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COMPUTATIONAL NEAR-FIELD RADIATIVE HEAT TRANSFER: CONVERGENCE ANALYSIS OF THE THERMAL DISCRETE DIPOLE APPROXIMATION USING THE EXACT SOLUTION FOR TWO SPHERES

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ABSTRACT The thermal discrete dipole approximation (T-DDA) is a numerical method for modeling near-field thermal radiation problems. In this work, the convergence of the T-DDA is investigated using the exact solution for two spheres separated by a vacuum gap. The results suggest that for a fixed number of sub-volumes, increasing the refractive index and/or the size parameter as well as decreasing the separation gap degrade the accuracy of the T-DDA. A non-uniform discretization scheme is proposed to accelerate the convergence of the T-DDA. Errors smaller than 5% are obtained for 13 out of 18 sets of simulations using up to 77196 sub-volumes. Resonant modes dominating heat transfer in the near field are predicted via the T-DDA with an error smaller than 4.10%.