On Computing Solutions to Optimal Control Problems in Radiative Heat Transfer

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Abstract: Optimal control problems for the radiative (heat) transfer equation are introduced and formulated. Those problems arise in many applications as for example cooling of glass, gas turbine combustion chambers or combustion in car engines. The problems are challenging from a mathematical and numerical point of view due to the high dimensionality of the underlying phase space. The starting point of the discussion are the necessary and sufficient optimality conditions for a tracking–type optimization problem using the full radiative transfer equations in two and three space dimensions. We focus on numerical methods for the derived optimality system and in particular present a discrete ordinates method (for the angle variables) combined with a finite volume discretization (for the space variables). The arising (huge) linear system is reduced by eliminating angular fluxes and the resulting problem is efficiently solved using the preconditioned GMRES method. Other possible numerical approaches are indicated, before computational results are given. We present examples on source inversion and edging show the feasibility of the given approach.

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