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EFFICIENT APPROXIMATE SOLUTIONS OF THE FRACTIONAL KURAMOTO–SIVASHINSKY EQUATION VIA SHEHU RESIDUAL POWER SERIES TECHNIQUE

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Abstract. This work employs the Shehu-residual power series method (SRPSM) to construct approximate solutions for the time-fractional Kuramoto-Sivashinsky (KS) equation. This strongly nonlinear evolution equation is widely recognized for describing complex chaotic dynamics in numerous physical contexts, such as reaction-diffusion systems, ion-acoustic waves in plasmas, and flame-front propagation. The presented SRPSM merges the straightforward idea of the residual power series with the convenient properties of the Shehu transform. The resulting hybrid approach delivers closed-form series solutions that exhibit rapid convergence to the exact result, without any need for discretization, linearization, small-parameter assumptions, or restrictive perturbation methods. Numerical tests confirm that the obtained approximations attain excellent accuracy when compared with exact solutions. Moreover, the simulations clearly reveal the significant influence of the fractional order ς on both the amplitude of travelling waves and the overall chaotic behaviour.

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