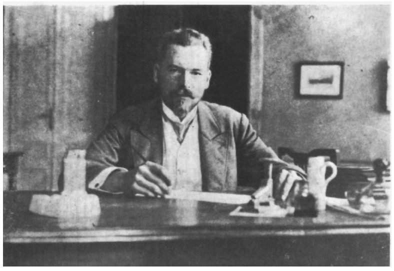

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Integral decomposition for the solutions of the generalized Cattaneo equation

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We present the integral decomposition for the fundamental solution of the generalized Cattaneo equation with both time derivatives smeared through convoluting them with some memory kernels. For power-law kernels $t^{-\alpha}$, $\alpha \in (0, 1]$ this equation becomes the time fractional one governed by the Caputo derivatives in which the highest order is 2.To invert the solutions from the Fourier-Laplace domain to the space-time domain we use analytic methods based on the Efross theorem and find out that solutions looked for are represented by integral decompositions which tangle the fundamental solution of the standard Cattaneo equation with nonnegative and normalizable functions being uniquely dependent on the memory kernels. Furthermore, the use of methodology arising from the theory of complete Bernstein functions allows us to assign such constructed integral decompositions the interpretation of subordination. This fact is preserved in two limit cases built into the generalized Cattaneo equations, i.e., either the diffusion or the wave equations. We point out that applying the Efross theorem enables us to go beyond the standard approach which usually leads to the integral decompositions involving the Gaussian distribution describing the Brownian motion. Our approach clarifies puzzling situation which takes place for the power-law kernels $t^{-\alpha}$ for which the subordination based on the Brownian motion does not work if $\alpha \in (1/2, 1]$.

[1] K. Górska, Integral decomposition for the solutions of the generalized Cattaneo equation, Phys. Rev. E 104 (2021) 024113

[2] K. Górska, A. Horzela, E. K. Lenzi, G. Pagnini, T. Sandev, Generalized Cattaneo (telegrapher's) equations in modeling anomalous diffusion phenomena, Phys. Rev. E 102 (2020) 022128

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