ψ–Katugampola Fractional Derivatives and Integrals-Application to Mass–Spring Damper System

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Abstract

We propose a new type of generalized fractional derivatives with respect to (wrt) another function. These new generalized fractional derivatives generalize ψ–Caputo, Riemann–Liouville (R–L) wrt another function, Caputo Hadamard wrt another function, R–L Hadamard wrt another function, Caputo, R–L, Caputo Hadamard and R–L Hadamard fractional derivatives. We propose a newly modified Laplace transform for linear ψ–Katugampola fractional differential equations (FDEs). Properties of this newly generalized Laplace transform are analyzed. Cauchy problems and mass-spring damper system with ψ–Katugampola fractional derivative are solved analytically by means of modified Laplace transform. Finally, a new numerical method is proposed for nonlinear ψ–Katugampola FDEs.

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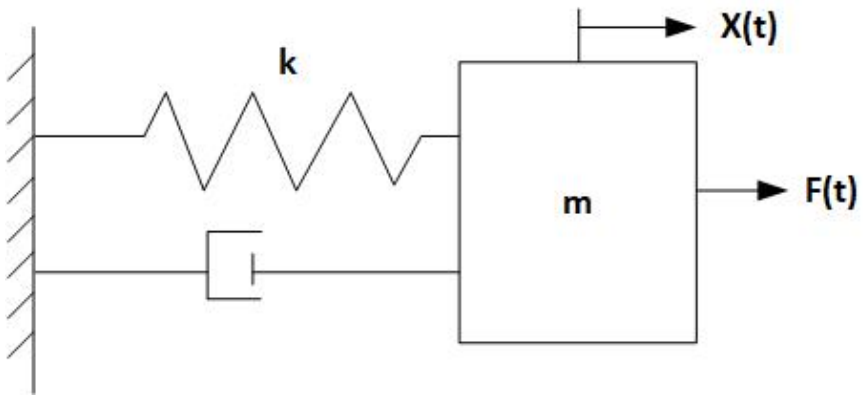
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