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abstract	This paper presents regularity results and associated high order numerical methods for one-dimensional fractional-Laplacian boundary-value problems. On the basis of a factorization of solutions as a product of a certain edge-singular weight Ï‰ times a "regular" unknown, a characterization of the regularity of solutions is obtained in terms of the smoothness of the corresponding right-hand sides. In particular, for right-hand sides which are analytic in a Bernstein ellipse, analyticity in the same Bernstein ellipse is obtained for the ``regular" unknown. Moreover, a sharp Sobolev regularity result is presented which completely characterizes the co-domain of the fractional-Laplacian operator in terms of certain weighted Sobolev spaces introduced in (BabuÅ¡ka and Guo, SIAM J. Numer. Anal. 2002). The present theoretical treatment relies on a full eigendecomposition for a certain weighted integral operator in terms of the Gegenbauer polynomial basis. The proposed Gegenbauer-based NystrÃ¶m numerical method for the fractional-Laplacian Dirichlet problem, further, is significantly more accurate and efficient than other algorithms considered previously. The sharp error estimates presented in this paper indicate that the proposed algorithm is spectrally accurate, with convergence rates that only depend on the smoothness of the right-hand side. In particular, convergence is exponentially fast (resp. faster than any power of the mesh-size) for analytic (resp. infinitely smooth) right-hand sides. The properties of the algorithm are illustrated with a variety of numerical results	This paper presents regularity results and associated high-order numerical methods for one-dimensional Fractional-Laplacian boundary-value problems. On the basis of a factorization of solutions as a product of a certain edge-singular weight w times a ``regularÂ´Â´ unknown, a characterization of the regularity of solutions is obtained in terms of the smoothness of the corresponding right-hand sides. In particular, for right-hand sides which are analytic in a Bernstein Ellipse, analyticity in the same Bernstein Ellipse is obtained for the ``regularÂ´Â´ unknown. Moreover, a sharp Sobolev regularity result is presented which completely characterizes the co-domain of the Fractional-Laplacian operator in terms of certain weighted Sobolev spaces introduced in (Babu{s}ka and Guo, SIAM J. Numer. Anal. 2002). The present theoretical treatment relies on a full eigendecomposition for a certain weighted integral operator in terms of the Gegenbauer polynomial basis. The proposed Gegenbauer-based Nystr"om numerical method for the Fractional-Laplacian Dirichlet problem, further, is significantly more accurate and efficient than other algorithms considered previously. The sharp error estimates presented in this paper indicate that the proposed algorithm is spectrally accurate, with convergence rates that only depend on the smoothness of the right-hand side. In particular, convergence is exponentially fast (resp. faster than any power of the mesh-size) for analytic (resp. infinitely smooth) right-hand sides. The properties of the algorithm are illustrated with a variety of numerical results.Fil: Acosta, Gabriel. Universidad de Buenos Aires. Facultad de Ciencias Exactas y Naturales. Departamento de MatemÃ¡tica; ArgentinaFil: Borthagaray, Juan Pablo. Universidad de Buenos Aires. Facultad de Ciencias Exactas y Naturales. Departamento de MatemÃ¡tica; ArgentinaFil: Bruno, Oscar Ricardo. California Institute Of Technology; Estados UnidosFil: Maas, MartÃn Daniel. Consejo Nacional de InvestigaciÃ³nes CientÃficas y TÃ©cnicas. Oficina de CoordinaciÃ³n Administrativa Ciudad Universitaria. Instituto de AstronomÃa y FÃsica del Espacio. - Universidad de Buenos Aires. Facultad de Ciencias Exactas y Naturales. Instituto de AstronomÃa y FÃsica del Espacio; Argentin		
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