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Irina Mitrea • Marius Mitrea

Multi-Layer Potentials and Boundary Problems

for Higher-Order Elliptic Systems in Lipschitz Domains

Springer

Irina Mitrea
Temple University
Department of Mathematics
Philadelphia, PA, USA

Marius Mitrea
University of Missouri
Department of Mathematics
Columbia, MO, USA

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Preface

Layer potentials constitute one of the most powerful tools in the treatment of boundary value problems associated with (elliptic and parabolic) partial differential equations (PDEs). They have been traditionally employed in the context of second-order PDE, and one of the main goals of this monograph is to systematically develop a multilayer theory applicable to the higher-order setting. This extension of the classical theory is carried out in the context of arbitrary Lipschitz domains and includes mapping properties of such multilayers associated with complex, matrix-valued, constant coefficient, homogeneous elliptic systems, in function spaces suitably adapted to the higher-regularity case (of Besov and Triebel–Lizorkin type), Carleson measure estimates, non-tangential maximal function estimates, jump-relations, etc., which turn out to be just as versatile and effective as their second-order counterparts. In particular, this theory applies to such basic differential operators like the Laplacian, the bi-Laplacian, the polyharmonic operator, and the Lamé system of elasticity, though the gist of the present work is constructing, for the first time, a comprehensive theory (of Calderón–Zygmund type) for singular integral operators of multilayer type associated with generic higher-order PDEs and to discuss some of the implications of this multilayer theory to the well-posedness of boundary value problems for higher-order PDEs. As such, one of the main purposes of this monograph is to address an obvious gap/discrepancy/imbalance in the present literature between the second- and higher-order case.

The intended audience consists of any mathematically trained scientist with an interest in boundary value problems and partial differential equations. While this is an original research monograph, significant effort has been put in to make the material as reasonably accessible as possible. In particular, this monograph should also be useful to junior scientists working in the area of PDE.

Philadelphia, PA — Irina Mitrea
Columbia, MO — Marius Mitrea
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