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## Boundary State Reconstruction for Semilinear Caputo Fractional Systems

### Communication Info

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(1) Regional Boundary

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(2) Caputo Derivative

(3) Control Theory

(4) Fixed Point

(5) Semilinear Fractional

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### Abstract

This work deals with the regional boundary reconstruction of the initial state for a semilinear time-fractional system governed by the Caputo derivative. The objective is to recover the initial state on a prescribed boundary sub-region rather than on the whole domain.

Our approach is based on establishing a rigorous link between the approximate regional observability of the linear part in a suitable internal sub-region and the regional boundary observability of the full semilinear system. Under appropriate assumptions on the analytic semigroup generated by the system operator and on the nonlinear term, we prove that boundary reconstruction can be achieved through an internal reconstruction procedure. Existence and uniqueness results are obtained using fixed-point arguments, and an explicit iterative sequence converging to the unknown regional initial state is derived.

An implementable algorithm is proposed, and numerical simulations with zonal and pointwise sensors confirm the effectiveness of the method and illustrate the influence of sensor placement on reconstruction accuracy.

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