A COMPARISON OF CONVERGENCE AND ERROR ESTIMATES FOR THE MONTE CARLO AND DISCRETE TRANSFER METHODS

Hendrik K. Versteeg, Jonathan C. Henson, Weeratunge Malalasekera
Wolfson School of Mechanical and Manufacturing Engineering
Loughborough University, Loughborough LE11 3TU, United Kingdom

ABSTRACT. In benchmark solutions the performance of radiation algorithms is normally studied by comparisons with the Monte Carlo method (MCM), since the latter is the only technique that can return both a solution and an estimate of its uncertainty. In recent work, we have developed sharp error bounds for the surface irradiation in the discrete transfer method (DTM). This paper explores the idea that the study of sequences of DTM results with systematic angular refinement can provide an alternative basis for error estimation. We present detailed comparisons of the DTM and MCM with two of Hsu and Farmer's benchmarks for a cubic enclosure with nonhomogeneous extinction, and add some additional problems. We find consistently good agreement between our error theory and observed convergence trends. Careful analysis of our findings also reveals excellent agreement between highly resolved DTM and MCM surface heat flux estimates. Since the DTM economically provides an accurate, deterministic solution and error bounds, our work highlights its potential as an alternate benchmarking tool.