

## Title : Time-Fractional Allen-Cahn Equations: Analysis and Numerical Methods

by

Jiang Yang ([yangj7@sustech.edu.cn](mailto:yangj7@sustech.edu.cn))

Abstract: In this work, we consider a time-fractional Allen-Cahn equation. First, the well-posedness and (limited) smoothing property are systematically analyzed, by using the maximal  $L^p$  regularity of fractional evolution equations and the fractional Gronwall's inequality. We also show the maximum principle like their conventional local-in-time counterpart. Second, after discretizing the fractional derivative by backward Euler convolution quadrature, we develop several unconditionally solvable and stable time stepping schemes. Finally, by using a discrete version of fractional Gronwall's inequality and maximal  $\ell^p$  regularity, we prove that the convergence rates of those time-stepping schemes are  $O(\tau^\alpha)$  without any extra regularity assumption on the solution. We also present extensive numerical results to support our theoretical findings and to offer new insight on the time-fractional Allen-Cahn dynamics.