

Fractional Integrable Nonlinear Soliton Equations

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Abstract

Nonlinear integrable equations are extremely important in the study of nonlinear dynamics and fractional equations are well known in anomalous diffusion. We connect these two fields by presenting the discovery of a new class of integrable fractional nonlinear evolution equations describing dispersive transport in fractional media. These equations can be constructed from nonlinear integrable equations using generalizable mathematical methods. This method is used to characterize fractional extensions to two physically relevant, universal integrable nonlinear equations: the Korteweg–de Vries and nonlinear Schrödinger equations, as well as many other nonlinear equations. These fractional equations are shown to predict super-dispersive transport of non-dissipative solitons in fractional media.