



Bachelor Thesis Simulation Report

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System Information

Application	Fluent
Settings	3d, pressure-based, SST k-omega
Version	24.1.0-10184
Source Revision	5b3f9fb3c8
Build Time	Nov 22 2023 10:25:54 EST
CPU	AMD Ryzen
OS	Windows

Geometry and Mesh

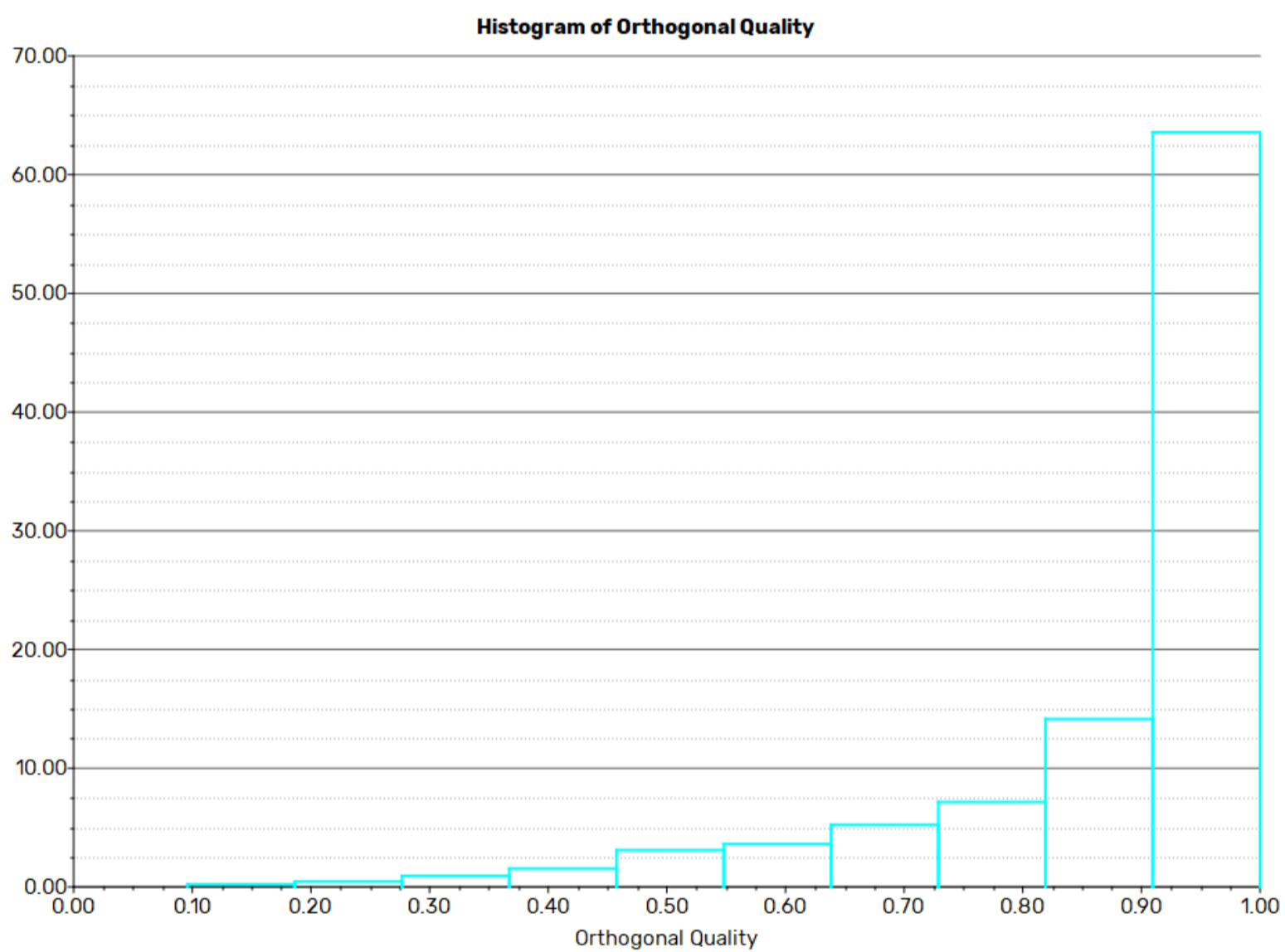
Mesh Size

Cells	Faces	Nodes
34126345	140722034	76373735

Mesh Quality

Name	Type	Min Orthogonal Quality	Max Aspect Ratio
f1	Mixed Cell	0.096022017	942.63861

Orthogonal Quality



Simulation Setup

Physics

Models

Model	Settings
Space	3D
Time	Steady
Viscous	SST k-omega turbulence model

Material Properties

— Fluid	
— air	
Density	1.225 kg/m ³
Cp (Specific Heat)	1006.43 J/(kg K)
Thermal Conductivity	0.0242 W/(m K)
Viscosity	1.7894e-05 kg/(m s)
Molecular Weight	28.966 kg/kmol
— Solid	
— aluminum	
Density	2719 kg/m ³
Cp (Specific Heat)	871 J/(kg K)
Thermal Conductivity	202.4 W/(m K)

Cell Zone Conditions

— Fluid	
— f1	
Material Name	air
Specify source terms?	no
Specify fixed values?	no
Frame Motion?	no
Laminar zone?	no
Porous zone?	no
3D Fan Zone?	no

Boundary Conditions

— Inlet	
— tunnel-inlet:38375554	
Velocity Specification Method	Magnitude, Normal to Boundary
Reference Frame	Absolute

Velocity Magnitude [m/s]	15
Supersonic/Initial Gauge Pressure [Pa]	0
Turbulent Specification Method	Intensity and Viscosity Ratio
Turbulent Intensity [%]	5
Turbulent Viscosity Ratio	10
— Outlet	
— tunnel-outlet:38375555	
Backflow Reference Frame	Absolute
Gauge Pressure [Pa]	0
Pressure Profile Multiplier	1
Backflow Direction Specification Method	Normal to Boundary
Turbulent Specification Method	Intensity and Viscosity Ratio
Backflow Turbulent Intensity [%]	5
Backflow Turbulent Viscosity Ratio	10
Backflow Pressure Specification	Total Pressure
Build artificial walls to prevent reverse flow?	no
Radial Equilibrium Pressure Distribution	no
Average Pressure Specification?	no
Specify targeted mass flow rate	no
— Symmetry	
tunnel-wall:38375551	symmetry
tunnel-top:38375552	symmetry
tunnel-symmetry:38375553	symmetry
— Wall	
— g8_r_wing-sideplate-17894489:38375523	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g8_r_wing-sideflap:38375524	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g8_r_wing-holder:38375525	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g8_r_wing-flap_5:38375526	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip

Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g8_r_wing-flap_4:38375527	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g8_r_wing-flap_3:38375528	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g8_r_wing-flap_2:38375529	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g8_r_wing-flap_1:38375530	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g8_r_wing-endplate:38375531	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g7_s_wing-splitter:38375532	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g7_s_wing-flap_3:38375533	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5

— g7_s_wing-flap_2:38375534	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g7_s_wing-flap_1:38375535	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g7_s_wing-endplate:38375536	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g6_f_wing-holder:38375537	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g6_f_wing-flap_3:38375538	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g6_f_wing-flap_2:38375539	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g6_f_wing-flap_1:38375540	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g6_f_wing-endplate:38375541	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip

Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g5_rear_tyre:38375542	
Wall Motion	Moving Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Define wall motion relative to adjacent cell zone?	yes
Apply a rotational velocity to this wall?	yes
Define wall velocity components?	no
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
Rotation Speed [rad/s]	-75
X-Position of Rotation-Axis Origin [m]	1.53
Y-Position of Rotation-Axis Origin [m]	0
Z-Position of Rotation-Axis Origin [m]	0
— g4_front_tyre:38375543	
Wall Motion	Moving Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Define wall motion relative to adjacent cell zone?	yes
Apply a rotational velocity to this wall?	yes
Define wall velocity components?	no
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
Rotation Speed [rad/s]	-75
X-Position of Rotation-Axis Origin [m]	0
Y-Position of Rotation-Axis Origin [m]	0
Z-Position of Rotation-Axis Origin [m]	0
— g3_rear_suspension:38375544	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g2_front_suspension:38375545	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g10_gepd:38375546	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard

Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g1_chassis-underbody:38375547	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g1_chassis-mainhoop:38375548	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— g1_chassis-hull:38375549	
Wall Motion	Stationary Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5
— tunnel-road:38375550	
Wall Motion	Moving Wall
Shear Boundary Condition	No Slip
Wall Surface Roughness	rough bc standard
Define wall motion relative to adjacent cell zone?	yes
Apply a rotational velocity to this wall?	no
Velocity Magnitude [m/s]	15
X-Component of Wall Translation	1
Y-Component of Wall Translation	0
Z-Component of Wall Translation	0
Define wall velocity components?	no
Wall Roughness Height [m]	0
Wall Roughness Constant	0.5

Reference Values

Area	0.5 m ²
Density	1.225 kg/m ³
Enthalpy	0 J/kg
Length	1 m
Pressure	0 Pa
Temperature	293.15 K
Velocity	15 m/s
Viscosity	1.7894e-05 kg/(m s)
Ratio of Specific Heats	1.4

Yplus for Heat Tran. Coef.	300
Reference Zone	f1

Solver Settings

— Equations	
Flow	True
Turbulence	True
— Numerics	
Absolute Velocity Formulation	True
— Pseudo Time Explicit Relaxation Factors	
Density	1
Body Forces	1
Turbulent Kinetic Energy	0.75
Specific Dissipation Rate	0.75
Turbulent Viscosity	1
Explicit Momentum	0.5
Explicit Pressure	0.5
— Pressure-Velocity Coupling	
Type	Coupled
Pseudo Time Method (Global Time Step)	True
— Discretization Scheme	
Pressure	Second Order
Momentum	Second Order Upwind
Turbulent Kinetic Energy	Second Order Upwind
Specific Dissipation Rate	Second Order Upwind
— Solution Limits	
Minimum Absolute Pressure [Pa]	1
Maximum Absolute Pressure [Pa]	5e+10
Minimum Static Temperature [K]	1
Maximum Static Temperature [K]	5000
Minimum Turb. Kinetic Energy [m ² /s ²]	1e-14
Minimum Spec. Dissipation Rate [s ⁻¹]	1e-20
Maximum Turb. Viscosity Ratio	100000

Run Information

Number of Machines	1
Number of Cores	6
Case Read	177.79 seconds
Data Read	46.27 seconds
Virtual Current Memory	34.1885 GB
Virtual Peak Memory	69.8104 GB
Memory Per M Cell	0.998965

Solution Status

Iterations: 785

	Value	Absolute Criteria	Convergence Status
continuity	0.006209329	0.001	Not Converged
x-velocity	7.055643e-07	0.001	Converged
y-velocity	5.8043e-07	0.001	Converged
z-velocity	5.954376e-07	0.001	Converged
k	0.0009073102	0.001	Converged
omega	0.0001529298	0.001	Converged

Report Definitions

moment	265.3685	N m
lift-n	-324.4186	N
lift-c	-4.708116	
drag-n	117.714	N
drag-c	1.708321	

Plots

Residuals

