

Lesson 11:

Modeling Aids

PEET provide several programs designed to ease the process of creating models for common cases: regularly spaced particles, spikes protruding from or embedded in membranes, spheres, or cylinders, and so on. In this exercise, we'll explore some of these programs.

SPHERES AND CYLINDERS

First, we'll consider `seedSpikes` to generate regularly spaced points with axes pointing radially inward or outward from the surface of one or more spheres or cylinders. Then we'll convert these models to a form suitable for use with PEET using `spikeInit`.

- 1) `cd $WORKSHOP_HOME/PEET_Labs/ModelingAids`
- 2) `3dmod spheres.mod`, switch to **Model** mode, and select **Object 1**. You'll see that this model contains 2 single-point objects, where Object 1 has a point size of 18 (**Edit / Point / Size**) and Object 2 has a point size of 12. Suppose we wanted to place candidate spikes pointing outward every 20° around these spheres.
- 3) `seedSpikes spheres.mod mySphereSeeds.mod sphere 20`
- 4) `3dmod -V mySphereSeeds.mod`
You'll find you now have a model with 4 objects; Objects 1 and 3 contain the newly seeded particles, while Objects 2 and 4 contain the centers and radii of the spheres from `spheres.mod`. To make the display less confusing, select **Edit / Objects** from the Model View window, chose **Points** and set the **Sphere size** to **2** for **Object 1** and

1 for **Object 3**, respectively. From the 3dmod info window, select **File / Save Model**, and then exit all 3dmod windows when finished.

5) `spikeInit mySphereSeeds.mod sphere`

Note the names of the output model, initial motive list, and rotation axes. Check the [spikeInit](#) man page for additional options, if you wish.

6) `3dmod -V mySphereSeeds_sphere_spikes.mod`

All the spike model points have been moved to Object 1 (potentially in several contours) as required for PEET alignments.

7) `plotRotAxes mySphereSeeds_sphere_spikes.mod \`
`mySphereSeeds_sphere_RotAxes.csv 5 1`

where “\” should be followed immediately by **Enter**. This creates a “quiver plot”, with “5” and “1” specifying the length and line thickness of the arrows in the quiver. Try zooming, panning, and rotating the plot with some of the controls at the top of the figure window. Close the figure and 3dmod windows when finished.

8) Cylindrical surfaces are handled in a similar fashion, but now 2-point open contours are required to define the radius, orientation, and height of the starting cylinder(s). `3dmod cylinders.mod` and toggle between Objects 1 and 2 in the 3dmod info window to see their definitions.

9) `seedSpikes cylinders.mod myCylinderSeeds.mod cylinder 20`

10) `3dmod -V myCylinderSeeds.mod`

As before, adjust the point sizes for better visibility. After examining the resulting model, exit all 3dmod windows, saving any changes if desired. If you wish, explore the man page for [seedSpikes](#) to see additional program options. Models generated by [seedSpikes](#) are not directly suitable for use in PEET alignments;

instead, they're designed to be used as input to another accessory program, spikeInit, which will generate the final models, initial motive lists, and rotation axes files.

11) `spikeInit myCylinderSeeds.mod cylinder`

Examine the results as in steps 9 and 10 above.

`3dmod -V myCylinderSeeds_cylinder_spikes.mod`

`plotRotAxes myCylinderSeeds_cylinder_spikes.mod \
myCylinderSeeds_cylinder_RotAxes.csv 5 1`

where “\
” should be followed immediately by **Enter**.

Close all the various windows when finished

IRREGULARLY SHAPED SURFACES

Spikes or particles of interest often lie on an irregularly shaped membrane or surface not well approximated by a sphere or a cylinder. The program meshInit can be used in place of spikeInit in these cases to generate spike orientations perpendicular to the membrane. Membranes are first modeled as an IMOD mesh. Meshing is covered in the 3dmod documentation. We will not repeat those instructions here, but will mention that meshes can be created either by choosing specific vertex locations (e.g. if you are modeling individual, visible spikes / particles) or by dragging with the middle mouse button to place points at regular intervals along an open contour defining the shape of the membrane in a particular slice (e.g. if you wish to seed spikes with approximately constant spacing). Spacing in the latter mode of operation is set by 3dmod's Edit / Model / Header / Drawing resolution. Typically spacing along each contour should be approximately the same as the interval between contours. Either open or closed contours can be used depending on the structure you wish to model.

12) `3dmod -V mesh.mod`

In this model, I've drawn 5 open contours indicating the shape of a hypothetical membrane in 5 slices, and then meshed the model. Exit 3dmod after examining the model.

13) `meshInit mesh.mod`

As above, note the names of the generated output files. You may wish to examine the [meshInit](#) man page for additional options.

14) `3dmodv mesh_mesh.mod`

and examine the resulting model. Exit 3dmodv when finished.

15) `plotRotAxes mesh_mesh.mod mesh_mesh_RotAxes.csv 5 1`

16) Feel free to repeat steps 13-15 if you like, experimenting with [meshInit](#)'s **offset** and **flgBothSides** options.