

Worked Example 8

Electroadhesion

The engineering question

Voltage across two dielectric layers produces attraction in the non-contact gap. The example follows the Peng gap-only interpretation: mechanical-contact cells are excluded from electrical traction, so the active-gap mask is an essential diagnostic.

What the model represents

This example uses the production model selected by the supplied input. The governing theory and assumptions are described in the TriboSolver Manual; here the emphasis is on setting up, reproducing and interpreting one complete calculation.

Input or control	Reproducible value
Simulation type	Adhesion
External load	40 mN
Adhesion controls	Electroadhesion checked; Adhesion clear
Voltage	20 V DC
Dielectrics	2.2 nm each; relative permittivity 3.9 each; gap 1.0
Geometry/grid	3 mm ball; 512 x 512 generated PSD

Supplied input: `electroadhesion.tribo.json`
SHA-256: 1857ff12af396f90d56e374db1d5f31c2927bb9f648c05641581c8b90b98a2c1

Set up and run the story

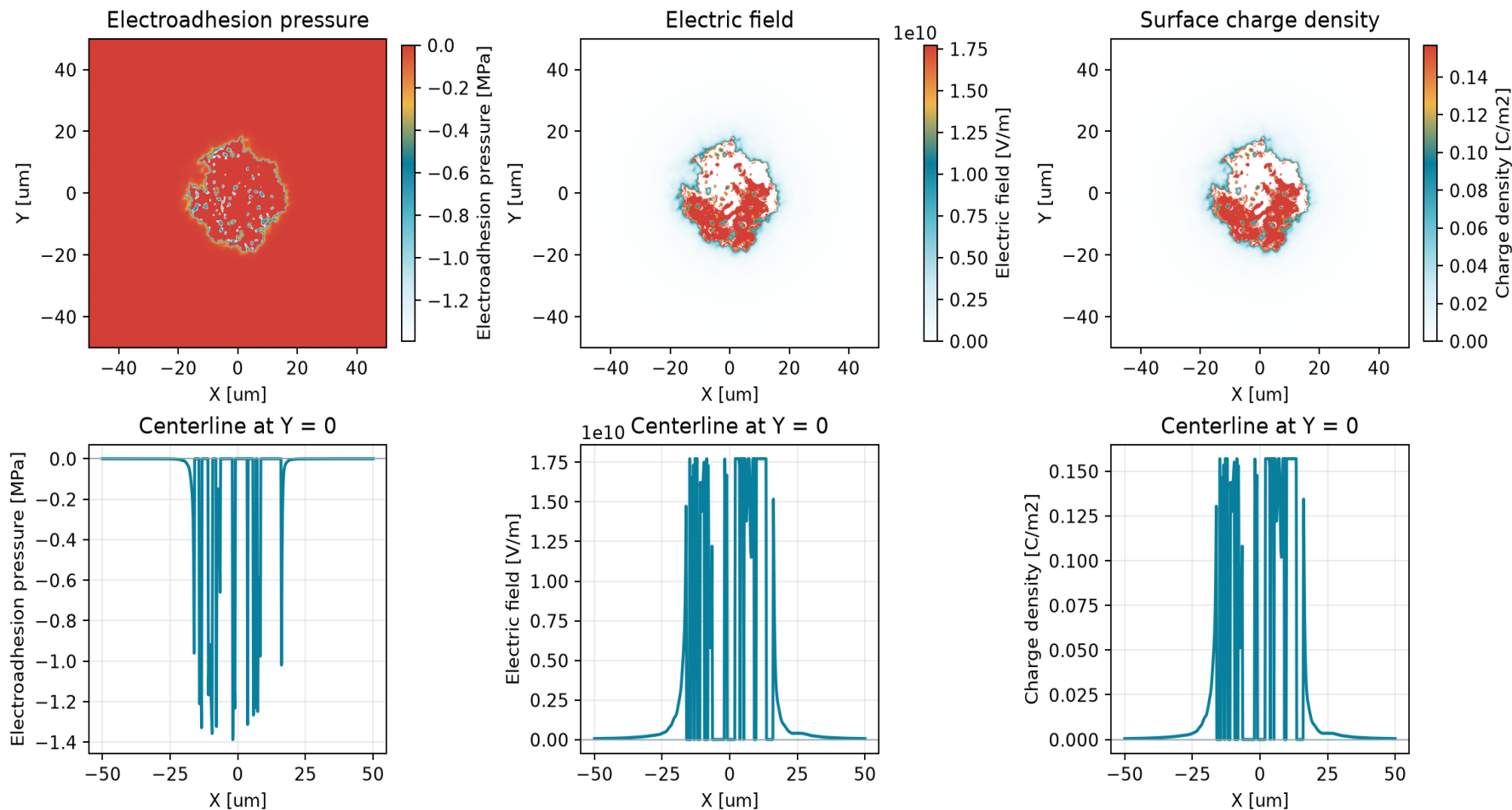
Step	Tab	What to do and why
1	Simulation Type	Choose Adhesion.
2	Contact Conditions	Set external load to 0.04 N and Include Friction with intrinsic COF 0.20.
3	Contact Grid/Macro Geometry	Use 512 x 512 Point Contact and a 3 mm ball radius.
4	Micro Geometry	Generate the supplied fixed-seed surface.
5	Adhesion	Clear Adhesion and check Electroadhesion. Enter dielectric thicknesses, permittivities, gap permittivity and 20 V.
6	Run	Run and verify that no surface-adhesion variables are listed. Only electroadhesion and regular contact outputs should be present.

Run checkpoint

Do not interpret a field until the status reports success. Compare the summary below with your run; it was read from the retained result set created from this exact input.

iterations 76 | repulsive force 0.193 N | electroadhesion force -0.15301 N | load error 0.00024689

Calculated result



Reproduced calculation: iterations 76 | repulsive force 0.193 N | electrode adhesion force -0.15301 N | load error 0.00024689

The attraction, electric-field and surface-charge maps must be read together with the gap and active-gap mask. In the retained Peng interpretation, mechanical-contact cells have exactly zero electrical traction, field and free surface-charge density; positive-gap cells carry the electrical solution. Apparent capacitance is the magnitude of integrated free charge divided by interface voltage. At 0 V all electrical outputs collapse to zero.

Selected calculated scalar outputs

Output	Value	Unit
Total normal force	0.03999	N
Repulsive contact force	0.193	N
Average repulsive contact pressure	0.3039	GPa
Electroadhesion force	-0.153	N
Average electroadhesive pressure	-15.81	MPa
Apparent capacitance	4.546	pF
Contact area	6.351e-10	m^2
Rigid body motion	0.08188	um
Relative load-balance error	2.469e-04	-
Contact solver iterations	76	-

How to explore and explain the result

In 1D, start with the default center cross-section. Choose X or Y only when the engineering question requires a different direction, then move the location control. The grid and cursor readout give the plotted value and its unit. In 2D, use the colorbar to locate high and low regions and read the numerical X/Y axes. In 3D, rotate the same matrix to understand peak prominence and orientation; the X, Y and Z directions are references, not a different calculation.

View	Question it answers	Reading rule
1D	What happens along one selected line?	Start at the center; use the grid and cursor value to quantify peaks, widths and gradients.
2D	Where are high, low or active regions?	Read the colorbar and X/Y units; compare runs only with their numerical scales visible.
3D	How prominent and oriented are the features?	Rotate for shape and orientation; use 1D/2D or export for exact values.

What to report

State the input filename and hash, simulation type, material and geometry, grid and surface definition, prescribed load, solver status, iteration or balance measure, selected output name and unit, and the engineering meaning of the plotted pattern.

A useful engineering explanation states the prescribed load and geometry, identifies the active physical mechanism, checks convergence or force balance, and only then interprets the spatial field. Keep the supplied input and retained result together so a colleague can reproduce every number and plot.

Retained result: electroadhesion-results.tribo-results.json
SHA-256: 84ef6e3f6d3239b25e1102ffee672942fde12006df25d22e046fd4db2cb1fe21