Development of a Family of Regularization Terms for the Solution of Inverse Radiative Transfer Problems

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Inverse problems are usually ill-posed, and therefore affected by the noise which is always present in the experimental data used for their solution. An effective strategy employed for their solution is to replace the original inverse problem of interest by another one that is close to the former, but is less affected by the experimental data noise [1]. Such approach was put forward by Tikhonov [2], in which a regularized functional is developed.

In the present work a family of regularization terms for Tikhonov’s functional is built using Bregman’s distances [3] which are constructed using the moments of a $q$-discrepancy functional [4]. Muniz et al. [5] used a similar idea for the solution of inverse problems in heat conduction, and Berrocal Tito et al. [6] used moments of the $q$-discrepancy [4] for the estimation of parameters for an environmental model. Here the inverse problem is formulated implicitly as an optimization problem [7] in which we seek to minimize the cost functional of the squared residues between calculated and measured quantities. Such approach is then applied for the estimation of the single scattering albedo, optical thickness and inner boundary diffuse reflectivities in a one-dimensional participating medium. The inverse problem is solved using synthetic experimental data acquired using external detectors only. Good results were obtained even for test cases for which other methods failed.

REFERENCES