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Fundamental Solutions for Discrete Dynamical Systems Involving the Fractional Laplacian

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Abstract : In this work, we obtain representation results for solutions of a time-fractional differential equation involving the discrete fractional Laplace operator in terms of generalized Wright functions. Such equations arise in the modeling of many physical systems, for example, chain processes in chemistry and radioactivity. The focus is on the linear problem of the simplified Moore - Gibson - Thompson equation, where the discrete fractional Laplacian and the Caputo fractional derivate of order on (0,2] are involved. As a particular case, we obtain the explicit solution for the discrete heat equation and discrete wave equation. Furthermore, we show the explicit solution for the equation involving the perturbed Laplacian by the identity operator. The main tool for obtaining the explicit solution are the Laplace and discrete Fourier transforms, and Stirling's formula. The methodology mainly is to apply both transforms in the equation, to find the inverse of each transform, and to prove that this solution is well defined, using Stirling´s formula.

Keywords : discrete fractional Laplacian, explicit representation of solutions, fractional heat and wave equations, fundamental
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