Radiation Between Surfaces - Verification & Validation

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Verification & Validation

Mesh Convergence

One way to check the accuracy of the simulation is to refine the mesh and re-run the simulation. The smaller the element in the mesh, the more accurate the simulation will be. The only drawback is longer computation time. To refine the mesh, insert ***Body Sizing*** on the specimen and set the element size to 0.001m. Also, enter 0.002m for the element size in the ***Details of "Mesh"***. The original mesh has ***620 Elements*** and ***4533 Nodes*** and the new mesh has ***1 600 Elements*** and ***11204 Nodes***.

	Shell Net Radiation at end step time (W)	Specimen Net Radiation at end step time (W)
Original Mesh	0.2015	-0.19705
Refined Mesh	0.20344	-0.19812

The net radiation shows very little change as the number of elements is doubled. No further mesh refinement is need.

View Factor

The view factor is calculated for surface to surface radiation. Recall from the radiation equation in pre-analysis, this is an important parameter in computing the radiation between surfaces that are in the same enclosure.

$$F_{ij} = \frac{1}{A_i} \int \int \frac{\cos\theta_i \cos\theta_j}{\pi R^2} dA_i dA_j$$

Where

F_{ij} is the fraction of the radiation leaving surface i that is intercepted by surface j.
A_i, A_j are the elemental surface area
R is the line that connects the two elemental areas
θ_i, θ_j are the polar angles formed by the line R with surface normals n_i, n_j

It is difficult to analytically calculate the view factor for this model. Hence, we will use a simplified exercise to show the validity of ANSYS simulation. Proceed to the next step to compare the analytic and ANSYS results.

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