An adaptive nested source term iteration for radiative transfer equations

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In this talk, we present a new approach to the numerical solution of radiative transfer equations with certified a posteriori error bounds. We formulate a fixed-point iteration in a suitable, infinite dimensional function space that is guaranteed to converge with a fixed error reduction per step. The numerical scheme is then based on approximately realizing this outer iteration within dynamically updated accuracy tolerances that still ensure convergence to the exact solution. To gurantee that these error tolerances are met, we employ rigorous a posteriori error bounds based on a Discontinuous Petrov–Galerkin (DPG) scheme. These a posteriori bounds are also used to generate adapted angular dependent spatial meshes to significantly reduce overall computational complexity. The scheme also requires the evaluation of the global scattering operator at increasing accuracy at every iteration and its computation is accelerated through low-rank approximation and matrix compression techniques. We will illustrate the theoretical findings with numerical experiments involving non-trivial scattering kernels.