FEM for Fractional Evolution Problems

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In this talk we introduce a finite element scheme for evolution problems involving fractional-in-time and in-space differentiation operators up to order two. The left-sided fractional-order derivative in time we consider is employed to represent memory effects, while a nonlocal differentiation operator in space accounts for long-range dispersion processes. We discuss well-posedness and obtain regularity estimates for the evolution problems 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. We present approximation error estimates for our method and illustrate its performance with numerical experiments in one- and two-dimensional domains.

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