FINITE ELEMENT METHOD FOR A TIME-SPACE FRACTIONAL ALLEN–CAHN EQUATION

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Abstract. This work introduces and analyzes a finite element scheme for a non-local version of the Allen–Cahn equation involving fractional-in-time and in-space differentiation operators. We use the Caputo derivative in time and the fractional Laplacian (in its integral form) in space. We discuss well-posedness and obtain regularity estimates for the problem under consideration. The discrete scheme we develop is based on piecewise linear elements for the space variable and a convolution quadrature for the time component. Finally, we study the asymptotic behavior of the solutions with respect to the increase of the non-locality in the diffusion term.

Keywords: Finite element method, fractional Laplacian, Caputo fractional derivative.

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