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Wang, L.
Xu, W.</td></tr>
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Li Wang
Wuzhe Xu</td></tr>
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<tr><th>abstract</th><td>This paper concerns solving the steady radiative transfer equation with diffusive scaling, using the physics informed neural networks (PINNs). The idea of PINNs is to minimize a least-square loss function, that consists of the residual from the governing equation, the mismatch from the boundary conditions, and other physical constraints such as conservation. It is advantageous of being flexible and easy to execute, and brings the potential for high dimensional problems. Nevertheless, due the presence of small scales, the vanilla PINNs can be extremely unstable for solving multiscale steady transfer equations. In this paper, we propose a new formulation of the loss based on the macro-micro decomposition. We prove that, the new loss function is uniformly stable with respect to the small Knudsen number in the sense that the L^2-error of the neural network solution is uniformly controlled by the loss. When the boundary condition is an-isotropic, a boundary layer emerges in the diffusion limit and therefore brings an additional difficulty in training the neural network. To resolve this issue, we include a boundary layer corrector that carries over the sharp transition part of the solution and leaves the rest easy to be approximated. The effectiveness of the new methodology is demonstrated in extensive numerical examples.</td></tr>
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