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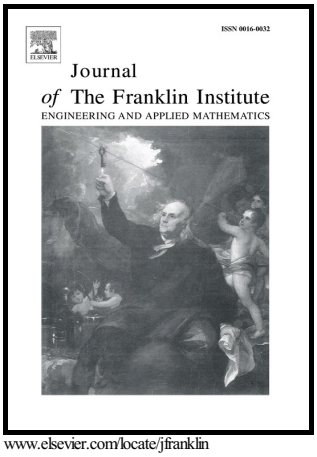


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# Fractional Order Iterative Learning Control with Randomly Varying Trial Lengths☆

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**Abstract**

In this paper, we establish a uniformly framework to deal with varying tracking problem in the finite time interval for fractional order system. In order to tracking the reference trajectory associated with nonlinear fractional differential systems with randomly varying trial lengths, we design a new type iterative learning control of the output equation with nonlinear input involving an integral term. As a result, convergence analysis results for several classes of learning laws with local average operator are given. Finally, some examples are given to illustrate our results.

*Keywords:* Iterative learning control, Fractional calculus, Forgetting factor, Varying reference trajectory.

## 1. Introduction

The concept of iterative learning control (short for ILC) was initially introduced in 1980s (see [1, 2, 3]). It has been widely researched in the filed of theory analysis and applications (see [4, 5, 6, 7, 8, 9]). Fractional calculus via differential equations are gaining much more attention in more and more research areas, like physics, engineering and control (see [10, 11, 12, 13, 14, 15, 16, 18, 19, 20, 21, 22, 23]). Recently, qualitative theory and various control problem of several types of fractional differential equations or inclusions have been paid more and more attention [24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 46, 47, 48] and the reference therein. In particular, Kerboua et al. [49, 50] give some sufficient conditions to guarantee the approximate controllability for fractional stochastic dynamic systems of Sobolev type with nonlocal conditions in Hilbert spaces. Moreover, Bragdi et al. [51] apply the fixed point technique to present existence of solutions for a class of some separated boundary differential inclusions of fractional order $2 < \alpha < 3$ involving the Caputo derivative. Next, the authors [52] analyze the stability of fractional order linear system with

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