NULL COLLISION MONTE CARLO ALGORITHMS: A MESHLESS TECHNIQUE TO DEAL WITH RADIATIVE PROBLEMS IN HETEROGENEOUS MEDIA

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ABSTRACT. A null-collision Monte Carlo algorithm is introduced. This technique allows free path sampling in heterogeneous media without the use of any grid or of tedious numerical inversions of optical thicknesses. Furthermore, its pure stochastic behaviour guarantees an unbiased statistical error since no reductive hypothesis is made concerning the field of optical properties (absorption and scattering coefficient). Its principle is based on the introduction of fictitious collisions (pure forward scattering events) in the extinction coefficient, thereby allowing a simple inversion of the modified extinction coefficient. We show how this can be rigorously justified by drawing a parallel between algorithm and integral formulation and how the formulation could be slightly modified to deal with the unexpected occurrences of negative null-collision coefficients. Finally, a complex case study is discussed to point out how the algorithm behaves in terms of variance and computation time.