

SCORGTM Setup for CFD Simulation of Twin Screw Machines with ANSYS CFX[®]

SCORG[™] is the CFD grid generation tool for rotary twin screw machines. The tool includes additional modules for designing and editing rotor profiles, executing a basic thermodynamic calculation based on quasi 1D chamber models and generating the deforming working chamber grids for selected commercial CFD solvers.

For more information on the product please visit the website: <u>www.pdmanalysis.co.uk</u> or refer to documentation help.

This guide lists the steps for setting up a CFD simulation for Twin Screw Compressor with SCORG[™] and ANSYS CFX Solver. The user is expected to be familiar with screw machines, CFD and ANSYS CFX[®] in order to be able to use these procedures. It is highly recommended that books on that topic are studied¹²

The setup steps here are demonstrated for Linux & Windows 7, x64 bit OS. Refer SCORG[™] Installation Guide for system and hardware requirements.

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² A. Kovacevic. N. Stosic, I.K. Smith, Screw Compressor Three Dimensional Computational Fluid Dynamics and Fluid Solid Interaction, Springer, 2006, ISBN 3-540-36302-5



¹ N. Stosic, I.K. Smith, A. Kovacevic Screw Compressor Mathematical Modelling and Performance Calculation, Springer, UK 2005, ISBN-10 3-540-24275-9



1 Introduction

Screw Compressors are rotary positive displacement machines. Although the working principle of these machines is simple, the geometry of rotors which are in the form of multi -lobe helical screws meshing with each other, is making analysis by use of Computational Fluid Dynamics (CFD) challenging. The process starts when the lobes are engaged at one end, which creates continuous increase of the volume between the rotors and the casing which reduces pressure in the suction domain and draws the working fluid in. Further rotation of the rotors makes this volume between the rotors and the casing enclosed when the compression of fluid begins. This increases the pressure within the chamber. Further rotation exposes the pressurized fluid to the outlet port and the fluid is delivered (Stosic, et al., 2005). Similar process is occurring in other helical screw machines such as pumps, vacuum pumps, gear pumps, expanders, extruders and motors. The CFD is equally challenging in such machines due to sliding and stretching

The main objectives of CFD simulations of a screw compressor are to:

- a. Obtain the pressure field inside the rotor chamber and in the suction and discharge domains. Example shown in *Figure 1-1*.
- b. Obtain the velocity fields in critical regions of the computational domain.
- c. Obtain temperature fields in critical regions of the computational domain.
- d. Obtain integral parameters of the machine such as power, mass flow rate, discharge temperature, torques on the rotor shafts, etc.
- e. Obtain the loads and temperatures on boundaries with solid parts of the machine for further structural and thermal analysis.



Figure 1-1 Pressure Variation diagram of a Twin Screw Compressor (Kovacevic, et al., 2007)





This Tutorial will provide a step by step guide for the procedure to setup and execute a typical twin screw compressor, pump or motor simulation. An example of a dry air compressor with 3/5 lobe combination, L/D ratio of 1.7 and wrap angle 285 deg has been considered.

2 SCORG[™] Project

- ► Launch SCORGTM on the Desktop.
- ▶ Select File \rightarrow New



► Select N35_Template.spt \rightarrow Open

👯 Open									
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Organize 🔻 New folder									
☆ Favorites	-	Name	Date modified						
🧮 Desktop		A46_Template.spt	27/08/2014 11:46						
〕 Downloads		Circ46_Template.spt	27/08/2014 11:46						
🖳 Recent Places		🔊 Inv22_Template.spt	27/08/2014 11:46						
퉬 SkyDrive		Inv33_Template.spt	27/08/2014 11:46						
	Ξ	🔊 N35_Template.spt	27/08/2014 11:46						
🥃 Libraries	nts		N45_Template.spt	27/08/2014 11:46					
Documents			N46_Template.spt	27/08/2014 11:46	No preview available.				
J Music						N56_Template.spt	27/08/2014 11:46		
Pictures									
Subversion		N67_Template.spt	27/08/2014 11:46						
🛃 Videos									
🖳 Computer									
🚢 Local Disk (C:)									
👝 D (D:)	Ŧ	•	4						
F	ile n	ame: N35_Template.spt		✓ Scorg template (spt) (*.spt)					
				Open Cancel					





► Save the project in a new folder named TwinScrewCFXSetup → SCORG_Grid_Tutorial.spf

Save As	omputer 🕨 D (D:) 🕨 TwinScrewCFXSetup	o	nScrewCFXSetup
 Recent Places SkyDrive Libraries Documents Music Pictures Subversion Videos 	Name	Date modified No items match your search.	Vype :
File name: Save as type: Hide Folders	SCORG_Grid_Tutorial Scorg Project file (spf) (*.spf)	III Save	Cancel

► The GUI of SCORGTM in the figure bellow shows the mains items of the front panel.







In Units Tab, Select Length units as 'm'. This selection has to be the same as the units in which input profile coordinates are available.

😫 C:\U - [SCORG V5.4.]							
File Edit Run	View Units Help						
🗋 💕 🛃 🔷 🧇	0 🍣 🗙 💼 💿 🖗						
Inputs Units Prop	perties						
Variable	Units 🔦						
Pressure	Pa 💌 😑						
Temperature	°C 🔻						
Length	m 👻						
Density	kg/m³ 💌						
SpecificHeat	J/(kg.K)						
	· · ·						

► Go to Help \rightarrow Tutorials \rightarrow Folder opens



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$\leftrightarrow \rightarrow \checkmark \uparrow$ \rightarrow This PC \rightarrow Work (D	ල Searc	h Tw ,0		
Name	Date modified	Туре	Size	
35FemaleProfile_P2.dat	03/03/2021 11:05	DAT File	18 KB	
35MaleProfile_P1.dat	03/03/2021 11:06	DAT File	23 KB	
GRG_CFX_Tutorial_Ports_V5.4.cfx	03/03/2021 11:07	ANSYS 2020 R2 .cf	18,696 KB	
SCORG_CFX_Tutorial_V5.9.ccl	03/03/2021 11:06	CCL File	43 KB	
4 items 4 items selected 18.3 MB				

- Copy the compressor rotor profile files → [35MaleProfile_P1.dat and 35FemaleProfile_P2.dat]
- ► Copy the compressor suction and discharge port grids → [SCORG_CFX_Tutorial_Ports_V5.4.cfx]





- ▶ Copy the CFX setup script \rightarrow [*SCORG_CFX_Tutorial_V5.9.ccl*]
- ▶ Paste these files in the working directory \rightarrow TwinScrewCFXSetup
- ►
- Go to User Profile \rightarrow Browse and Select the Male Rotor Profile from working directory.

User Profile				}	
- Imported Profiles - Import Male	Import Female	Reset To Imported	[← 1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1	-64	0
Default Profiles					
Write To D	efault	Reset To Default	100000		
Profile Transformation	tions		4		
Apply to both	Male	Female			
Rotate (Deg)	0.00	÷ 0.00			
Scale	1.000	1.000			
Flip Coordinates					
Mirror About X					
Mirror About Y					
ACCE	PT Transform	nations			

35MaleProfile_P1.dat

Click 'Yes' to overwrite P1.dat.



Similarly Select the Female Rotor Profile.

35FemaleProfile_P2.dat

Click Write To Default.





User Profile		
- Imported Profiles -		
Import Male	Reset To Imported	
Default Profiles		_
Write To D)efault	Reset To Default
Profile Transforma	tions	
Apply to both	Male	Female
Rotate (Deg)	0.00	0.00 ≑
Scale	1.000	1.000
Flip Coordinates		
Mirror About X		
Mirror About Y		
ACCE	PT Transfo	mations

Click Refresh to view new profiles.







Inspect the Rotor Profile in the GUI for gaps in the tips, starting points of the profile indicated by the small yellow circles. Below is the required orientation.



Set Project Units to SI



Set the following Profile Parameters to get desired clearance size:

GAPI = 0.06mm

GAPR = 0.06mm

GAPA = 0.05mm

*Setting GAPI = 0.06 sets the minimum interlobe clearance as the GAPI.





▶ Go to Geometry \rightarrow Set the following parameters:

			Rotor Configuration			
				Relative Length	1.7	
				Rotor Length	216.45	mm
				Wrap Angle	285	Deg
				Pitch Low Pressure Port	0	mm
				Pitch High Pressure Port	0	mm
▲ Profile	_			Rotor Pitch	Uniform 🔻	
Profile Setup	b			Rotor Profile	Constant 💌	
: ⊳ · Geometry				Main Rotor Centre X	0	mm
▷ Thermodynamics	S			Main Rotor Centre Y	0	mm
p · cinas				Main Rotor Centre Z	0	mm
				Main Rotor Start Angle	0	Deg
Profile Setup]	1	Rotor Stage Number	0	
Avis Distance	93	mm		Main Rotor Helix	Right 💌	
Z1	3			Gate Rotor Position	Right -	
Z2	5					
GAPI	0.06	mm		Machine Configurat	ion	
GAPR	0.06	mm		Machine Type	Compressor	-
GAPA	0.05	mm		N Gate	1	
Clearance Distribution	Clearences			Compression Start	0	D
User Profile				Compression End	161.001	D.,

• Go to Thermodynamics \rightarrow Set the following parameters:

Wtip	66,6665	m/s	
Rotor Speed	10000	RPM	
PO	100000	Pa	
Pr	300000	Pa K	
то	293		
Tr	350	К	
Tevp	268	К	
Tcond	313	К	
T Ambient	293	К	
Ts	0	К	
х	1		

Save the Project.





3 SCORG[™] Mesh Generation

SCORG[™] is stand-alone numerical CAD-CFD interface used to generate a numerical mesh of rotating parts of a screw machine and to transfer it to a general finite volume numerical solver. The program generates a block structured hexahedral numerical grid for rotor flow domains, solid rotor domains, inlet and outlet ports.

Inputs Required

In this step the rotor domain mesh is generated in SCORGTM. The inputs required for this mesh generation are: (Kovacevic, et al., 2007).

Control Parameters:

- Type of the machine.
- Number of mesh divisions along the lobe in circumferential direction.
- Number of mesh divisions in radial direction.
- Number of Angular divisions of the rotation.

Control Switches:

These Inputs are used to specify the method used for Rotor Profile Input and the required mesh calculation options.

- Click Grid Module in the project tree
- ▶ In Mesh Type Size set:
 - \circ Circumferential Main = 0
 - \circ Circumferential Gate = 60
 - \circ Radial = 8
 - \circ Angular = 50
 - \circ Interlobe Divisions = 50

Rotor Mesh Size						
Circumferential Divisions Main Rotor	0					
Circumferential Divisions Gate Rotor	60					
Radial Divisions	8					
Angular Divisions	50					
Axial Divisions	0					
Interlobe Divisions	50					

Distribution Parameters:

These inputs are used for adaptation and distribution of the grid points on the boundaries of the domain and for smoothing of rack (Rack is the curve representing a rotor with infinite radius which uniquely separates the flow domains of the male and female rotors).

• Type of Distribution \rightarrow Casing to Rotor Conformal

sing to Rotor Conformal 🗸 🗸
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Meshing Parameters:

Meshing parameters provide control over the distribution of the internal mesh points in each cross section of the rotors.

Meshing Parameters	
Mesh Orthogonality and Sm	
Relaxation Factor (0 - 1)	1
Tolerance Factor (1 - 100)	100
Inflation Layer Control	
Radial Bias Factor (0 - 1)	0.5
Radial Bias Intensity (1 - 10)	1

• both the distribution and meshing parameters can be changed later

▶ Start Grid Generation through a three step process as below.

Select Rack Refinement Points = 400

Control Switches		
Rack Generation	Off	~
Rack Refinement Points	400	
Boundary Generation	Off	~
Fluid Rotor Grid	Off	~
Solid Rotor Grid	Off	~
Inlet Port Grid	Off	~
Outlet Port Grid	Off	~
Preprocessor Input File	Off	~
Vertex Files Start Number	1	
Vertex Files End Number	50	

Click Numerical Rack Generation

File	Edit	Run	View	Units	Help													
	j 🛃	<u> </u>	0	2 ×	ê 🕥	%	6	03	П	Ø	0	÷	5109	1	G	T	\diamond	4
· ·	γ_{-}							(11	- D4		2						

This operation produces the rack curve between the two profiles. It is required to be executed only once in the grid generation process.





 \times

Default profiles!





Information about the progress of the selected activities in the meshing procedure is displayed in the output window. Any warning or error and their locations are indicated. If errors occur, it is important to manually tune the input parameters which will produce a mesh without errors. Graphically the mesh distribution in each section can be visualized and checked for any deviation from requirements. The detailed description of methods used for distribution, adaptation and generation of numerical mesh is available through the Help in the drop down menu.





▶ Inspect report and check that there are no distribution warnings listed

C:\SCORG\Grid>echo off

. InstallPath = C:\SCORG ProjectPath = D:\TwinScrewCFXSetup\SCORG_Grid_Tutorial SCORG - Screw COmpressor Rotor Geometry grid generator V.5.9 Screw compressor/p wrap = 283.2 RPM=12344. Vel= 82.3 Ncel= 566400 Z1/Z2= 3/5 d1=127.38 [mm] d2=120.32 [mm] a= 93.00 [mm] len=216.45 [mm] Nfi Nr Nz Nadd Rot Rack Boun Mesh RotM InpP OutP Prep RaSm Line Oil 60 8 118 50 3 1 1 0 0 0 0 0 1 1 0 1: 0.00 Dist 0.00 Cos Calculation: ROTOR 2: 0.00 Ang. 0.00 Sin Calculation: RACK Calculation: BOUNDARY Smoothing factor: 0.80 Male = 300 Smooth: ON Female = 300Initial Smoothing Distribution:Casing to Rotor Conformal TFI_Mesh routine - Rotor TFI_Mesh routine - Rotor Initial Smoothing GRID RelaxFac, TolFac, RadBFac, RadBInt, InterlobeBInt 1.0 100 0.5 1.0 PDF Interlobe mesh routine Distribution Type: Casing to Rotor Conformal . Distribution: Casing to Rotor Conformal Overall number of cells Cell statistics 0 .Inlet port .Outlet port 0 0 .Rotor fluid .Rotor solid 0 0 Start: 11:23:18 End: 11:24: 2 Running time: Oh: Om:43s = 42 sec 3/ 3/2021... SCORG - Screw COmpressor Rotor Geometry grid generator - Ver. 5.9

Click Distribution Mesh to visually inspect the distribution in each cross section

 Image: Selections
 Properties

 Image: Selections
 Image: Selections

 Image: Selections
 Image: Selections







▶ In the Distribution Display \rightarrow Select Quality Criteria = Error Cell

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User Profile x Rotor Grid ×	2
Distribution: Mesh: Quality Orteis: 1 1 0 0 0 0 0 0	E
Main E Gate E	rrors: 0 rrors: 0
Inspect all the distribution positions and ensure that 0 error are reported position.	in each
 Click Rotor Grid Generation 	
File Edit Run View Units Help	
i 🗅 📽 🖬 🗢 🤏 @ 🌫 🗙 💼 💿 🌩 👗 🕘 👯 🎞 🞯 🔿 😤 🚭 🔭 💷 💷 🤅) M (
Insuite Descention Units	

▶ Inspect report and check that there are no grid errors listed







C:\SCORG\Grid>echo off

```
. . . . .
                                                            InstallPath = C:\SCORG
ProjectPath = D:\TwinScrewCFXSetup\SCORG_Grid_Tutorial
SCORG - Screw COmpressor Rotor Geometry grid generator V.5.9
Screw compressor/p Wrap = 283.2 RPM=12344. Vel= 82.3 Ncel= 566400
Z1/Z2= 3/5 d1=127.38 [mm] d2=120.32 [mm] a= 93.00 [mm] len=216.45 [mm]
                               .....
Nfi Nr I
              . . . . . . . . . . . . . . . . .
 NFi Nr Nz Nadd Rot Rack Boun Mesh RotM InpP OutP Prep RaSm Line Oil
60 8 118 50 0 0 0 1 0 0 0 0 1 1 0
                                                                                0
         . . . . . . . .
                        . . . . . . . . . . . . . . . .
                                           . . . . . . . . .
Calculation: FLUID GRID RelaxFac, TolFac, RadBFac, RadBInt, InterlobeBInt
                                 1.0
                                         100
                                                0.5
                                                            1.0
 TFI_Mesh routine - Rotor
TFI_Mesh routine - Rotor
                                        1
                                         2
 PDE_mesh routine - Rotor
PDE_mesh routine - Rotor
                                         1
                                         2
 PDE_Interlobe_mesh2 routine: Smooth Interlobe
            . . . . . . . .
                                                            Check_Grid - Rotor:
Check_Grid - Rotor:
                                   1
                                   2
 Write 2D Grid Data
 Grid Data Count:
Male rotor domain, Vertices: 321300, Cells
Female rotor domain, Vertices: 321300, Cells
                                                     283200
                                                     283200
Written Control.dat
                         Overall number of cells
Cell statistics
                                                              0
                       0
                           .Inlet port
.Rotor fluid
                                                              0
.Rotor solid
                      0
                                                              0
                                      .Outlet port
Start: 11:29:31 End: 11:29:42 Running time: Oh: Om:10s = 2 sec
3/ 3/2021...
SCORG - Screw COmpressor Rotor Geometry grid generator - Ver. 5.9
. . . . . . . .
```

Click Rotor Grid 2D Mesh to visually inspect the grid in each cross section



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▶ Click Quality Critera \rightarrow Error Cell and Inspect.

● st 口 @ ○ 才 ● パ ト エ 参 ○ N 多								
User Profile 🗙	Rotor Grid 🗴)						
Distribution:	Mesh: 1	•	Quality Criteria:	Show Lines	Quality Report			
								Main Errors: 0 Gate Errors: 0

▶ Click Quality Critera \rightarrow Orthogonality and Inspect.



▶ Inspect the 3D mesh







- ▶ In Control Switches \rightarrow Preprocessor Input File select \rightarrow ANSYS CFX
- Set Vertex Files Start = 1
- Set Vertex Files End = 50 [= Number of Angular Divisions]

Rack Generation	Off	~
Rack Refinement Points	400	
Boundary Generation	Off	~
Fluid Rotor Grid	On	~
Solid Rotor Grid	Off	~
Inlet Port Grid	Off	~
Outlet Port Grid	Off	~
Preprocessor Input File	ANSYS CFX	~
Vertex Files Start Number	1	
Vertex Files End Number	50	

Calculate Preprocessor Files Generation





File Edit Run View Units Help
D 📽 🖬 🔷 🔦 🛛 😂 🗙 💼 👀 🛛 🏕 🔥 🚭 👯 🛄 🐼 🥃 🐨 🔭 💷 🗮 险 🕅
C:\SCORG\Gr1a>ecno ott
InstallPath = C:\SCORG ProjectPath = D:\TwinScrewCFXSetup\SCORG_Grid_Tutorial
All control parameters for grid generation are disabled
Conformal
Generation of Port Pre Processor files Low Pressure Port not calculated Pre-Processing Skipped High Pressure Port not calculated Pre-Processing Skipped
Generation of Rotor Pre Processor files Checking volumes in Male Min/Max Volume= 1.0739071E-11 1.4677777E-08 Checking volumes in Female Min/Max Volume= 8.2917484E-12 1.8342320E-08
CFX SETUP Grids written
Generation of time step grid files Start time step: 1 End time step: 50
Rotor 1, Grid position 1 Rotor 1, Grid position 2 Rotor 1, Grid position 3

- ▶ With this the SCORGTM Project is complete and the CFX setup can be started.
- ► In the directory structure of SCORGTM Project → Grid → Output with consist of CFX and grids folder.
- ▶ Copy these two folders in the project working directory \rightarrow TwinScrewCFXSetup
- ► The CFX folder consists of two sub folders
 - CFXPreSetup
 - o JunctionBox







JunctionBox folder consists of the Fortran codes that need to be compiled to generate an external library that will be linked to the CFX solver during executions in order to be able to read the set of grids generated by SCORGTM

🚱 🔍 🛡 길 « D (D:) 🕨 TwinScrewCf	XSetu	ıp → CFX → JunctionBox	 ✓ 4y Search Jun
Organize 🔻 Include in library 🔻	Sha	re with 🔻 🛛 Burn 🔹 New folder	i= • 🔟 🔞
☆ Favorites	-	Name	Date modified
🤜 Desktop		Compile.txt	07/10/2011 17:56
😺 Downloads	Ξ	🖹 mycal_easymap.F	22/08/2014 19:26 F
🖳 Recent Places		🖹 mycal_meshmap.F	22/08/2014 19:26 F
SkyDrive		set_mesh_user.F	22/08/2014 19:26 F
		upd_crdvx_user.F	22/08/2014 19:26 F
🥽 Libraries		update_crdvx_user.F	22/08/2014 19:26 F
Documents		update_mesh_user.F	22/08/2014 19:26 F
🌙 Music		🖹 userpart.F	22/08/2014 19:26 F
Pictures			
Subversion	Ŧ	•	
8 items			

4 Compiler Environment setup [One time procedure]

Intel Fortran Compiler is required in the initial stages of the case setup. It is not required to repeat this step for every CFX case setup.

For Windows OS,

• Install Microsoft Visual Studio 2008 or any later version.





• Install Intel Parallel Studio XE 2011 for the Fortran compiler.

Below are some links that provide these installers (Evaluation Editions), but if you have other Fortran compiler then it can be used.

http://www.microsoft.com/en-gb/download/details.aspx?id=40787

https://software.intel.com/en-us/intel-parallel-studio-xe/

You can then access the Intel Fortran compiler command prompt as shown below. Try to run **ifort** command to check if it is recognized and properly works.



For Linux, check if either of F77, F90, G77, G90 or a Portland compiler is installed.

4.1 Compilation of Junction box Subroutines

Junction box subroutines are used by CFX solver to read the new mesh coordinates of the rotor domain every time step. The source code and compilation command used for this purpose is available in the [**TwinScrewCFXSetup\CFX\JunctionBox**] folder.

For Windows,

In order to create the library and link the object files compiled by Fortran compiler we will use the cfx command **'cfx5mkext'**. For this you need to first set the environment variable 'Path' and point to the CFX installation directory.

System Properties \rightarrow Advanced \rightarrow Environment Variables \rightarrow System Variables \rightarrow Path.

Add the path of [..*AnsysInc*v130CFXbin] to the variable separated by a semicolon from others.





System Properties		8		
Computer Name Hardwa	are Advanced System Protection Remote			
Environment Variable	s ty University	X		
Variable AWP_LOCALE130 FLUENT_INC	Value en-us c:\program files\ansys inc\v130\fluent			
TEMP	C: \Snamkane \Snam_2011 \Disco_trial;c: %USERPROFILE% \AppData \Local \Temp	-	Edit System Variable	X
System variables	New Edit Delete		Variable name: Variable value:	Path C:\Program Files\ANSYS Inc\v130\CFX\bink
Variable Path	Value C: Program Files (x86) \Intel\Composer	^		OK Cancel
PROCESSOR_A	AMD64	- -		
	New Edit Delete			
-	OK Cancel			

Once the path is set, launch Intel Fortran Compiler command prompt. Change the working directory. Issue the command mentioned in **Compile.txt** file.

-double is a flag for double precision CFX simulation. You need to remove it for Single precision simulations.

-name is a flag for the routine object and is called by the solver.

► Tw	vinScrewCFXSetup 🕨 CFX 🕨 Junct	ionBox			
nt	Burn New folder				
	Name	Date modified	Туре	Size	
	Compile.txt	07/10/2011 17:56	Text Document	1 KB	
	mycal_easymap.F	22/08/2014 19:26	Fortran Source	3 KB	
	🖹 mycal_meshmap.F		(F 2011 J-1-1/D) C4 1/-	- I Ct I'- 2000	
	set_mesh_user.F	Administrator: Intel Composer 7	KE 2011 Intel(K) 64 Visi	ual studio 2008	
	upd_crdvx_user.F	C:\Program Files (x86)\I	ntel\Composer	XE 2011 SP1>D:	- I I I I I I I I I I I I I I I I I I I
	update_crdvx_user.F	D:\TwinScrewCFXSetup\CFX	\JunctionBox>c	fx5 &_	
	update_mesh_user.F				
	🖹 userpart.F				





Administrator: Intel Composer XE 2011 Intel(R) 64 Visual Studio 2008 - cfx5					
C:\Program Files <x86>\Intel\Composer XE 2011 SP1>D: D:\TwinScrewCFXSetup\CFX\JunctionBox>cfx5 &</x86>					
ANSYS CFX-13.0 Launce File Edit CFX Show TurboGrid 13.0 CFX-Pre Working Directory D:/Twi	ther (on SHAM-PC) Tools User Help ANSYS Client Licensing Utility Command Line Edit File Edit Site-wide Configuration File				
		.4			

Administrator: C:\Windows\system32\cmd.exe
Microsoft Windows [Version 6.1.7601] Copyright (c) 2009 Microsoft Corporation. All rights reserved.
D:\TwinScrewCFXSetup\CFX\JunctionBox>cfx5mkext -double -name meshread mycal_easy map.F mycal_meshmap.F set_mesh_user.F upd_crdvx_user.F update_crdvx_user.F updat e mesh user F

 Copy the created library "winnt-amd64" in the C:\windows folder for easy access and subsequent reuse





Goo ♥ ↓ ≪ CFX ▶ JunctionBox ▶	
Organize 🔻 Include in library 🔻	Share with 🔻 🛛 Burn 😕 🔠 🔻 🗍 🔞
 ★ Favorites ■ Desktop Downloads ₩ Recent Places SkyDrive Clibraries Documents 	Name Name Name Compile.bxt mycal_easymap.F mycal_meshmap.F set_mesh_user.F upd_crdvx_user.F update crdvx user.F
Music Pictures Subversion 9 items	update_mesh_user.F userpart.F < IIII

For Linux,

Go to the working directory using Linux command prompt and issue the following commands.

- ▶ Use Intel Fortran Compiler 2015
- ▶ The procedure for compilation is same as for windows.
- A folder **linux-amd64** will be created when this step is successful.

It is not required to repeat this step for every CFX case setup and the folder **winnt-amd64/linux-amd64** can be just copied and used again in another case. But this library is specific to a given operating system and a given architecture. So in case you are running on a 32 bit OS or any other OS (Win 8) etc. you need to execute this step and provide the library so created to the CFX solver definition file. The library is common for Serial and Parallel Simulations.







5 CFX Pre case setup

Launch CFX from [**TwinScrewCFXSetup****CFX****CFXPreSetup**] folder

GRX ANSYS CFX 2020 R2 Launcher (on DESKTOP-M89HFJ0)	_		×
File Edit CFX Show Tools User Help			
PRE SM PST			
CFX-Pre CFX-Solver Manager CFD-Post			
Working Directory D:/TwinScrewCFXSetup/SCORG_Grid_Tutorial/Grid/Output/CFX/CFXPreSetup		~ 🖻	
	_		^
			\sim

► Select New \rightarrow General

File Edit Session Insert Tools	New Case Simulation Type Simulation Type General Turbomachinery Urbomachinery Ultrary Template OK	
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▶ Go to \rightarrow Session \rightarrow Play Session \rightarrow Select SingleRotorDomainImport.pre





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- This imports the rotor grid in starting position and single domain rotor is created in the setup.
- Save case as Rotor.cfx

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▶ Right click Mesh → Import Mesh → CFX Mesh → Select SCORG_CFX_Tutorial_Ports_V5.4.cfx





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▶ Go to File \rightarrow Import \rightarrow CCL \rightarrow Select SCORG_CFX_Tutorial_V5.9.ccl



Save case as Testrun1.cfx





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- ▶ In the setup there are three non-conformal grid interfaces
 - o Domain Interface 1
 - o Domain Interface 2
 - Domain Interface 3

Interface 1 is between the Suction Port and the two rotors.

- Inspect the interface settings.
- Right click Domain Interface $1 \rightarrow$ Mesh Statistics \rightarrow min / max z should match so that there is no gap between the faces.



SCORGTM V2022, 2022





Interface 2 is between the Discharge Port and the two rotors.

- Inspect the interface settings.
- Right click Domain Interface $2 \rightarrow$ Mesh Statistics \rightarrow Min / Max Z should match so that there is no gap between the faces.



SCORGTM V2022, 2022



CFX-Pre: TestRun1		
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- ▶ Interface 3 is between the two rotors and also with the Discharge Port and a special zone selection is required in such type of domain connection.
 - Inspect the interface settings.
 - Notice that the face zones form a cross exchange of boundaries as highlighted.



▶ Go to User → Edit in Command Editor → Set the correct MeshDir, NMeshes and rog Centre.







- \circ helperiode = Number of divisions in Angular = .
- \circ nlobe = Number of Lobes on Male Rotor = 3
- \circ revpermin = rpm of Male rotor = 8000

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Go to Mesh Read → Set correct Library Path → Start of time Step
 ○ Library Path is the folder where winnt-amd64 has been placed

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- ► Move TestRun1.cfx and grids folder \rightarrow TwinScrewCFXSetup \rightarrow Open TestRun1.cfx
 - Only rotor.1, rotor.2 etc file from grids folder will be used, other files can be deleted.

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35MaleProfile_P1.dat	03/03/2021 11:06	DAT File	23 KB
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🕰 TestRun1.cfx	03/03/2021 12:07	ANSYS 2020 R2 .cf	34,858 KB

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6 **CFX Solver Calculation**

▶ Click Define Run \rightarrow Save Definition file as TestRun1.def

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▶ Select → Double Precision → HP MPI Local Parallel → Start Run



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In the Time stepping Information, mesh map generation and replacement with consecutive meshes should be reported

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6.1 Restarting a Simulation from an intermediate Stop

You can stop the simulation at an intermediate step by hitting the stop button in CFXSolver GUI or through command line. This will complete the current coefficient loop iteration and close the solver. Results file is written for the current completed time step.

To restart from the same flow time specify this result file as the initialization file and check on the continue history from initial file. This will continue the residual monitors from the same time steps and also the junction box routine will call the corresponding mesh file from the grids directory.

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Solver Input File				6	
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7 Distribution Options

There are three options available in the Type of Distribution (Rane, 2015)

a. Rotor to Casing

Generates a smooth rotor surface and node distribution on the rotor can be controlled using Distribution Adaptation factors. This gives good quality rotor profile in 3D.

- b. Casing to Rotor Nonconformal Generates an orthogonal cell structure with possibility to independently refine the interlobe leakage region. This gives better leakage predictions.
- c. Casing to Rotor Conformal Generates an orthogonal cell structure with a single domain containing both the rotors.

Distribution Parameters			
Type of Distribution	Rotor to Casing 🔹		
K Main	Rotor to Casing		
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Dools Smoothing Easter	n o		

The selection of the type of distribution is dependent on the type of screw machine being solved and the CFD solver in consideration. For ANSYS CFX all the three options are available.

The preferred option is Casing to Rotor Conformal as this will generate a single block structured grid that has both the rotors and eliminates the interface between them

Refer to SCORG Help Manual for more details.

8 Summary

This document describes the steps to setup an ANSYS CFX model for Screw compressor CFD analysis starting from output data generated by SCORG[™] Meshing tool. More detailed information on using SCORG and Screw compressor mesh generation can be found in user guide (SCORG, 2021). As mentioned earlier the compilation of junction box routines is a onetime process but has to be done whenever the operating system or its architecture changes. The set of mesh files generated for a complete cycle are reused cyclically when the simulation is run for more than one cycle. Thus it is possible to continuously run the simulation until repeatable results in the monitors and good convergence is obtained. It is also possible to stop and restart the simulation in between, change certain Boundary conditions, Solver control parameters or save the intermediate results. More details information on using ANSYS CFX, Transient simulations and Post-Processing can be found in user guide (ANSYS CFX, 2021).





9 Bibliography

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