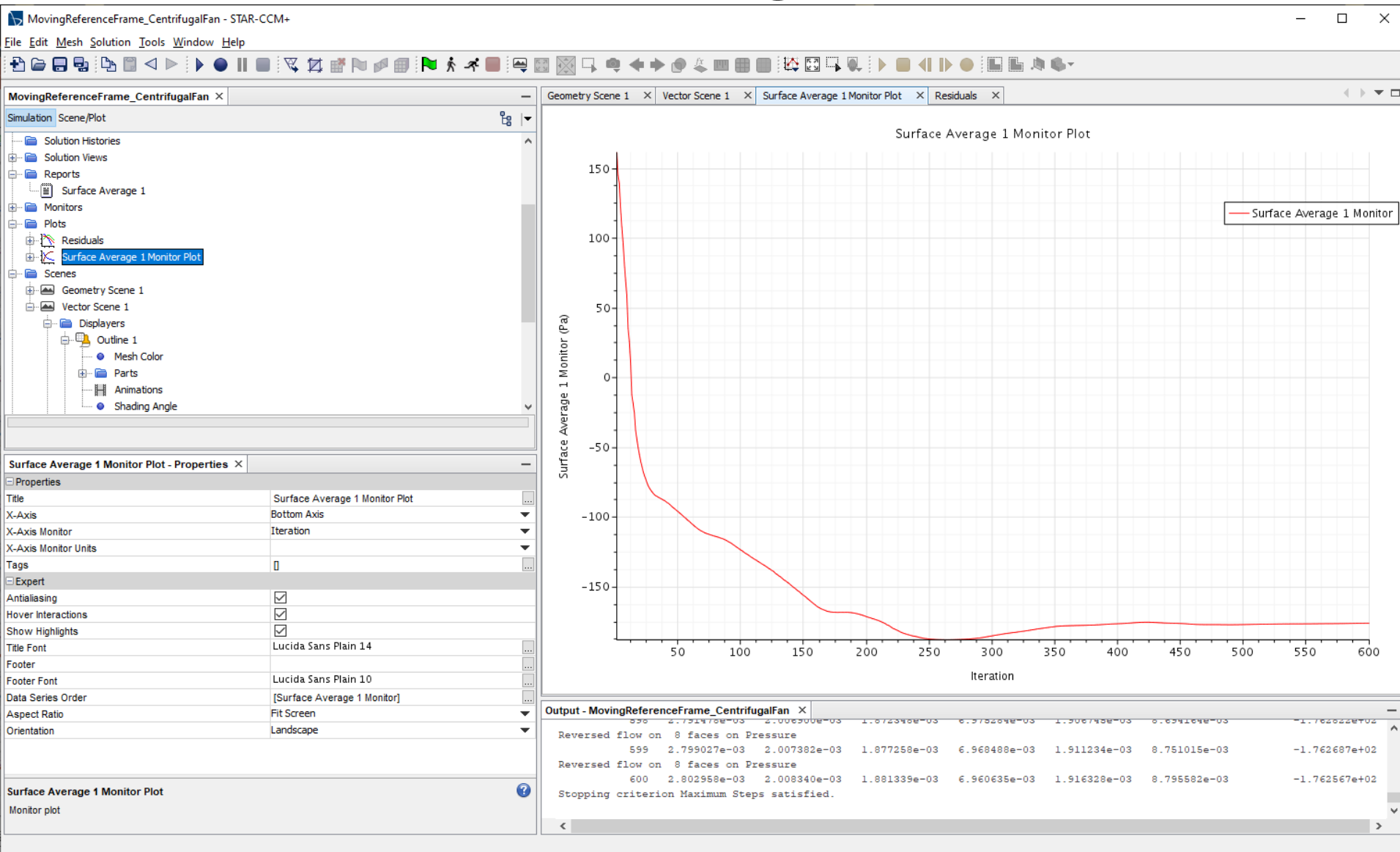
MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+



MRF Simulation Centrifugal Fan in StarCCM+

