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LAYER POTENTIALS BEYOND SINGULAR INTEGRAL OPERATORS

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Abstract: We prove that the double layer potential operator and the gradient of the single layer potential operator are L_2 bounded for general second order divergence form systems. As compared to earlier results, our proof shows that the bounds for the layer potentials are independent of well posedness for the Dirichlet problem and of De Giorgi-Nash local estimates. The layer potential operators are shown to depend holomorphically on the coefficient matrix $A \in L_\infty$, showing uniqueness of the extension of the operators beyond singular integrals. More precisely, we use functional calculus of differential operators with non-smooth coefficients to represent the layer potential operators as bounded Hilbert space operators. In the presence of Moser local bounds, in particular for real scalar equations and systems that are small perturbations of real scalar equations, these operators are shown to be the usual singular integrals. Our proof gives a new construction of fundamental solutions to divergence form systems, valid also in dimension 2.

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Key words: Double layer potential, fundamental solution, divergence form system, functional calculus.