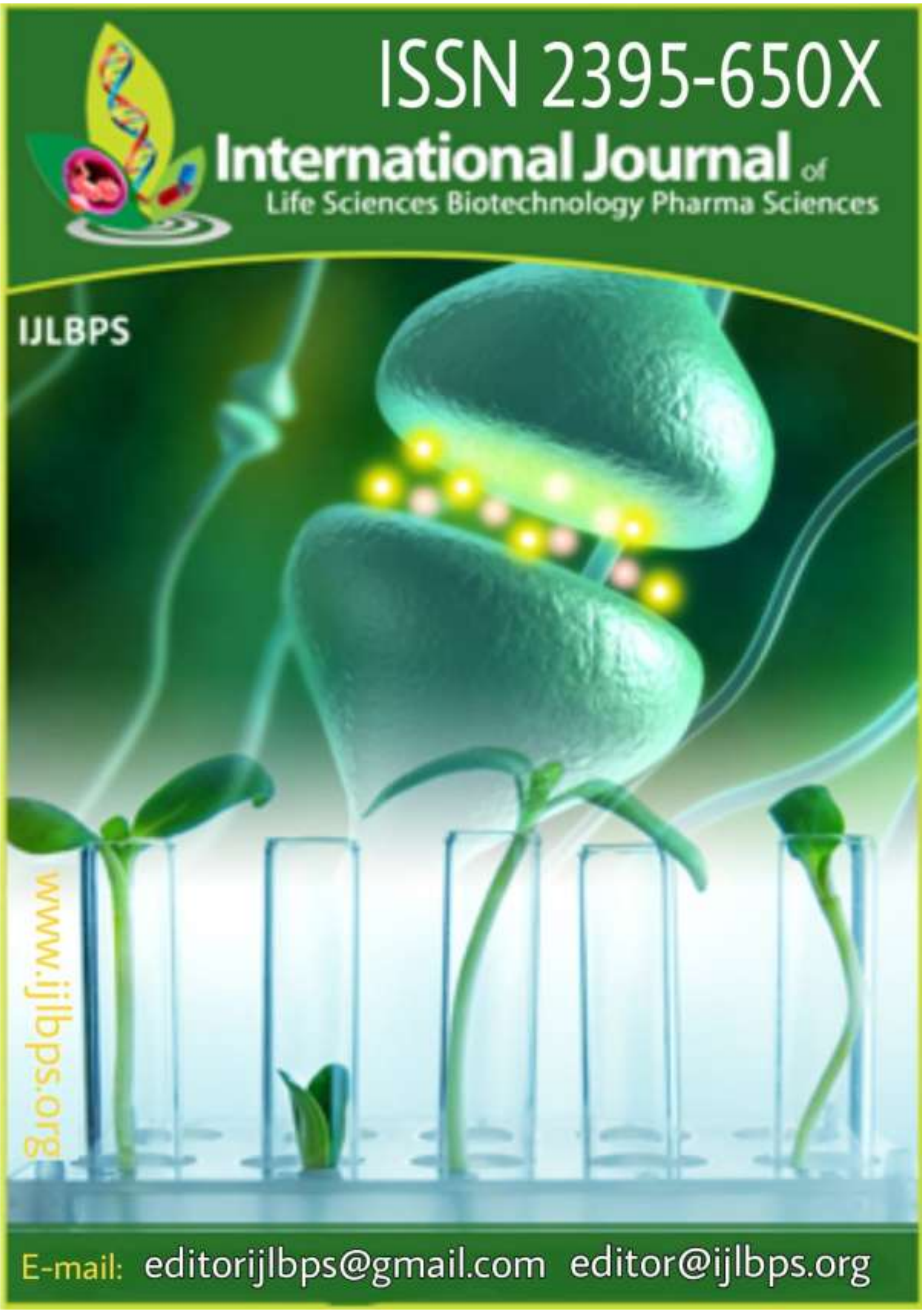
ISSN 2395-650X
International Journal of
Life Sciences Biotechnology Pharma Sciences
IJLBPS
www.ijlbps.org
E-mail: editorijlbps@gmail.com editor@ijlbps.org

International Journal of Life Sciences Biotechnology Pharma Sciences

Volume 9 Issue2 2021

MODELLING AND ANALYSIS ON ROBOTIC MANIPULATORS

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ABSTRACT

Originally practical use of fractional differential operators in transmission line analysis of electrical systems is made by Oliver Heaviside in 1890, after Guillaume de l'Hôpital first proposed the concept of fractional calculus. The lack of a physical understanding of FC made it unpopular among engineers and scientists. Derivatives and integrals of the fractional order (FO) do not have the same properties as those of the integer-order derivatives or integrals. However, because of this, they can be generalized (fractional or non-integer order) An unstable pendulum system on a cart was used in this thesis, and controlling such systems can be a bit of a challenge. Heavy loads are often transported using a 2-D Gantry crane system, which is controlled by workers manually and often attained at the user's ability level to transport and may lead to serious mishaps. We provide in this thesis a new approach for improving FO models of systems in order to develop controllers without using hit-and-trial methods that yield fractional models. Results from this technique are compared to previous fractionalorder models. For these existing models, we propose a new fractional-order model that enhances performance by a factor of two.

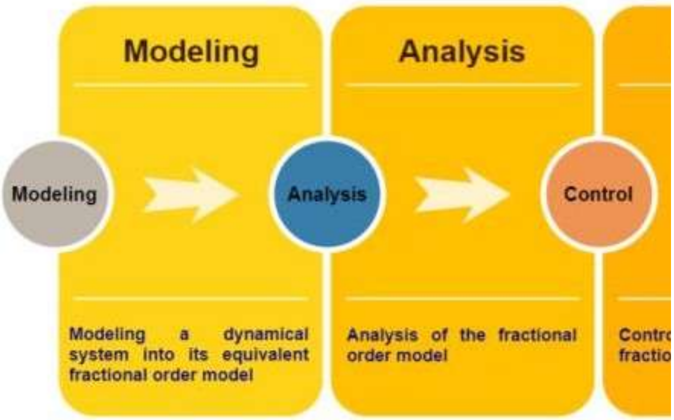
1. INTRODUCTION

It can be applied to both integer and fractional order equations in FC, which is a variation of differential calculus that uses fractional order integratives and derivatives. FC has attracted a lot of attention in recent years, with a variety of applications, particularly in control systems, being discovered. Fractional system order modeling outperforms the Integer model in terms of performance. The Integer Order Model is an approximation of a FO model in its own right. For example, noise filtering and rejection, resilience, transient stability, and noise filtering and rejection can all be improved by using the fractional model implementation.of disturbances. Another major problem is thedesign of a controller for a particular system,andeveninthisfield,partialorder(FO)Thecontrollers have done a fantastic job. A FO Integrator and FO Differentiator for a fractional order system were found to be Fractional Order PID controllers in the first work of Podlubny[1,2] (FOPID). It is possible to carefully and accurately construct FOPID controllers to suit system requirements because of the controller's increased number of configurable parameters.

Famous mathematicians like as Liouville, Weyl, and Riemann made a substantial contribution to the field of mathematics.

the process via which the FC was created. The history of fractional calculus (FC) study may be traced back to Sonin, Krug, Abel, Fourier, Lacroix, Grunwald, Leibniz, and Letnikov, who have made significant contributions to the field over the course of several centuries [3, 5]. It wasn't until 1974[5] that a treatise on fractional calculus was published. For a wide range of frequencies and times[6-8], it is now known that FO systems can represent systems, processes, and concepts with computable and compact models.

Plant response characteristics that are inappropriate or undesired can be handled by



Plant response characteristics that are

$$H(s) = \begin{pmatrix} \frac{0.1s^2+0.24}{s^4+1.64s^2} & \frac{-0.03}{s^2+1.64} \\ \frac{-0.01}{s^2+1.64} & \frac{-0.004}{s^2+1.64} \end{pmatrix}$$

inappropriate or undesired can be handled by advanced control systems using FO controls and signal filtering methods [9, 10].

The fractional integrated differential, or FC operator, is extremely popular in the fields of robotics and control engineering because of its flexibility. Transient and frequency responses accompany the FO Integral Model to demonstrate its use in control engineering.

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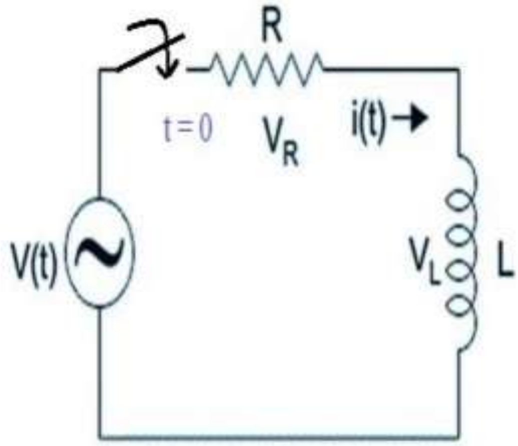


Figure3.1: RLCircuit

The fractional modeling can be better understood by using an example of an RL circuit. An inductor (L) and resistor (R) are shown in Figure 3.1, with a switch connecting the supply voltage to the inductor. i(0) = 0 is the beginning condition for this circuit because the inductor does not allow for a sudden shift in current.

Fractional Embedding to Missile LaunchingPad/Vehicle(MLV)

Now,ifweconsidermulti-inputandmulti-output systems, let us move to a bit greatercomplexity.

7. One or more ground-to-ground missiles, as well as personnel and equipment for managing and controlling the launch of those weapons, make up a missile launch vehicle. Launching a missile is accomplished through the employment of the missiles. Many rocket launchers are operated by hand. Launch vehicles' angular movements must be regulated if missiles are to be launched correctly.

8. **EXPERIMENTALVALIDATION**

We'll examine how effective a FO controller is in real-time systems in this chapter. Three alternative controller design situations are shown in this chapter.presented. The IO model of a system and the FO controller design is the first approach. The IO Controller and FO model is the second technique. The final option is to use the FO model and the FO controller. Experiments with two separate robotic manipulators are used to verify the controller designs in all three of these scenarios.

When designing a FO controller, two different types of 2DOF Serial Flexible Link Robotic Manipulators and two 2DOF Serial Flexible Joint Robotic Manipulators were considered:.

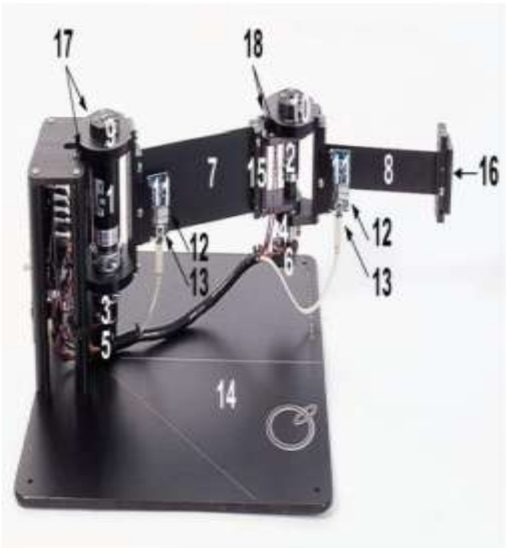


Figure4.1:2DOFSerialLinkRoboticMani pulator.

Figure 4.2 shows the 2DOF Serial Flexible Joint (2DSFJ) Robot. Two DC motors drive symphonic gearboxes, and a two-bar sequential linkage connects the entire robot system. Stiffness in both joints. Two springs are used for each adjustable joint. For each spring end, a thumbscrew tool is available for adjusting its position along the assistance bars. Let's take a closer look at these robots' components.

Figure 4.2: 2DOF Serial Joint RoboticManipulator

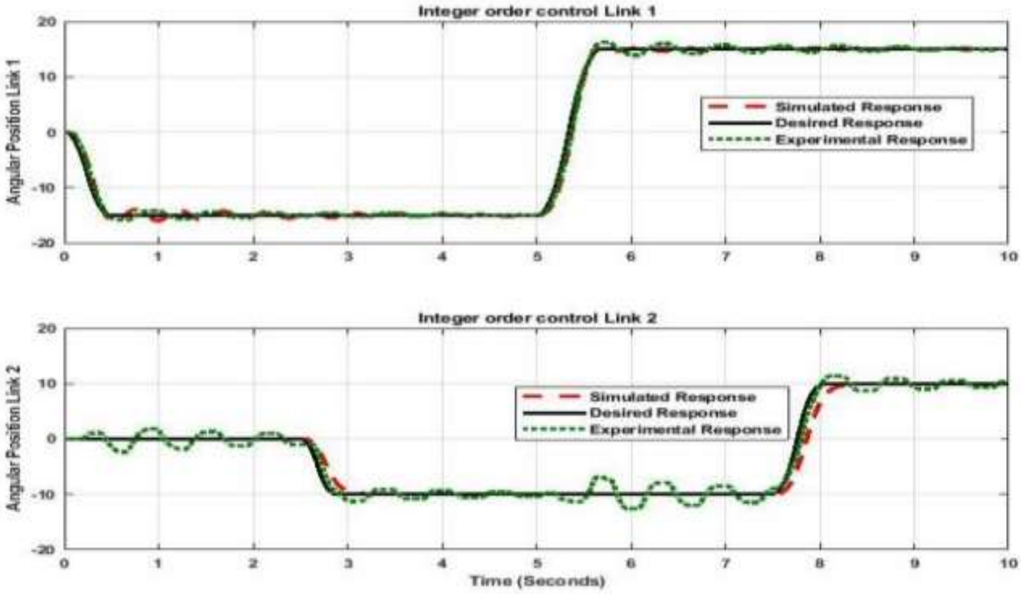
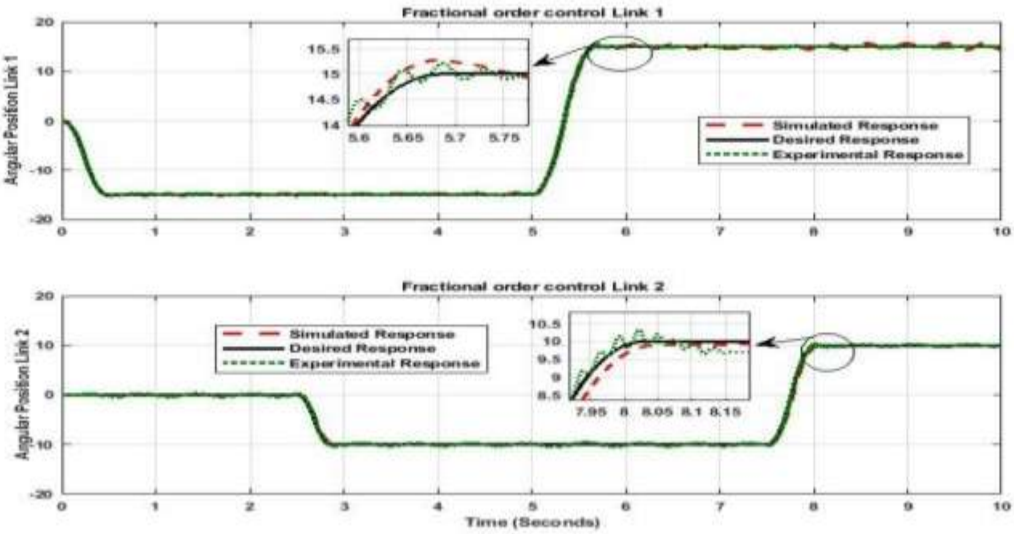


Figure4.3:FOControllerDesignforIOModelof2DSFLRobotic Manipulator

In Fig. 4.3, the simulated and experimental responses are illustrated. As shown in Figure 4.4, the 2DSFL is tracking the desired reaction with Link 1 and Link 2 of the 2DSFL. With oscillations in Link 1 and Link 2, the IO controller requires a longer period of time to stabilize than the FO controller. For



the sake of comparison, the tuned values of P, I, and D for the IO controller and FO controller are left constant..As seen in Figs. 4.3 and 4.4, a FO controller can provide better-controlled responses than IO, and the controller's and values can be changed to achieve a more precise control of the response.

FOControllerDesignforIOmodelof2DSFJRoboticManipulatorandExperimental Validation systemhastwojoints,bothofwhicharenotconnected.Thereisthusanindependentdesign for the controls for the corner positionof these two. Four cases were considered todesign the controller according to the angularposition.Thefollowing are:-

1. Joint1ControllerandJoint2ControllerFractional

2. Joint1ControllerandJoint2ControllerFractional

3. Joint1ControllerandJoint2IntegerControllerJoint

4. Joint1Integerand2IntegerController

CONCLUSION

When compared to human operators, robots are more precise and accurate. This project's major goal is to help people.

As the demand for more precise manipulators grows, researchers are working to improve the efficiency and control of robotic manipulators. A POAC system's FO modeling parameters are discovered by a trial-and-error approach. For the POAC FO Model, MATLAB simulations are performed and compared to the findings of the regular IO Model for the same system. The simulation results clearly illustrate that the regulated output of the FO Model has a better transient response than the IO model.

FO modeling of a two-dimensional garage crane system is based on a trial and error approach. The 2D Gantry Crane FO model is simulated in MATLAB and compared to the regular IO model of the same system. The simulation results clearly illustrate that the regulated output of the FO Model has a better transient response than the IO model.

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