ICRAMCS 2026

THE EIGHTH EDITION OF THE INTERNATIONAL CONFERENCE ON RESEARCH IN APPLIED MATHEMATICS AND COMPUTER SCIENCE

April 23-24-25, 2026 | Marrakech, Morocco

Inverse Parameter Identification for a Diffusion Equation with Ventcel Boundary Conditions

Communication Info

Authors:

Mohamed Aiman RBAH [1,2]

Lekbir AFRAITES [1]

Fabien CAUBET [2]

Aissam HADRI [3]

Charles PIERRE [2]

[1] *FST Béni-Mellal, Béni-Mellal, Morocco*

[2] *Université de Pau et des Pays de l'Adour, Pau, France*

[3] *Faculté Polydisciplinaire de Ouarzazate, Ouarzazate, Morocco*

Keywords:

(1) Inverse problems

(2) Optimization

(3) Keyword3

Abstract

In this work, we investigate an inverse problem for elliptic equations with Ventcel boundary conditions, where two unknown parameters we aim to identify appear on the boundary, which are generalized impedance operators involving tangential derivatives. We formulate the inverse parameter identification problem in a regularized least-square optimization problem. We adopt a functional framework in nonstandard Sobolev spaces to accommodate the higher-order boundary operator in order to ensure the well-posedness of the forward problem. We establish the existence of minimizers for the optimization problem, derive continuity and differentiability of the parameter-to-observation map, and obtain explicit adjoint-based gradient expressions enabling efficient gradient-based optimization. Moreover, we prove conditional strict convexity of the cost functional for sufficiently large regularization and one fixed parameter, which ensures uniqueness of the identified solution. We introduce a modified Morozov discrepancy principle to select the regularization level in the presence of noisy data. We conclude by some numerical simulations which prove accurate and stable reconstructions for constant and spatially varying parameters under noise-free and noisy measurements.

References

[1] L. Bourgeois, N. Chaulet, and H. Haddar, On simultaneous identification of a scatterer and its generalized impedance boundary condition, Tech. Report INRIA 7645, INRIA, 2011.

[2] F. Caubet, J. Ghantous, C. Pierre, Numerical study of a diffusion equation with Ventcel boundary condition using curved meshes. arXiv preprint arXiv:2302.02680, 2023.

[3] S. Chaabane and M. Jaoua, Identification of Robin coefficients by the means of boundary measurements, Inverse Problems, 15 (1999), pp. 1425–1438.

[4] . Kashiwabara, C. M. Colciago, L. Ded`e, A. Quarteroni, (2015). Well-posedness, regularity, and convergence analysis of the finite element approximation of a generalized Robin boundary value problem. SIAM Journal on Numerical Analysis, 53(1), 105-126.