EngOpt2018 - 6th International Conference on Engineering Optimization
Instituto Superior Técnico, Lisbon Portugal • 17-19 September, 2018
Editors: H.C. Rodrigues, J. Herskovits, C.M. Mota Soares, et al.

Abstract ID 1215

THE METHOD OF FUNDAMENTAL SOLUTIONS FOR POINTWISE SOURCE RECONSTRUCTION ASSOCIATED WITH MODIFIED HELMHOLTZ EQUATION

Jairo de Faria, Thiago Machado, Romulo Lima, Raul Sá

UFPB, Brazil
jairo@ci.ufpb.br, thiagao.matematica@gmail.com, romulo_dasilva@hotmail.com, raulrennerm@gmail.com

Keywords: pointwise sources reconstruction,modified Helmholtz equation,method of fundamental solution,inverse problems,sensitivity analysis.

Abstract: Pointwise source identification presents a great variety of applications in engineering, like location of pollution sources for a given environment, identification of dipoles and monopoles in both electroencephalography and magnetoencephalography and so on. This problem consists of reconstruct sources (quantity, location and intensity), distributed in a domain based on boundary measurements. In particular, in this work we study problems associated with the modified Helmholtz equation, which are of interest in implicit marching schemes for the heat equation and in the linearization of the Poisson–Boltzmann equation, for instance. The strategy adopted for the reconstruction of the point sources is, as usually found in the literature, to rewrite the inverse problem as an optimization one, where the minimization of an appropriated shape functional is associated to the solution of the inverse problem. More specifically, we minimize the L2-distance between the boundary measurements and the correspondent numerical solution of direct problem taking into account some pointwise source distribution. Then, we derive the sensitivity of the shape functional with respect to the set of admissible pointwise sources. From the numerical point of view, we adopt the Method of Fundamental Solutions (MFS) in order to approximate the numerical solutions of the direct problems. In addition to all the known advantages of this meshless method over domain discretization techniques - such as the Finite Element Method (MEF) and Finite Difference Method (MDF) - the MFS allows us to properly represent a pointwise source by a point (a MFS source point), reducing the noise that is inherent when using MEF or MDF in the reconstruction algorithm. The numerical results obtained, for the identification of multiple pointwise sources, even for partial noisy data, indicate that the proposed algorithm is accurate, convergent, stable and efficient.