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Article

An Artificial Approach for the Fractional Order Rape and Its Control Model

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Abstract: The current investigations provide the solutions of the nonlinear fractional order mathematical rape and its control model using the strength of artificial neural networks (ANNs) along with the Levenberg-Marquardt backpropagation approach (LMBA), i.e., artificial neural networks-Levenberg-Marquardt backpropagation approach (ANNs-LMBA). The fractional order investigations have been presented to find more realistic results of the mathematical form of the rape and its control model. The differential mathematical form of the nonlinear fractional order mathematical rape and its control model has six classes: susceptible native girls, infected immature girls, susceptible knowledgeable girls, infected knowledgeable girls, susceptible rapist population and infective rapist population. The rape and its control differential system using three different fractional order values is authenticated to perform the correctness of ANNs-LMBA. The data is used to present the rape and its control differential system is designated as 70% for training, 14% for authorization and 16% for testing. The obtained performances of the ANNs-LMBA are compared with the dataset of the Adams-Bashforth-Moulton scheme. To substantiate the consistency, aptitude, validity, exactness, and capability of the LMBA neural networks, the obtained numerical values are provided using the state transitions (STs), correlation, regression, mean square error (MSE) and error histograms (EHs).

Keywords: Rape and its control differential system; neural networks; fractional order; levenberg-marquardt backpropagation approach; reference solutions

1 Introduction

This study represents the naive susceptible population, which have not proper connection with the sex activities. The knowledgeable susceptible populations represent the previous information of sex. *Nv* shows the total susceptible girl's population, which is separated into subclasses of susceptible naive Sn, infected knowledgeable I_k, susceptible knowledgeable S_k and infected naive I_n. Therefore, the total naive girl's population is $N_v = I_n + S_n + I_k + S_k$. The factor NR represents the whole rapist population and is categorized into infective rapist IR and susceptible rapist SR, written as $NR = I_R + S_R$. All vulnerable recruitment classes are supposed to the naive susceptible population with immigration or/and birth at λv. The naive susceptible vulnerable girl's population is enhanced by the infected naive, which can be improved without knowledgeable at γ_n. It is reduced by infection force Λ_v and the natural death rate ϕ_v with the actual rapist contacts. The infection force through the rapists to susceptible females is demonstrated as $\Lambda v = \frac{abI_R}{Nh}$, here a is rapist's contact rate and b is infection force of vulnerable susceptible women, i.e., $\frac{dS_n(x)}{dx} = \lambda_v - \phi_n S_n(x) + \gamma_n I_n(x) - \Delta_v S_n(x) - a_n S_n(x) - \mu_1 S_n(x)$.

The knowledgeable susceptible population of the vulnerable is produced by the naive healthier, which educated through the rate β_n and growing susceptible naïve, which become knowledgeable without raped at α_n rate. The infected knowledgeable individuals increased by improving the rate γ_k. It is decreased due to the force of infection $\Lambda v = \frac{abI_R}{Nv}$ along with the natural death rate ϕ_v, i.e., $\frac{dS_k}{dx} = \alpha_n S_n - \phi_v S_k + \gamma_k I_k - \Delta_v S_k + \beta_n I_n - \mu_3 S_k$. The vulnerable population through the infected naive women is produced by using the vulnerable susceptible population based on the naive raped women. The infected recovered naive can be decreased by using the population based on the maintains or knowledgeable. The rate of natural death can be decreased at a rate ϕ_v along with the rape connected to death δn, i.e., $\frac{dI_n}{dx} = \Delta_n S_n - (\gamma_n + \beta_n + \delta_n + \phi_n) I_n - \mu_2 I_n$.

The infected knowledgeable vulnerable population girls are produced from the vulnerable susceptible population through the rapist based knowledgeable girls. That shows the infected/recovered knowledgeable girls, rape related death δ_k and natural death at a rate ϕ_v, i.e., $\frac{dI_k}{dx} = \Delta_v S_k - (\gamma_k + \delta_k + \phi_v) I_k - \mu_4 I_k$. The population of susceptible rapist is increased through the social difficulties, which produce the sexual strength at λ_R. The contact ration of the knowledgeable, vulnerable, and infected women decreased with the natural death ϕR along with the infection force i.e., $\Lambda R = \frac{\tau_k I_k}{N_R}$. The dynamical form of this representation is given as $\frac{dS_R}{dx} = \lambda_R - \phi_R S_R - \Delta_R S_R - \mu_5 S_R$. The infective rapist's population is enhanced by the susceptible rapist ΛR and decreased by ϕR (natural rate of death) is being caught δR, i.e., $\frac{dI_R}{dx} = \Delta_R S_R - (\phi_R + \delta_R) I_R - \mu_6 I_R$.

There are various studies that have been proposed to solve the dynamical models. To mention few of the studies are epidemic SIR models with equal death and birth rates have been proposed by the analytic schemes [1], stochastic procedures have been proposed to solve the HIV differential model [2], dynamical behavior and analytical solutions of nonlinear fractional differential systems arising in chemical reaction [3], nonlinear model based on dengue fever [4], nonlinear Parabolic dynamical wave equations [5], buckling of improved couples based functionally porous classified micro-plates [6], a system based on the phase-field using the fracture spread in the poroelastic media [7], dynamical studies of a fractional SITRS discrete system [8], dynamic study through the porous graded beam along with the sinusoidal rate of deformation shear model [9], the behavior of tumor as well as immune cells using the immunogenetic system based on the fractional kinds of the non-singular derivatives [10] and many more [11–29].

In this work, a fractional order mathematical rape and its control model is numerically discussed by using the strength of artificial neural networks (ANNs) together with the Levenberg-Marquardt backpropagation approach (LMBA), i.e., ANNs-LMBA.

The remaining parts of the paper are organized as: The design of fractional order model is described in Section 2. The stochastic applications are reported in Section 3. The structure of ANNs-LMBA is explained in Section 4. The simulations of the fractional order model are derived in Section 5. Conclusions are discussed along with future research in the last Section.

2 Mathematical Construction of the Fractional Order Mathematical Rape and Its Control Model

In this section, the design of fractional order mathematical rape and its control model is provided. The differential mathematical form of the nonlinear mathematical rape and its control model has six classes: susceptible native girls, infected immature girls, susceptible knowledgeable girls, infected knowledgeable girls, susceptible rapist population and infective rapist population. The mathematical form of the nonlinear mathematical rape and its control model is given as [30]:

$$\begin{cases} \dfrac{dS_n(x)}{dx} = \lambda_v - \phi_n S_n(x) + \gamma_n I_n(x) - \Delta_v S_n(x) - a_n S_n(x) - \mu_1 S_n(x), & S_n(0) = l_1, \\ \dfrac{dI_n(x)}{dx} = \Delta_n S_n(x) - (\gamma_n + \beta_n + \delta_n + \phi_n) I_n(x) - \mu_2 I_n(x), & I_n(0) = l_2, \\ \dfrac{dS_k(x)}{dx} = \alpha_n S_n(x) - \phi_v S_k(x) + \gamma_k I_k(x) - \Delta_v S_k(x) + \beta_n I_n(x) - \mu_3 S_k(x), & S_k(0) = l_3, \\ \dfrac{dI_k(x)}{dx} = \Delta_v S_k(x) - (\gamma_k + \delta_k + \phi_v) I_k(x) - \mu_4 I_k(x), & I_k(0) = l_4, \\ \dfrac{dS_R(x)}{dx} = \lambda_R - \phi_R S_R(x) - \Delta_R S_R(x) - \mu_5 S_R(x), & S_R(0) = l_5, \\ \dfrac{dI_R(x)}{dx} = \Delta_R S_R(x) - (\phi_R + \delta_R) I_R(x) - \mu_6 I_R(x), & I_R(0) = l_6. \end{cases} \quad (1)$$

The detail of each parameter of nonlinear mathematical rape and its control model is provided in Tab. 1.

Table 1: Comprehensive detail of each parameter of the nonlinear mathematical rape and its control model

Parameters	Details
$S_n(x)$	Susceptible native girls
$I_n(x)$	Infected immature girls
$S_k(x)$	Susceptible knowledgeable girls
$I_k(x)$	Infected knowledgeable girls
$S_R(x)$	Susceptible rapist population
$I_R(x)$	Infective rapist population
ϕ_R	Natural death in the population of rapist
λ_v	Rate of recruitment into vulnerable population

(Continued)

Table 1: Continued

Parameters	Details
δ_R	Rapist rate to be caught
ϕ_v	Rate of natural death in vulnerable people
β	vulnerable rate to becomes knowledgeable
γ_n, γ_k	Infected rate becomes susceptible in knowledgeable and naive populations
Δ_n, Δ_k	Susceptible rate becomes infected in knowledgeable and naïve populations
Δ_R	Susceptible rate to becomes infected in population the population of rapist
β_n	Infected rate to convert naive into susceptible
λ_R	Rate of recruitment into rapist people
$\mu_p, p = 1, 2, 3 \ldots 6$	optimal control functions
$l_q, q = 1, 2, 3 \ldots 6$	ICs
x	Time

The present work shows a nonlinear fractional order mathematical rape and its control model (1) based on the artificial intelligence (AI) together with the ANNs-LMBA. The construction of the fractional order mathematical rape and its control model is shown as:

$$\begin{cases} \dfrac{d^{(v)}S_n(x)}{dx^{(v)}} = \lambda_v - \phi_n S_n(x) + \gamma_n I_n(x) - \Delta_v S_n(x) - a_n S_n(x) - \mu_1 S_n(x), & S_n(0) = l_1, \\ \dfrac{d^{(v)}I_n(x)}{dx^{(v)}} = \Delta_n S_n(x) - (\gamma_n + \beta_n + \delta_n + \phi_v) I_n(x) - \mu_2 I_n(x), & I_n(0) = l_2, \\ \dfrac{d^{(v)}S_k(x)}{dx^{(v)}} = \alpha_n S_n(x) - \phi_v S_k(x) + \gamma_k I_k(x) - \Delta_v S_k(x) + \beta_n I_n(x) - \mu_3 S_k(x), & S_k(0) = l_3, \\ \dfrac{d^{(v)}I_k(x)}{dx^{(v)}} = \Delta_v S_k(x) - (\gamma_k + \delta_k + \phi_v) I_k(x) - \mu_4 I_k(x), & I_k(0) = l_4, \\ \dfrac{d^{(v)}S_R(x)}{dx^{(v)}} = \lambda_R - \phi_R S_R(x) - \Delta_R S_R(x) - \mu_5 S_R(x), & S_R(0) = l_5, \\ \dfrac{d^{(v)}I_R(x)}{dx^{(v)}} = \Delta_R S_R(x) - (\phi_R + \delta_R) I_R(x) - \mu_6 I_R(x), & I_R(0) = l_6. \end{cases} \tag{2}$$

where v shows the fraction order derivative of the mathematical rape and its control model.

3 Novel Features and Frameworks of the Stochastic Solvers

In this section, the solutions of the fractional kind of mathematical rape and its control model are presented using the ANNs-LMBA. The stochastic computing performances through the ANNs based on the local and global operators have been implemented to solve several nonlinear, stiff, complex, and singular models [31–43]. Recently, these applications have been used to solve the Lane-Emden nonlinear system [44], functional order system [45], singular form of the fractional order equations [46–48], periodic differential system [49], delayed differential systems [50] and HIV infection based mathematical models [51,52].

The motive of this study is to provide the fractional order investigations based on the mathematical rape and its control model using the ANNs-LMBA. There are various applications related to the fractional order derivatives have been proposed based on the system conditions. Few of the fractional derivative applications based on the real-world system applications are provided in these references [53–55]. Furthermore, the stochastic procedures recently have been used to solve the fractional order models, like infection-based fractional-order nonlinear prey-predator system [56], seventh order singular system [57], fractional-order SIDARTHE COVID-19 pandemic differential model [58], fractional order dynamical nonlinear susceptible infected and quarantine differential model [59], immune-chemotherapeutic treatment for breast cancer [60], Bagley–Torvik mathematical model [61] and fractional infectious disease model [62]. The novel features of the designed stochastic ANNs-LMBA for the fractional order mathematical rape and its control model are designated as:

- A design of the mathematical nonlinear model is constructed based on the fractional order mathematical rape and its control model.
- The stochastic procedures have not been implemented before for the fractional order mathematical rape and its control model.
- The investigations using the stochastic numerical paradigms are effectively accessible using the fractional order mathematical rape and its control model.
- The design of LMBA using the procedures of AI is accessible for the fractional order mathematical rape and its control model.
- The different variants of the fractional order mathematical rape and its control model have been proposed numerically to validate the consistency of the proposed ANNs-LMBA.
- The comparison of the obtained and reference (Adams-Bashforth-Moulton) solutions indicate the brilliance of the proposed ANNs-LMBA.
- The accuracy and convergence of the proposed numerical ANNs-LMBA scheme is performed through the performance of the absolute error (AE), which is accomplished in good order for the fractional order mathematical rape and its control model.
- The STs, regression, MSE, correlation and regression performances support the constancy and dependability of the proposed ANNs-LMBA scheme for the fractional order mathematical rape and its control model.

4 Proposed Method: ANNs-LMBA

In this section, the proposed ANNs-LMBA structure for the fractional order mathematical rape and its control model is presented. The methodology ANNs-LMBA is divided in two sections. First, the critical performances of ANNs-LMBS operative are drawn. Whereas the implementation of ANNs-LMBA is executed for the fractional order mathematical rape and its control model.

Fig. 1 shows the multi-layer procedures of optimization through the numerical stochastic ANNs-LMBA. The statistical ANNs-LMBA solvers are indicated using the command 'nftool' in Matlab with the assortment of data as 70% for training, 14% for authorization and 16% for testing.

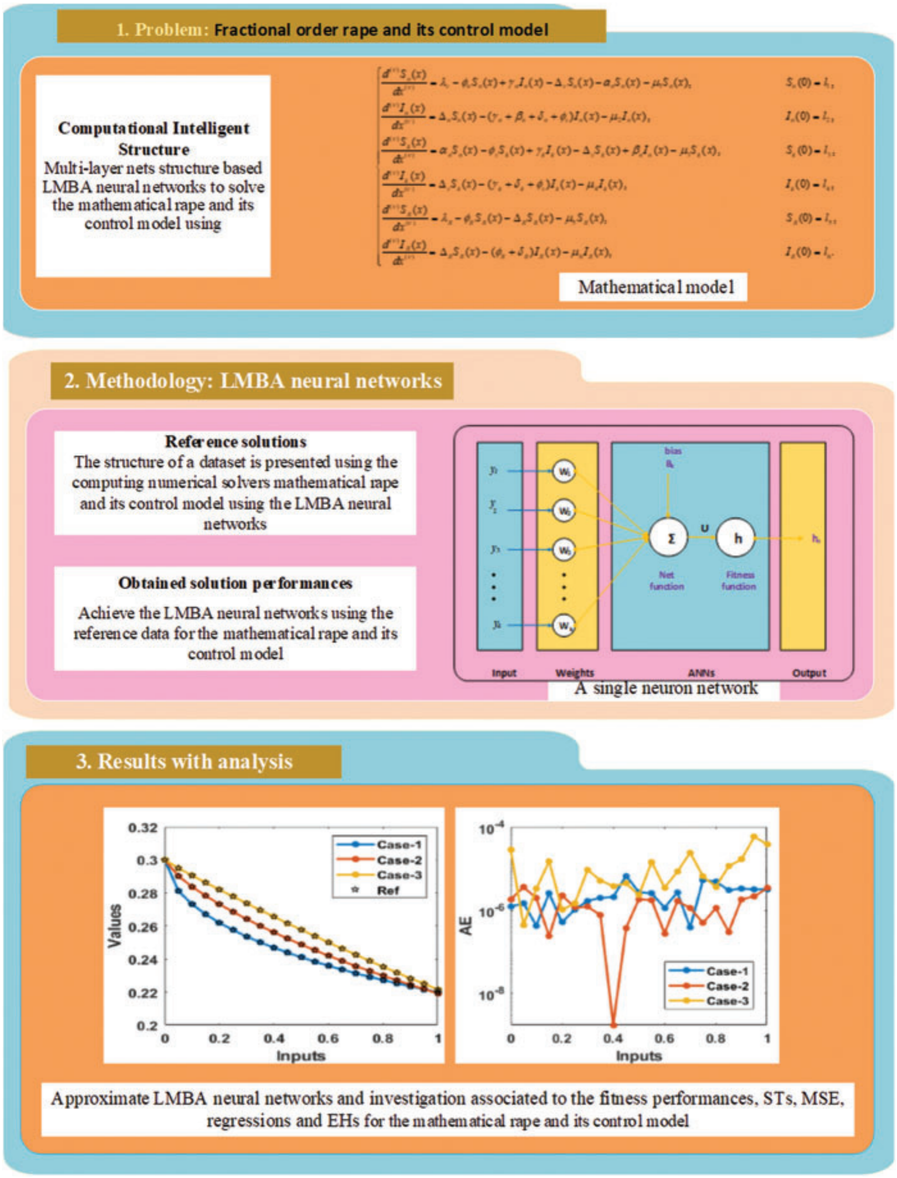


Figure 1: Workflow of ANNs-LMBA for the fractional order mathematical rape and its control model

5 Numerical Result Performances Using the Proposed Scheme

In this section, the mathematical rape and its control model along with three different variants is presented. The proposed scheme ANNs-LMBA is applied to find the numerical solutions of the mathematical rape and its control model, mathematically signified as:

Case 1: Consider a fractional order rape and its control model using the $\nu = 0.5$, $\lambda_\nu = 0.1$, $\beta_n = 0.1$, $\delta_n = 0.2$, $\phi_\nu = 0.2$, $\phi_n = 0.2$, $\Delta_\nu = 0.3$, $\mu_1 = 0.1$, $a_n = 0.1$, $\Delta_n = 0.2$, $\mu_2 = 0.2$, $\alpha_n = 0.1$, $\delta_R = 0.1$, $\gamma_k = 0.2$, $\delta_k = 0.3$, $\mu_3 = 0.3$, $\mu_4 = 0.4$, $\lambda_R = 0.3$, $\phi_R = 0.2$, $\Delta_R = 0.1$, $\mu_5 = 0.5$, $l_4 = 0.4$, $\Delta_R = 0.2$, $l_2 = 0.2$, $l_1 = 0.1$, $l_3 = 0.3$, $l_6 = 0.6$ and $l_5 = 0.5$ is shown as:

$$\begin{cases} \dfrac{d^{(0.5)}S_n(x)}{dx^{(0.5)}} = 0.1 - 0.7S_n(x) + 0.05I_n(x), & S_n(0) = 0.1, \\ \dfrac{d^{(0.5)}I_n(x)}{dx^{(0.5)}} = 0.2S_n(x) - 0.75I_n(x), & I_n(0) = 0.2, \\ \dfrac{d^{(0.5)}S_k(x)}{dx^{(0.5)}} = 0.1S_n(x) - 0.6S_k(x) + 0.2I_k(x) + 0.1I_n(x), & S_k(0) = 0.3, \\ \dfrac{d^{(0.5)}I_k(x)}{dx^{(0.5)}} = 0.3S_k(x) - 1.1I_k(x), & I_k(0) = 0.4, \\ \dfrac{d^{(0.5)}S_R(x)}{dx^{(0.5)}} = 0.3 - 0.8S_R(x), & S_R(0) = 0.5, \\ \dfrac{d^{(0.5)}I_R(x)}{dx^{(0.5)}} = 0.2S_R(x) - 0.9I_R(x), & I_R(0) = 0.6. \end{cases} \tag{3}$$

Case 2: Consider a fractional order mathematical rape and its control model using the $\nu = 0.7$, $\lambda_v = 0.1$, $\beta_n = 0.1$, $\delta_n = 0.2$, $\phi_v = 0.2$, $\phi_n = 0.2$, $\Delta_v = 0.3$, $\mu_1 = 0.1$, $a_n = 0.1$, $\Delta_n = 0.2$, $\mu_2 = 0.2$, $\alpha_n = 0.1$, $\delta_R = 0.1$, $\gamma_k = 0.2$, $\delta_k = 0.3$, $\mu_3 = 0.3$, $\mu_4 = 0.4$, $\lambda_R = 0.3$, $\phi_R = 0.2$, $\Delta_R = 0.1$, $\mu_5 = 0.5$, $l_4 = 0.4$, $\Delta_R = 0.2$, $l_2 = 0.2$, $l_1 = 0.1$, $l_3 = 0.3$, $l_6 = 0.6$ and $l_5 = 0.5$ is shown as:

$$\begin{cases} \dfrac{d^{(0.7)}S_n(x)}{dx^{(0.7)}} = 0.1 - 0.7S_n(x) + 0.05I_n(x), & S_n(0) = 0.1, \\ \dfrac{d^{(0.7)}I_n(x)}{dx^{(0.7)}} = 0.2S_n(x) - 0.75I_n(x), & I_n(0) = 0.2, \\ \dfrac{d^{(0.7)}S_k(x)}{dx^{(0.7)}} = 0.1S_n(x) - 0.6S_k(x) + 0.2I_k(x) + 0.1I_n(x), & S_k(0) = 0.3, \\ \dfrac{d^{(0.7)}I_k(x)}{dx^{(0.7)}} = 0.3S_k(x) - 1.1I_k(x), & I_k(0) = 0.4, \\ \dfrac{d^{(0.7)}S_R(x)}{dx^{(0.7)}} = 0.3 - 0.8S_R(x), & S_R(0) = 0.5, \\ \dfrac{d^{(0.7)}I_R(x)}{dx^{(0.7)}} = 0.2S_R(x) - 0.9I_R(x), & I_R(0) = 0.6. \end{cases} \tag{4}$$

Case 3: Consider a fractional order mathematical rape and its control model using the $\nu = 0.9$, $\lambda_v = 0.1$, $\beta_n = 0.1$, $\delta_n = 0.2$, $\phi_v = 0.2$, $\phi_n = 0.2$, $\Delta_v = 0.3$, $\mu_1 = 0.1$, $a_n = 0.1$, $\Delta_n = 0.2$, $\mu_2 = 0.2$, $\alpha_n = 0.1$, $\delta_R = 0.1$, $\gamma_k = 0.2$, $\delta_k = 0.3$, $\mu_3 = 0.3$, $\mu_4 = 0.4$, $\lambda_R = 0.3$, $\phi_R = 0.2$, $\Delta_R = 0.1$, $\mu_5 = 0.5$, $l_4 = 0.4$, $\Delta_R = 0.2$, $l_2 = 0.2$, $l_1 = 0.1$, $l_3 = 0.3$, $l_6 = 0.6$ and $l_5 = 0.5$ is shown as:

$$\begin{cases} \frac{d^{(0.9)}S_n(x)}{dx^{(0.9)}} = 0.1 - 0.7S_n(x) + 0.05I_n(x), & S_n(0) = 0.1, \\ \frac{d^{(0.9)}I_n(x)}{dx^{(0.9)}} = 0.2S_n(x) - 0.75I_n(x), & I_n(0) = 0.2, \\ \frac{d^{(0.9)}S_k(x)}{dx^{(0.9)}} = 0.1S_n(x) - 0.6S_k(x) + 0.2I_k(x) + 0.1I_n(x), & S_k(0) = 0.3, \\ \frac{d^{(0.9)}I_k(x)}{dx^{(0.9)}} = 0.3S_k(x) - 1.1I_k(x), & I_k(0) = 0.4, \\ \frac{d^{(0.9)}S_R(x)}{dx^{(0.9)}} = 0.3 - 0.8S_R(x), & S_R(0) = 0.5, \\ \frac{d^{(0.9)}I_R(x)}{dx^{(0.9)}} = 0.2S_R(x) - 0.9I_R(x), & I_R(0) = 0.6. \end{cases} \tag{5}$$

The numerical simulations of the fractional order mathematical rape and its control model is obtained through the stochastic ANNs-LMBA with 15 numbers of neurons with the data selection are designated as 70% for training, 14% for authorization and 16% for testing. The output, input and hidden neuron'sconstruction is presented in Fig. 2.

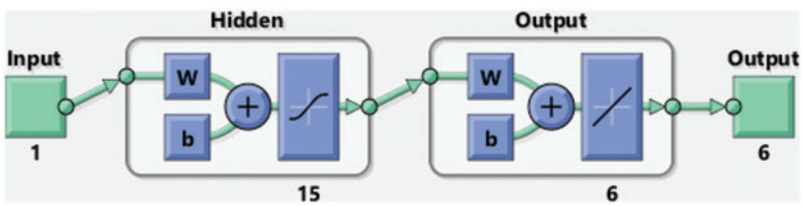


Figure 2: Proposed ANNs-LMBA for the fractional order mathematical rape and its control model

The graphical plots are demonstrated in Figs. 3–5 for the fractional order mathematical rape and its control model by applying the ANNs-LMBS procedures. To authenticate the best presentations and STs, Figs. 3 and 4 have been drawn. The values of the MSE and EHs using the training, authentication and best curves have been illustrated in Fig. 4 by applying the ANNs-LMBS procedures. The achieved best performances of the fractional order mathematical rape and its control model have been provided at epochs 49, 53 and 19 calculated as 1.4859×10^{-09}, 4.9799×10^{-09} and 9.2361×10^{-09}. The performances of the gradient values are depicted in Fig. 3 for the fractional order mathematical rape and its control model by applying the ANNs-LMBS procedures. The gradient measures have been performed around 9.6853×10^{-08}, 9.4888×10^{-08} and 2.866×10^{-06} for 1st, 2nd and 3rd case. These graphical plots show the convergence of the designed ANNs-LMBA for the fractional order mathematical rape and its control model. The first portion of Figs. 4 indicates the fitting curves performances for the fractional order mathematical rape and its control model. These illustrations indicate the comparative presentations of the obtained and reference solutions. The second part of the Fig. 4 represents the values the EHs. The values perform the values around 9.57×10^{-07}, 7.83×10^{-06} and 5.55×10^{-06} for 1st, 2nd and 3rd case of the fractional order mathematical rape and its control model. The correlations are plotted to authenticate the regression presented in Fig. 5 of the fractional order mathematical rape and its control model. It is easy to understand that the correlation illustrations are calculated as 1 using the fractional order mathematical rape and its control system. The testing, authentication and training depictions signify the accuracy of the stochastic ANNs-LMBA for the fractional order mathematical rape and its control model. The MSE convergence using the training, complexity, verification, iterations, and testing is drawn in Tab. 2 for the fractional order mathematical rape and its control model using the ANNs-LMBA.

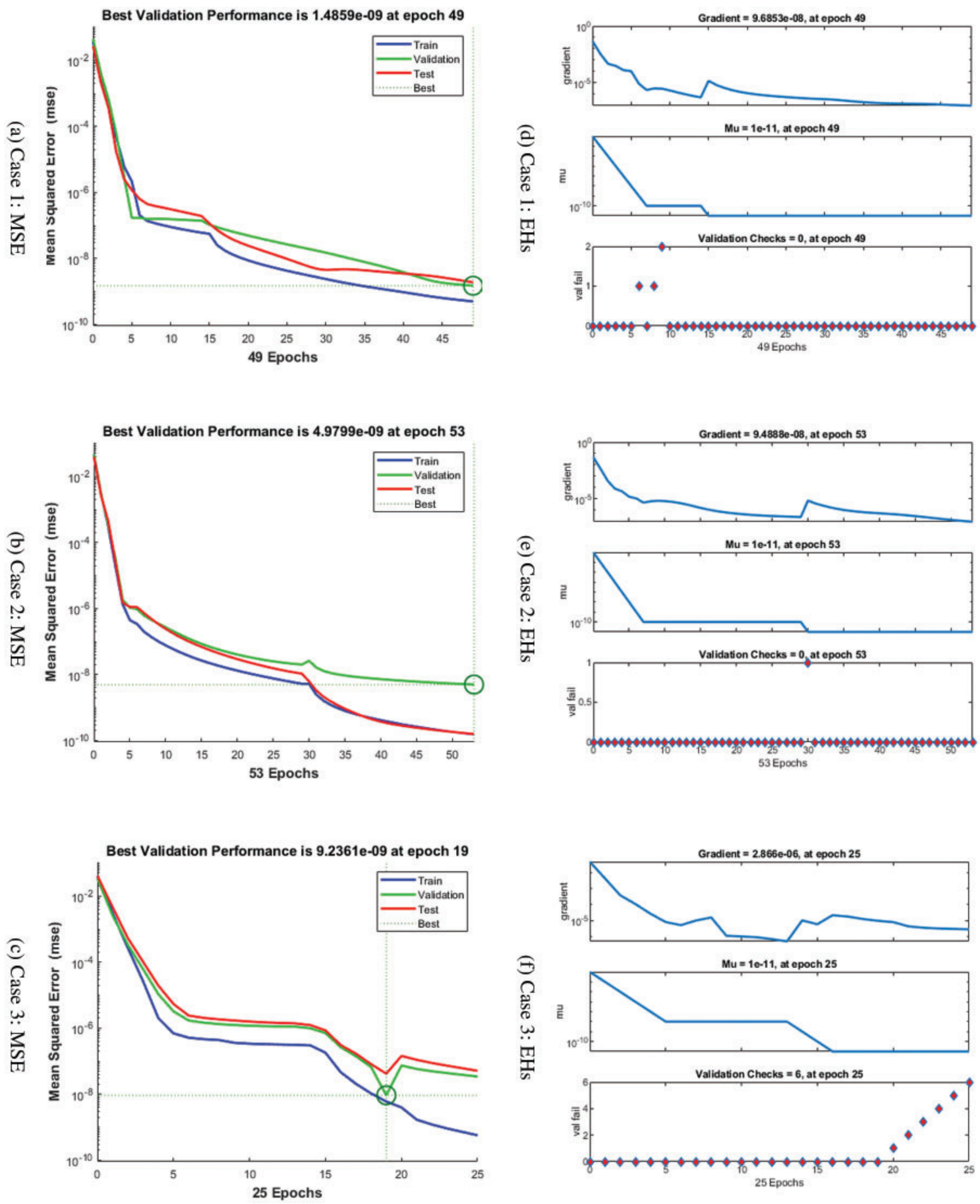


Figure 3: EHs and MSE for the fractional order mathematical rape and its control

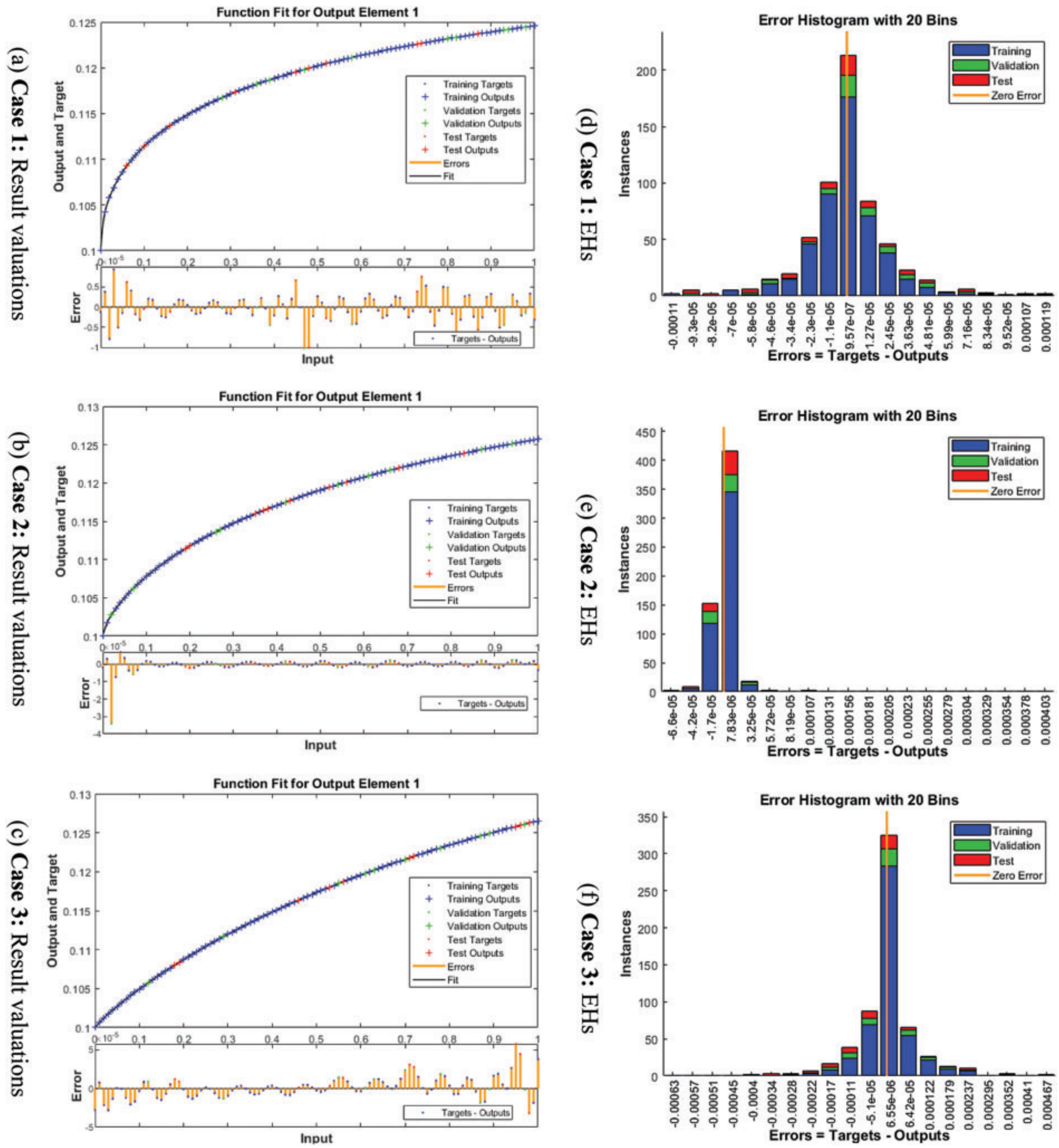
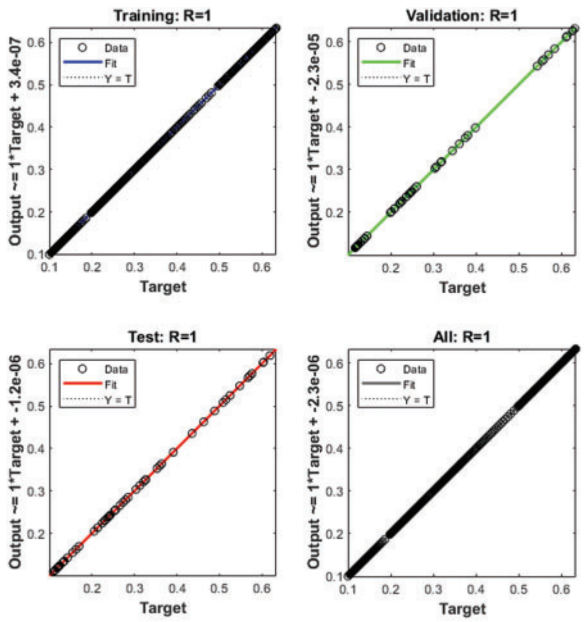
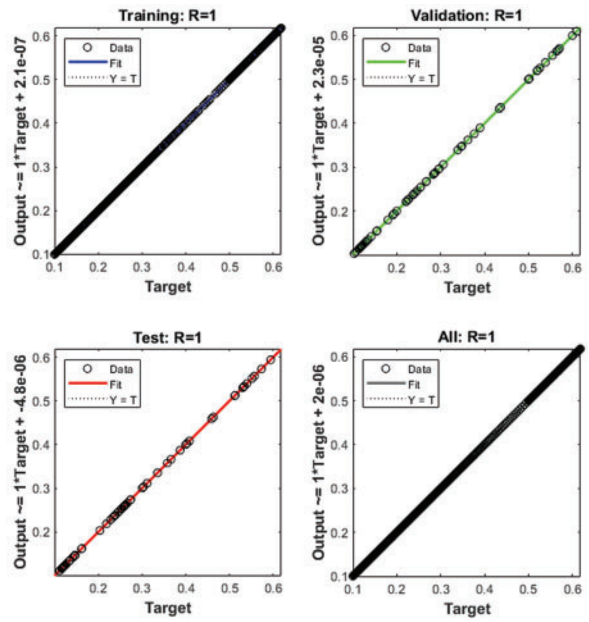


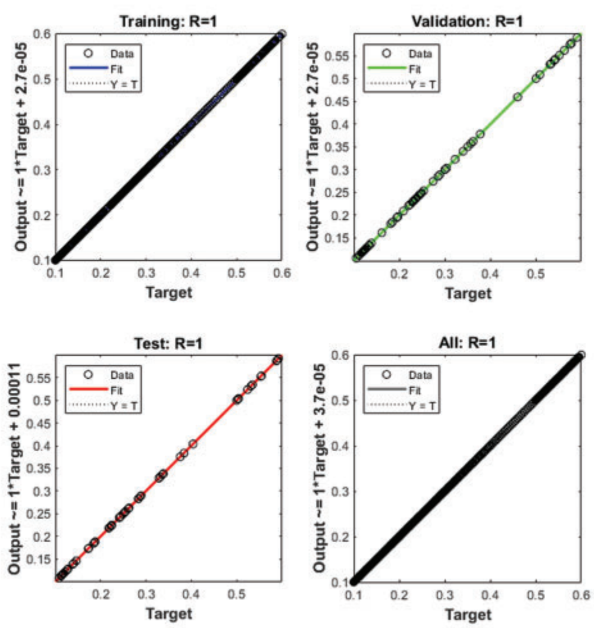
Figure 4: Valuations and EHs for the fractional order mathematical rape and its control system



(a) Regression: Case 1



(b) Regression: Case 2



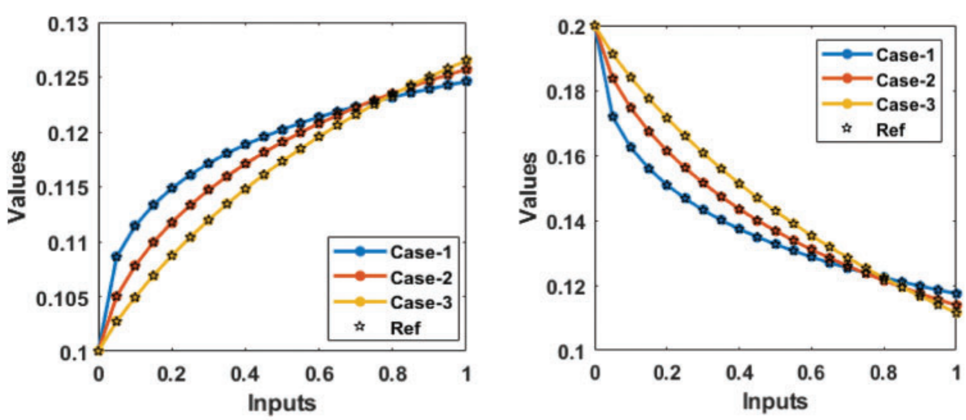
(c) Regression: Case 3

Figure 5: Regression for the fractional order mathematical rape and its control model

Table 2: ANNs-LMBA procedure for the fractional order mathematical rape and its control model

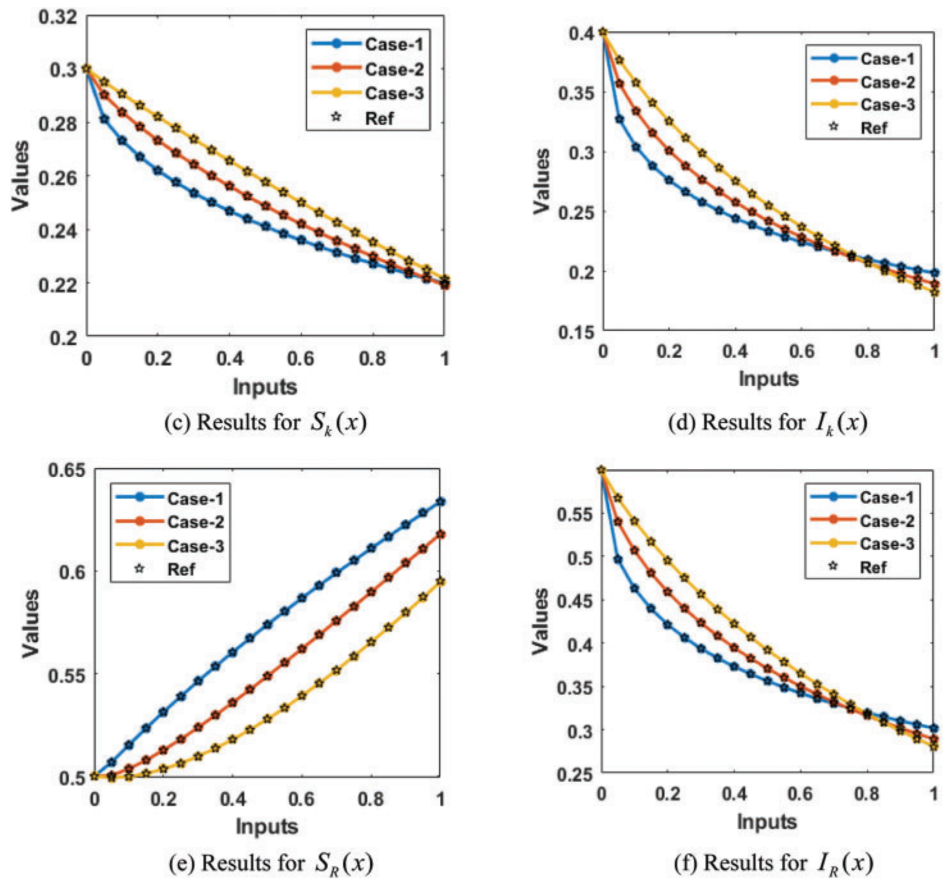
Case	MSE			Gradient	Performances	Iterations	Mu	Time
	Training	Testing	Authentication					
1	4.95×10^{-10}	1.87×10^{-09}	1.48×10^{-09}	9.69×10^{-08}	4.96×10^{-10}	49	1×10^{-10}	3 s
2	1.53×10^{-10}	1.57×10^{-10}	4.97×10^{-09}	9.49×10^{-08}	1.54×10^{-10}	53	1×10^{-11}	3 s
3	5.96×10^{-09}	4.16×10^{-08}	9.23×10^{-09}	2.87×10^{-06}	5.97×10^{-09}	25	1×10^{-11}	3 s

The result comparisons illustration along with AE have been drawn in Figs. 6–7. The numerical performances are derived to authenticate the fractional order mathematical rape and its control model using the stochastic ANNs-LMBA procedures. The obtained and reference numerical results have been plotted in Fig. 6 that shows the overlapping of the solutions. These exactly overlapping of the solution authenticates the correctness of the ANNs-LMBS for the fractional order mathematical rape and its control model. The AE for the susceptible native girls $S_n(x)$, infected immature girls $I_n(x)$, susceptible knowledgeable girls $S_k(x)$, infected knowledgeable girls $I_k(x)$, susceptible rapist population $S_R(x)$ and infective rapist population $I_R(x)$ for the fractional order mathematical rape and its control model are provided in Fig. 7. The susceptible native girls $S_n(x)$ calculated as 10^{-06} to 10^{-08}, 10^{-06} to 10^{-10} and 10^{-04} to 10^{-07} for 1st, 2nd and 3rd case of the fractional order mathematical rape and its control model. The infected immature girls $I_n(x)$ class values are calculated as 10^{-04} to 10^{-07}, 10^{-04} to 10^{-08} and 10^{-04} to 10^{-06} for 1st, 2nd and 3rd case of the fractional order mathematical rape and its control model. The susceptible knowledgeable girls $S_k(x)$ category values are calculated as 10^{-05} to 10^{-06}, 10^{-05} to 10^{-07} and 10^{-04} to 10^{-06} for 1st, 2nd and 3rd case of the fractional order mathematical rape and its control model. The infected knowledgeable girls $I_k(x)$ category values are calculated as 10^{-05} to 10^{-06}, 10^{-05} to 10^{-07} and 10^{-04} to 10^{-05} for 1st, 2nd and 3rd case of the fractional order mathematical rape and its control model. The susceptible rapist population $S_R(x)$ values are calculated as 10^{-04} to 10^{-06}, 10^{-05} to 10^{-07} and 10^{-04} to 10^{-06} for 1st, 2nd and 3rd case of the fractional order mathematical rape and its control model. Likewise, the infective rapist population $I_R(x)$ values are calculated as 10^{-05} to 10^{-06}, 10^{-05} to 10^{-07} and 10^{-04} to 10^{-05} for 1st, 2nd and 3rd case of the fractional order mathematical rape and its control model. These best AE indicate the precision of the ANNs-LMBA for the fractional order mathematical rape and its control model.



(a) Results for $S_n(x)$ (b) Results for $I_n(x)$

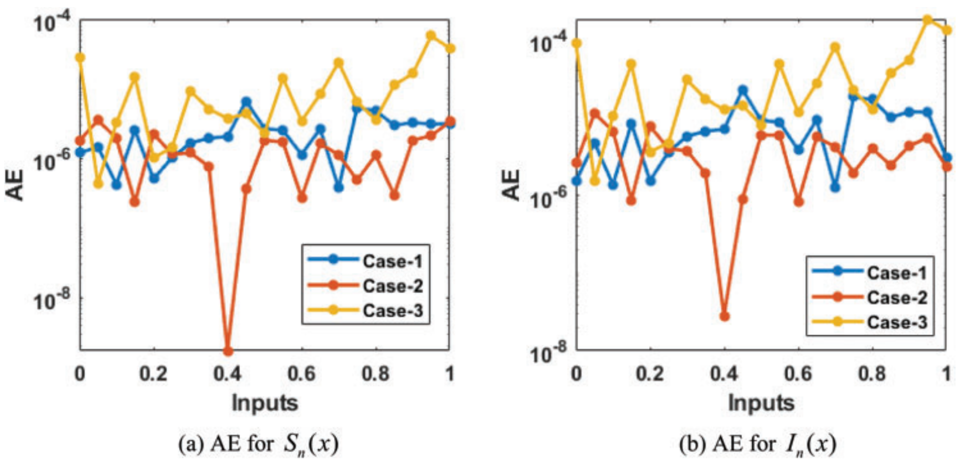
Figure 6: (Continued)



(c) Results for $S_k(x)$ (d) Results for $I_k(x)$

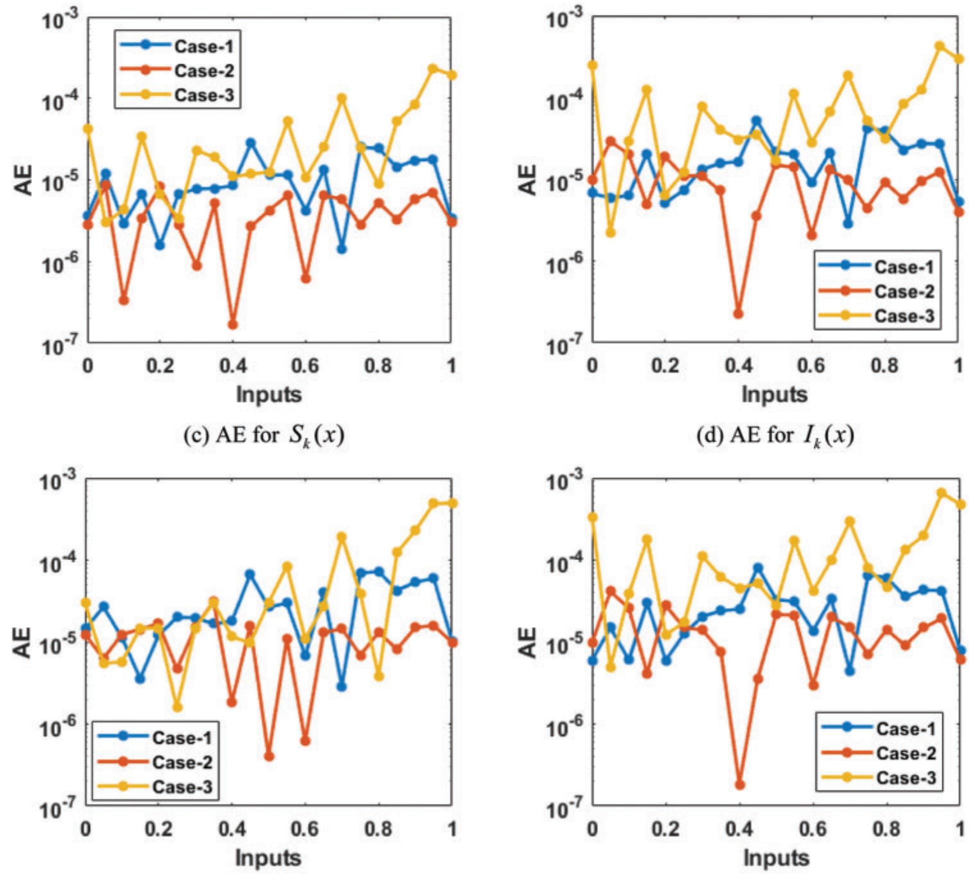
(e) Results for $S_R(x)$ (f) Results for $I_R(x)$

Figure 6: Result for the fractional order mathematical rape and its control model



(a) AE for $S_n(x)$ (b) AE for $I_n(x)$

Figure 7: (Continued)



(c) AE for $S_k(x)$ (d) AE for $I_k(x)$

(e) AE for $S_R(x)$ (f) AE for $I_R(x)$

Figure 7: AE for the fractional order mathematical rape and its control model

6 Conclusion

In this study, a nonlinear fractional order mathematical rape and its control model are numerical simulated using the strength of ANNs along with the LMBA. The fractional order investigations have been provided to obtain more realistic results of the mathematical form of the rape and its control model. The fractional order mathematical rape and its control model are classified into six dynamics, susceptible native girls $S_n(x)$, infected immature girls $I_n(x)$, susceptible knowledgeable girls $S_k(x)$, infected knowledgeable girls $I_k(x)$, susceptible rapist population $S_R(x)$ and infective rapist population $I_R(x)$. The numerical routines for the fractional order mathematical rape and its control model have never been applied nor evaluated before through the stochastic ANNs-LMBS. Three different variants of the fractional order mathematical rape and its control model have been numerically solved to check the correctness of the proposed ANNs-LMBA. The data is used to present the rape and its control differential system is designated as 70% for training, 14% for authorization and 16% for testing. Fifteen neurons throughout the study have been used to solve the dynamical system. The dataset is proposed by the Adams-Bashforth-Moulton to check the comparison of results. The correctness is observed through the AE, which have been performed in best measures as 10^{-05} to 10^{-07} for each class of the fractional order mathematical rape and its control model. The dependability and capability of the proposed ANNs-LMBA is observed using the numerical performances through STs, MSE correlation, regression, and EHs. The precision of the ANNs-LMBA is observed via matching of results and AE values. The scheme performance is testified based on the constancy and reliability of proposed ANNs-LMBA.

Future Research Directions

In future, the designed ANNs-LMBA can be implemented to solve the fractional kind of derivatives [63–67] and sonic processes [68].

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