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UNCERTAINTY QUANTIFICATION TO ASSESS A REDUCED MODEL FOR THE REMOTE HEATING OF A POLYMER

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Abstract. This article studies the feasibility of a 1D radiative transfer model to compute the thermal source for a remote heating problem associated to the physics of the so-called plasmonic resonance (PR) in a synthetic polymeric material. The PR is responsible for converting the optical radiation from the incident laser beam into an equivalent thermal source and is achieved by embedding gold nanoparticles during the design of the synthetic polymer. Since the Radiative Transfer Equation cannot be analytically solved for a real experimental case, a two-staged simplified process is considered which requires the uncertainty quantification as a prior stage, in order to make an appropriate control of the resulting temperature profile. In this work, we include propagation errors for lattices of 1D, 2D and 3D geometries, due to the approximate laser source profile used, as well as those arisen from uncertainties in the thermal parameters and the ones derived from the variables involved in the design of the polymer. Computational simulations for a suitable experimental polymer are carried out using COMSOL®. Corresponding results show the scope of the reduced model in terms of a range of parameter values where it can be effectively used in practice.