Design of Integrated Microrobotic Fish

Presentation 5 - COMSOL Simulation (3D Partial)

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Contents

1 COMSOL Simulation (3D)

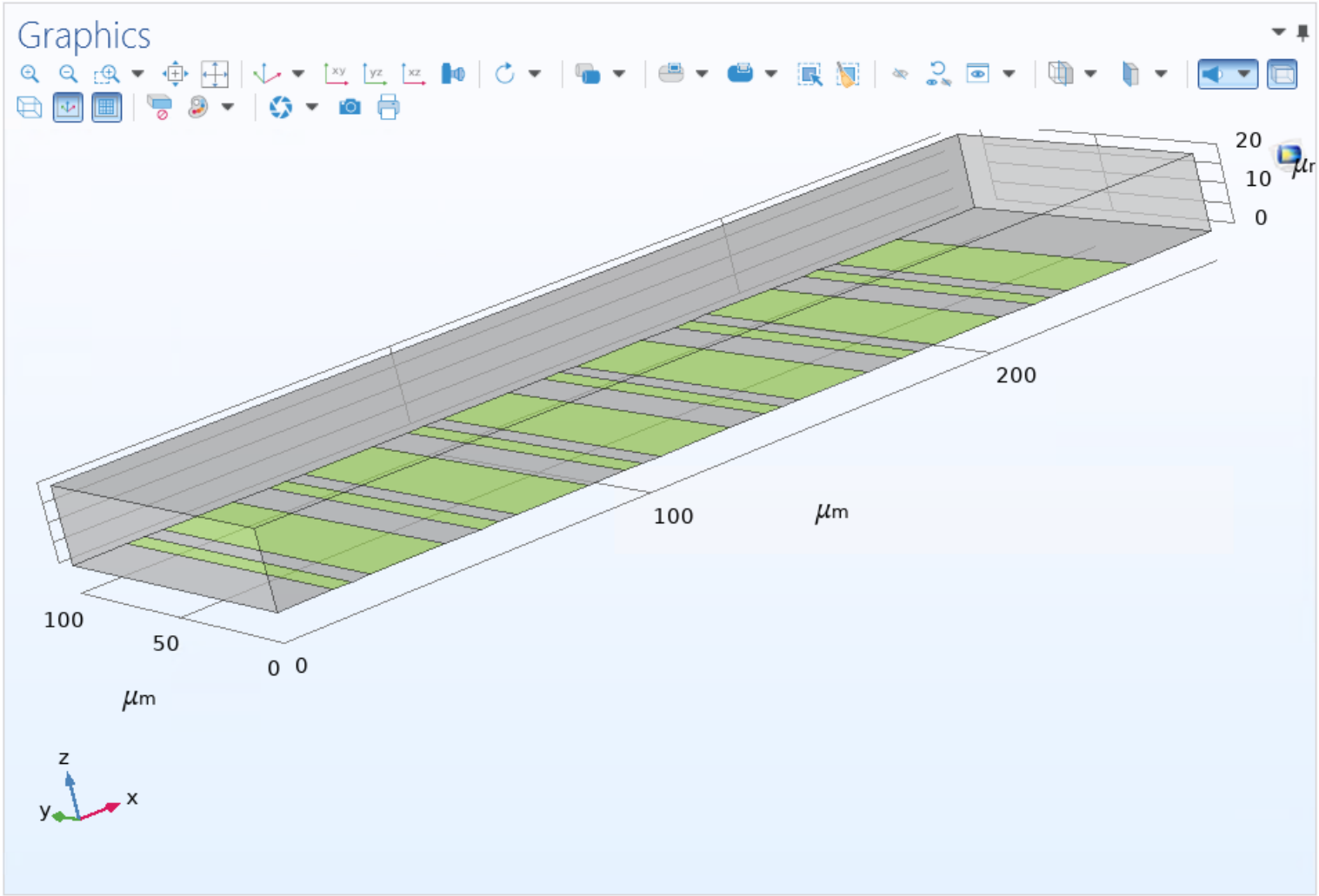
COMSOL Simulation (3D)

Parameters

Name	Expression	Value	Description
sigma_KCL	2.1*10^(-3)[S/m]	0.0021 S/m	Conductivity of the KCL solution
c0	1.4[mol/m^3]	1.4 $\mathrm{mol/m^3}$	Initial concentration
eps_r	80.2	80.2	Relative permittivity of the fluid
t	0[s]	0 s	Start time
V0	0.1[V]	0.1 V	Applied voltage
omega	2*pi[rad]*1000[Hz]	6283.2 Hz	Frequency of the applied potential
D	1e-11[m^2/s]	1E-11 m^/2s	Sample ion diffusivity
zeta	-0.1[V]	-0.1 V	Zeta potential
U0	0.001[mm/s]	1E-6 m/s	Average velocity

Component

Geometry



Component

Material

KCL [liquid] (mat1)

	Property	Variable	Value	Unit
☑	Electrical conductivity	sigma...	sigma_K...	S/m
☑	Dynamic viscosity	mu	eta(T[1/...	Pa·s
☑	Relative permittivity	epsilo...	eps_r	1
	Thermal conductivity	k_iso ;...	k_liquid...	W/(m·...
	Resistivity	res_is...	res(T[1/...	Ω·m
	Coefficient of thermal expansi...	alpha...	(alpha_li...	1/K
	Heat capacity at constant pres...	Cp	C_liquid...	J/(kg·K)
	Density	rho	rho_liqu...	kg/m³
	Tangent coefficient of thermal...	alphat...	CTE_liqu...	1/K
	Thermal strain	dL_iso...	(dL_liqui...	1

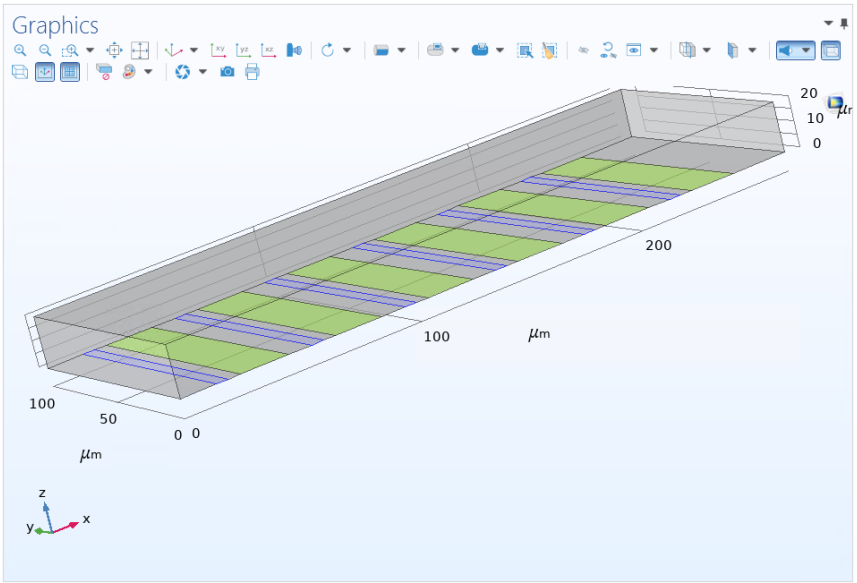
Gold [solid] (mat2)

	Property	Variable	Value	Unit
	Thermal conductivity	k_iso ;...	k_solid_...	W/(m·...
	Resistivity	res_is...	res_soli...	Ω·m
	Coefficient of thermal expansi...	alpha...	(alpha(T...	1/K
	Heat capacity at constant pres...	Cp	C_solid_...	J/(kg·K)
	Electrical conductivity	sigma...	sigma_s...	S/m
	Density	rho	rho(T[1/...	kg/m³
	Tangent coefficient of thermal...	alphat...	CTE(T[1...	1/K
	Thermal strain	dL_iso...	(dL(T[1/...	1
	Young's modulus	E	E(T[1/K]...	Pa
	Poisson's ratio	nu	nu(T[1/K])	1
	Bulk modulus	K	kappa(T...	N/m²

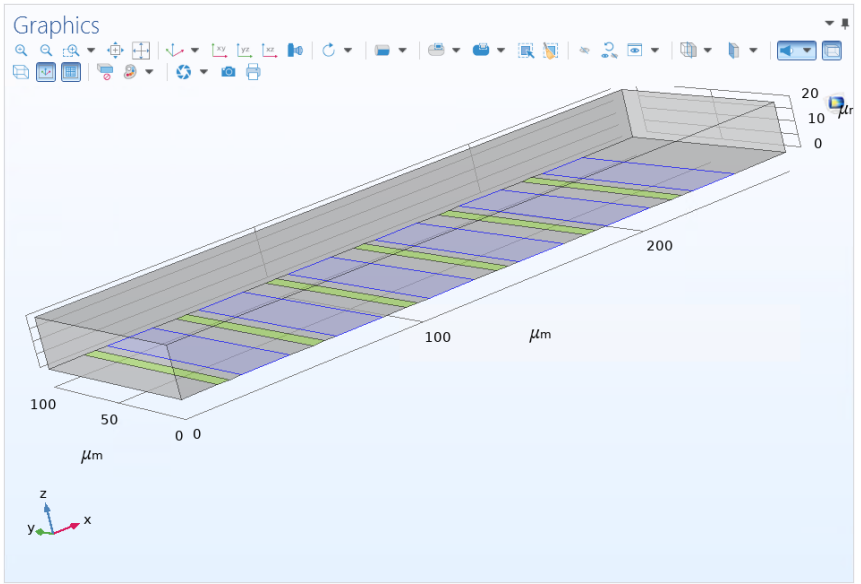
Component

Electric Currents *ec*

small electrodes



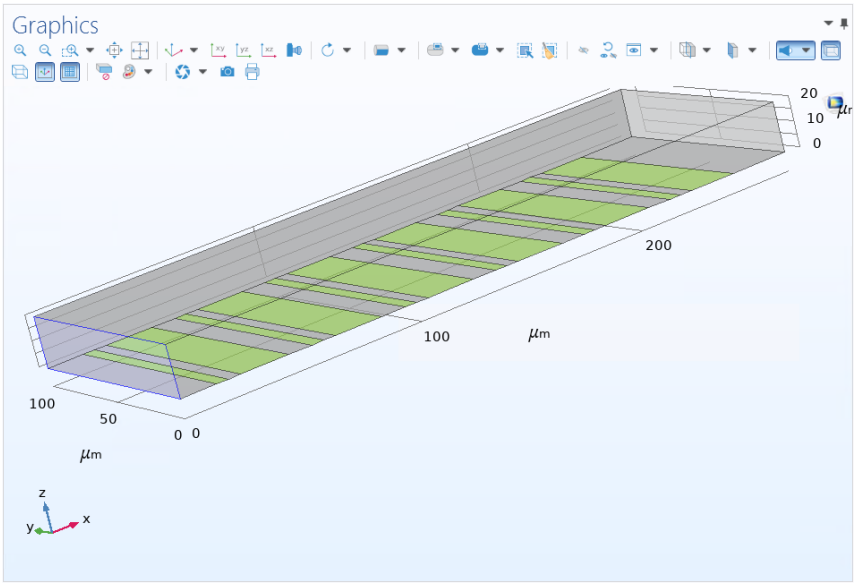
large electrodes



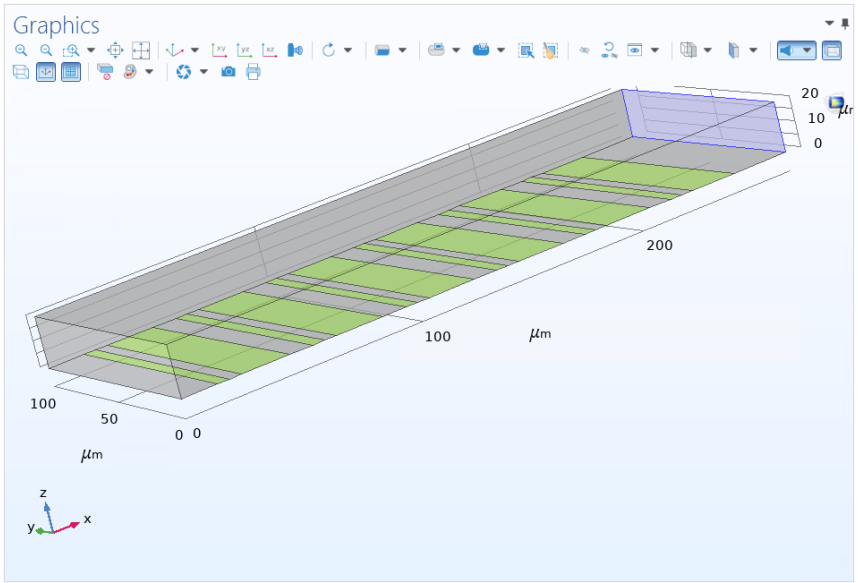
Component

Transport of Diluted Species *tds*

Concentration 1



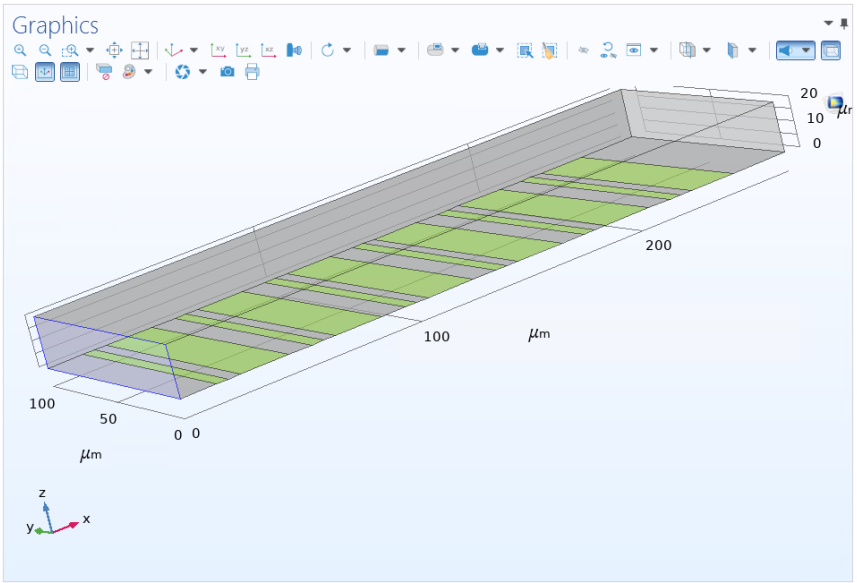
Outflow 1



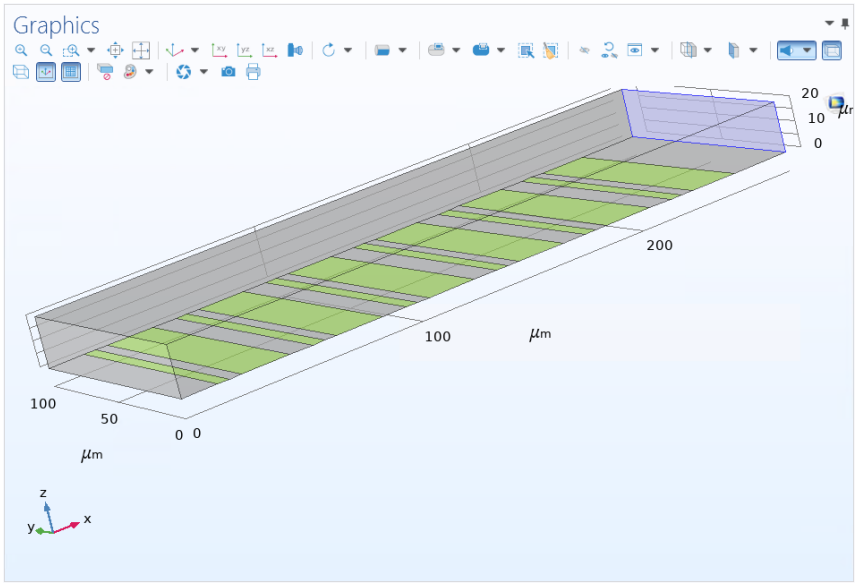
Component

Creeping Flow *spf*

Inlet 1



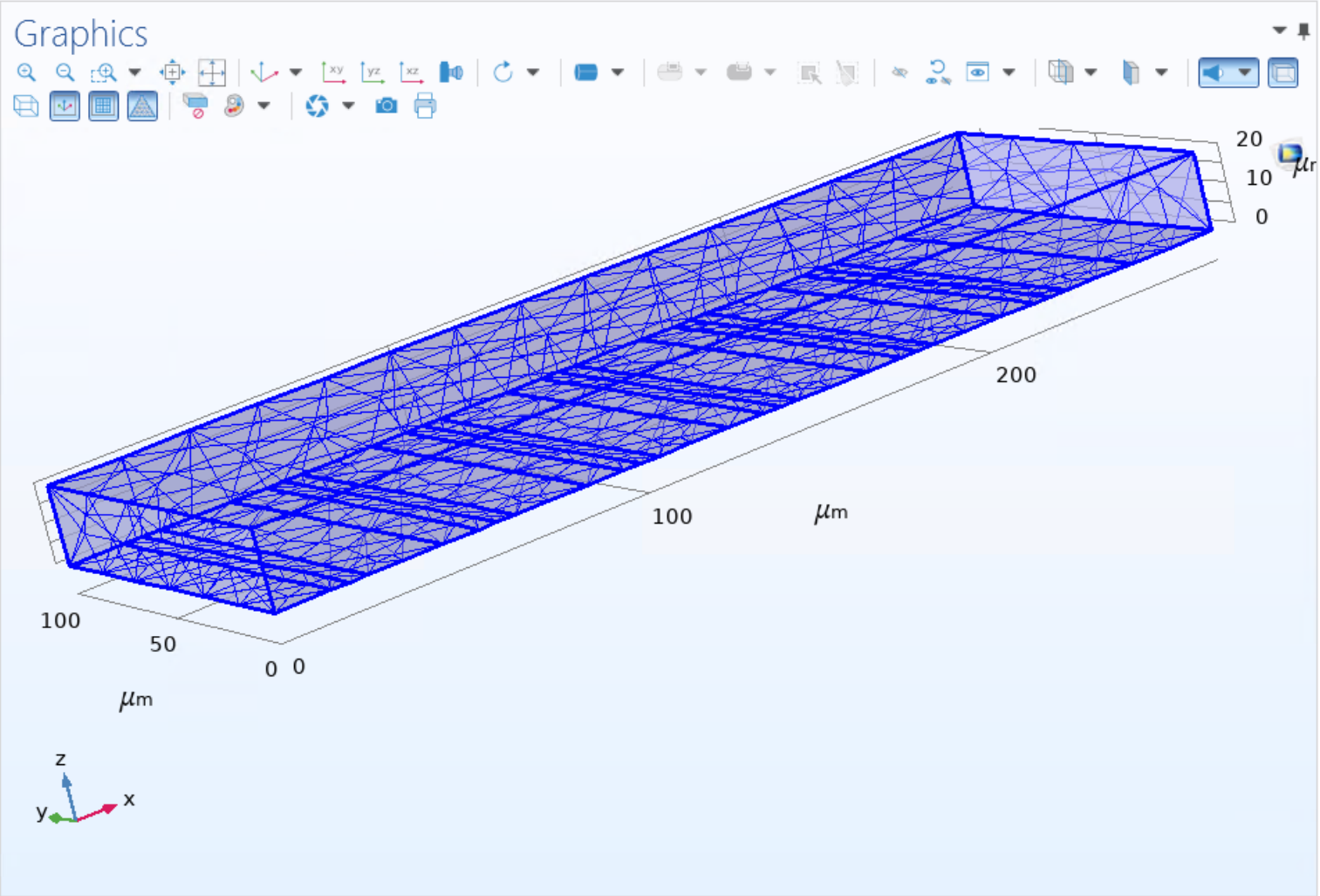
Outlet 1



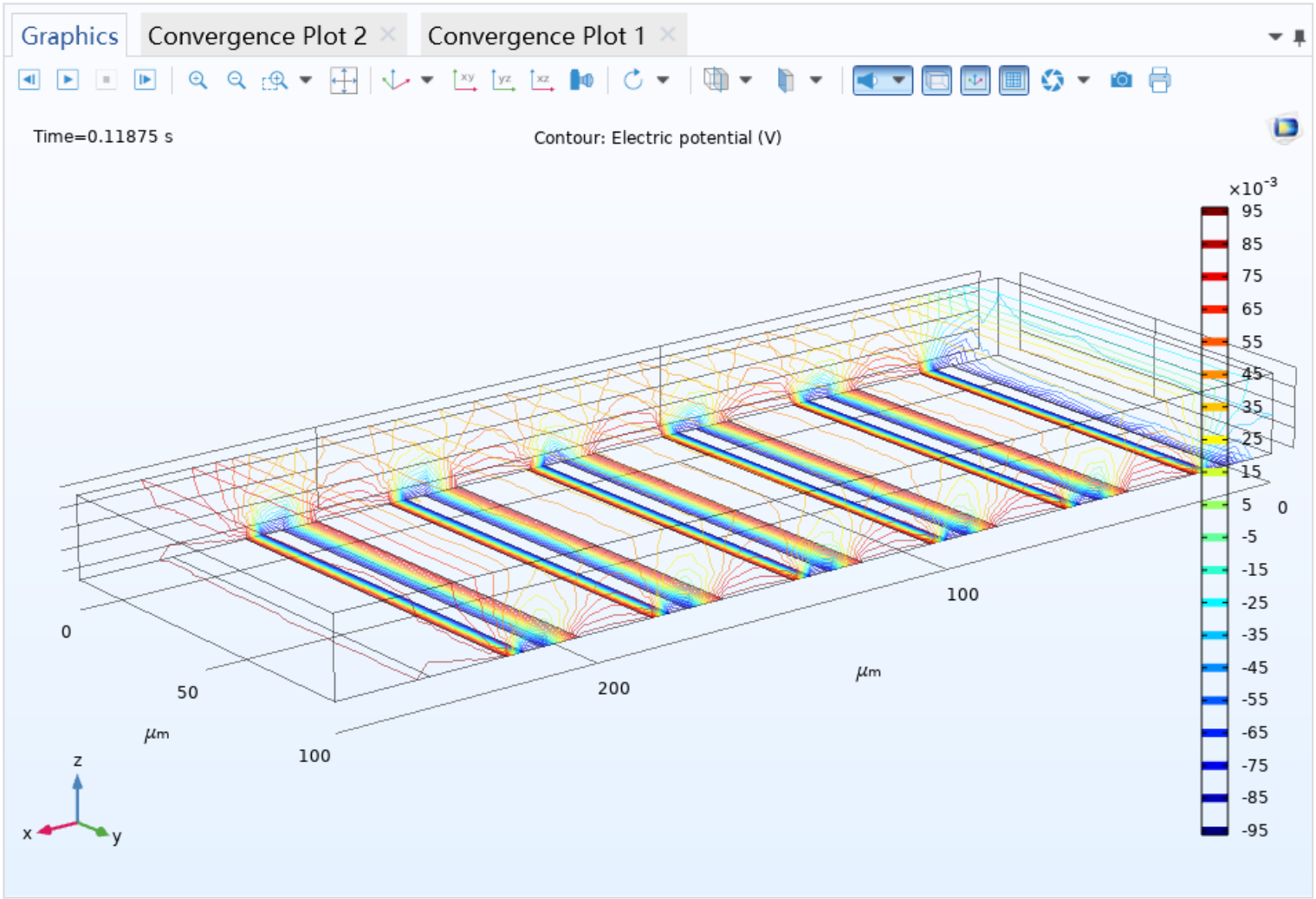
Component

Mesh

Free Tetrahedral 1



Result


Graphics
Convergence Plot 2
Convergence Plot 1
Time=0.11875 s
Contour: Electric potential (V)
×10^-3
95
85
75
65
55
45
35
25
15
5
0
-5
-15
-25
-35
-45
-55
-65
-75
-85
-95
0
50
100
μm
0
100
200
μm
z
x
y

Thanks!