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PARAMETRIC INVESTIGATION OF THE TRANSIENT RADIATIVE TRANSFER IN PARTICIPATING MEDIA AND RAPID ESTIMATION OF THE RADIATIVE PARAMETERS

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ABSTRACT The problem of transient radiative transfer in participating media has attracted increasing interest over the last decade due to the development of ultra-short pulse laser. In this research, a parametric investigation was performed involving different extinction coefficients and scattering albedos in participating media. The system of interest was a plane-parallel slab consisting of a homogeneous absorbing, isotropic scattering but non-emitting medium exposed to collimated Gaussian incident pulse. In the present study, the Finite Volume Method was applied to solve the direct problem. Considering the fact that the direct model needs to be solved numerous times during the inverse process, the grid independence was discussed to reduce the number of the grids while satisfying a certain accuracy. In the previous researches, the dimensionless time was used for describing the time-resolved transmittance and reflectance signals. However, it was found that for some cases of transient radiative transfer problems, different optical properties may lead to the same transmittance and reflectance results. Furthermore, the concepts of Optimal Detection Distance and Critical Optical Thickness were presented and investigated thoroughly. The results demonstrate that for the optical thick media, the reflectance signal is no longer relevant to the optical thickness which means the information of the media thickness cannot be obtained from the reflectance signal. On this basis, the inverse transient radiation analyses were carried out for retrieving the extinction coefficient and scattering albedo in an absorbing and scattering but non-emitting plane-parallel slab applying three inverse methods *i.e.*, the Relation, the Stochastic Particle Swarm Optimization (SPSO) and the SPSO-Relation, in which the Relation refers to the functions established by Smith *et al* [2007] which shows the correlation between the maximum hemispherical reflectance and the single scattering albedo, dimensionless pulse width, optical thickness. In conclusion, the proposed SPSO-Relation was demonstrated to be fast and accurate.

REFERENCES

Smith, K.D [2007], Maximum Time-resolved Hemispherical Reflectance of Absorbing and Isotropically Scattering Media, *J. Quant. Spectrosc. Radiat. Transfer*, Vol. 104, No. 3, pp 384-399.