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*Retraction*

# Retracted: Improved Design of Engineering Cost Model Based on Improved Genetic Algorithm

**Wireless Communications and Mobile Computing**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] Y. Chen, "Improved Design of Engineering Cost Model Based on Improved Genetic Algorithm," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 1443823, 6 pages, 2022.

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*Research Article*

# Improved Design of Engineering Cost Model Based on Improved Genetic Algorithm

**Yu Chen**

*Architectural Engineering Institute, Huanggang Normal University, Huanggang Hubei 438000, China*

Correspondence should be addressed to Yu Chen; 201812210202027@zcmu.edu.cn

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In order to solve the problems of traditional engineering cost model derivation process based on genetic algorithm complex, low convergence efficiency, and low accuracy of cost results, an improved design method of engineering cost model based on improved genetic algorithm is proposed. Through this algorithm, the cost model is optimized, better simulation data is selected, and the cost function model is constructed with the cost of the simulation data. The data parameter value is the accurate cost data calculated by the formula. Practice has proved that the dynamic cost precontrol system based on the improved genetic algorithm can effectively realize the dynamic precontrol of the project cost in the postearthquake building repair construction stage. As the number of cost samples increases, the error rate will gradually decrease, and the precontrol performance is good. Moreover, the flexibility of precontrol is always greater than 95%, and the use limit is only 0.04, which is highly practical and can be used as a reference for cost control of postearthquake building repair construction departments. The designed model can accurately and quickly estimate the project cost.



## 1. Introduction

With the rapid development of economy, the great improvement of the technical level and economic level of the construction industry has brought new challenges to the cost control and project management of construction projects. The restoration of postearthquake buildings not only needs to realize the well-being and work of people in disaster areas but also aims at small cost and large effect. Therefore, the dynamic precontrol of project cost in the restoration construction stage of postearthquake buildings has become the focus of attention of people in related fields [1]. During the restoration of buildings after earthquake, a large number of factors have great interference to the cost of construction projects, such as changes in the design of postearthquake restoration projects and contract changes. With the increasingly fierce competition environment in the construction market, construction units also pay great attention to the precontrol of the construction cost, in the construction stage of the construction project, so as to reduce the cost of the restoration construction of buildings after the earthquake. At present, China is one of the countries with the largest capital construction investment in the world. By 2003, the total output value of China's construction industry has reached 2,186,549 billion yuan, with 984,490 construction enterprise projects and 38.93 million construction employees, accounting for about 1/3 of the total industrial employees in China [2]. The huge investment in engineering construction and the huge scale of employees make the consequences of construction safety accidents extremely serious and huge. Every year, more than one thousand employees are killed due to safety accidents, and the direct economic loss is more than ten billion yuan. Although the state attaches great importance to safety management in recent years and has issued a series of laws and regulations related to safety, the construction safety situation has improved but compared with foreign developed countries, no matter in the total number of accidents or output value of ten billion yuan mortality is still very serious. It is mainly due to the low level of safety management in engineering construction in China. Therefore, draw lessons from international advanced safety management theory and experience, the construction safety system analysis, prediction, and evaluation, put forward a new management thought and method, and finally set up perfect safety early warning control system of construction enterprises, to prevent and reduce the occurrence of safety accidents has very important theoretical and practical significance.

Studies have shown that Xin et al., for example, proposed a risk assessment model of power transmission and transformation project cost based on bill of quantities valuation model, which requires a complete and high-precision bill of quantities to budget the cost of postearthquake reconstruction power transmission and transformation project and has poor practicability [3]. Li et al., based on the fuzzy neural network cost prediction model, determined the number of layers and nodes of BP neural network to carry out the cost budget of postearthquake reconstruction projects. This model is prone to fall into local minimum and convergence rate difference [4]. Cao et al. established a prediction model of power engineering cost based on ANN and used historical data to train the network to obtain the optimal network so as to realize the budget of postearthquake reconstruction power engineering cost, with large errors [5].

In this paper, the dynamic precontrol system of project cost in the restoration construction stage of postearthquake building groups is designed, which is used in the dynamic precontrol experiment of project cost in the restoration construction, stage of postearthquake building groups. It can be seen that the precontrol accuracy of this system is significantly better than that of similar systems and has excellent application [6].

## 2. Basic Genetic Algorithm

Goldberg summarized a unified basic genetic algorithm—-simple genetic algorithms (SGA) based on the imitation of genetic and evolutionary mechanisms of organisms in nature. The operation process of genetic evolution is simple and easy to understand, and it is the basic framework of various genetic algorithms. It does not depend on the domain and type of the problem, so it has certain application value. In general, genetic algorithms for solving problems can be constructed as follows:

(1) Determine the decision variables, various constraints, and objective functions

(2) Determine the chromosomal coding and decoding methods of feasible solutions

(3) Quantitative evaluation method to determine individual fitness. This objective function is a minimization problem, which can be transformed as follows:

$$F(X) = \begin{Bmatrix} C_{\max} - f(x), f(x) < C_{\max} \\ 0, f(X) \geq 0 \end{Bmatrix}, \quad (1)$$

where $f(X)$ is the objective function; $C_{\max}$ is a given large number [7]

(4) Design genetic operators, that is, determine the specific operation methods of selection operation, crossover operation, mutation operation, and other genetic operators. Proportional selection operator is used in selection operation, single point crossover operator is used in crossover operation, and basic bit change operator is used in mutation operation

(5) Determine the relevant operating parameters of the genetic algorithm, including population size $M$ (generally 20-100), termination algebra $T$ of genetic operation (generally 100-500), and crossover probability $P_c$ (generally 0.4-0.99), mutation probability $P_m$ (generally 0.0001-0.1). In this example, $M = 80$, $T = 100$, $P_c = 0.60$, and $P_m = 0.05$

*2.1. Improved Genetic Algorithm.* Although genetic algorithm has been widely used, it has many defects such as slow convergence speed, poor stability of algorithm, and premature maturity. Therefore, the solving process of genetic algorithm is improved as follows:

(1) Mixed selection: rank individual fitness from highest to lowest and then perform fitness ratio selection. In this way, population diversity can be maintained at the later stage of evolution and the deviation between selection probability and fitness can be avoided

(2) Adaptive genetic algorithm: Srinvivas proposed an adaptive genetic algorithm (AGA). In this algorithm, $P_c$ and $P_m$ can be automatically changed with fitness, but this adjustment method is suitable for the late evolution of species population, but unfavorable for the early evolution. Wang Xiaoping improved this, making the crossover rate and variation rate of individuals with the maximum fitness value in the population not 0, respectively, to $P_{c2}$ and $P_{m2}$, which correspondingly improved the crossover rate and variation rate of individuals with good performance in the population, so that they would not be in a state of approximate stagnation. In order to ensure that the good individuals of each generation are not destroyed, the strategy of elite selection is adopted to make them directly copied into the next generation. The $P_c$ and $P_m$ expressions are as follows:

$$\begin{aligned} p_c &= p_{c1} - \frac{(p_{c1} - p_{c2})\left(f' - f_{\text{avg}}\right)}{f_{\max} - f_{\text{avg}}}, f' \geq f_{\text{avg}}, \\ p_m &= p_{m1} - \frac{(p_{m1} - p_{m2})(f_{\max} - f)}{f_{\max} - f_{\text{avg}}}, f \geq f_{\text{avg}}, \end{aligned} \quad (2)$$

where $f_{\max}$ is the one with the largest adaptive value in the population, $f_{\text{avg}}$ is the average adaptive value of each generation, $f'$ is the fitness value of the two intersecting individuals is larger, and $f$ is the fitness value of individual variation. In general, $p_{c1} = 0.9$, $p_{c2} = 0.6$, $p_{m1} = 0.1$, and $p_{m2} = 0.001$.

*2.2. Analysis of Influencing Factors of Reconstruction Project Cost after Earthquake.* The process of budgeting the reconstruction project cost after earthquake is very complicated, mainly because it is affected by a large number of important factors. When the cost budget is carried out, it is necessary to summarize the relevant information of the national government, the economic conditions of the people in the earthquake area, the state of the engineering construction structure before the earthquake, and national policies according to the situation of the earthquake area [8]. In order to clearly reflect the characteristics of different important influencing factors, the important influencing factors of postearthquake reconstruction project cost are divided into three categories, namely, earthquake characteristics, pre-earthquake construction structure status, and political, economic, and cultural data.

After analyzing the earthquake reconstruction project cost factors, on the basis of through gray coupling degree theory will pick 14 impact on reconstruction after the earthquake engineering cost is one of the important factors as the input layer nodes, reconstruction after the earthquake engineering cost as the output layer nodes, on the basis of past experience and layer number and the number of nodes of BP neural network calculation for many times.

Buildings after an earthquake repair construction stage engineering design details of the cost function is after the complex repair construction stage engineering cost information in the data using a set of $(x_1, y_1)$, $(x_2, y_2)$,…, $(x_n, y_n)$, $c$, $d$, $e$, in turn, set complex repair construction stage engineering cost data of parameters after the quake, according to the earthquake $x = c + dy$ complex repair construction stage engineering cost function formula calculation results are obtained. If the data of cost budget and the complex $\alpha$ repair construction stage engineering cost differences between the actual data $\alpha_1$ is small, the absolute value is 0, $c + dy_i^c$ formula and the function model and the complex repair construction stage engineering cost difference between the value is small, earthquake complex repairing construction stage engineering cost dynamic control counter success [9]. In order to minimize the error of the budget value obtained by the project cost function model in the postearthquake restoration construction stage, the function theorem "binary $\theta$" is used to calculate the cost data:

$$\theta = \sqrt{\sum_{i-1}^{n} \frac{(c + dy_i^c - \alpha_1)^2}{n}}, \tag{3}$$

where $n$ represents quantifier. The error value is set as $\theta$, and the most accurate simulation parameter in the cost model is the minimum $\theta$ value obtained after repeated calculation [10].

Based on the above calculation, according to the binary operation of the cost formula used in the management function method of the improved genetic algorithm, the validity of parameters is guaranteed through repeated calculation

Table 1: Comparison of error values.

| Actual built value (ten thousand yuan) | 40 groups of samples | | |
|---|---|---|---|
| | Budget result (ten thousand yuan) | Error (ten thousand yuan) | Error rate (%) |
| 1621.2 | 1557.61 | -63.59 | 3.56 |
| 2735.34 | 2845.5 | 110.16 | 3.76 |
| 1725.23 | 1788.03 | 62.8 | 3.31 |
| 2635.3 | 2526.53 | -108.77 | 3.85 |
| 1927.17 | 1829.74 | -97.43 | 4.67 |
| 1712.4 | 1801.71 | 89.31 | 4.24 |

data, which increases the calculation accuracy of the cost function model. Through the improved genetic algorithm $W$ coefficient setting, it can deeply study the cost function model data, increase its accuracy, and obtain relevant parameters:

$$W = \sqrt{1 - \frac{\sum[\alpha_i - (c + dy_i^c)]^2}{\sum((\alpha_i - (1/n)\alpha_i))}}, \tag{4}$$

where $W$ can describe the difference between the calculation result of the model cost formula and the actual cost data. If $W$ value is larger, the simulation cost function model has a smaller fit with the cost data. On the contrary, the $W$ value is smaller, the fit is larger, and the cost budget is more accurate.

Cost model based on section on building, $c$, $d$, $e$, describes the cost data parameters, but before the cost model recognition, cost data parameter value constraint is unaware, so according to the improved genetic algorithm of binary algorithm, on the basis of setting parameter recognition, refer to the binary rules using genetic algorithm simulating formula calculation, and shall be implemented for $\theta$ get the parameter values of $c$ and $d$. If the parameters of $c$ and $d$ are worthy of recognition, the residual square and $R$ value of the simulation formula are

$$R = \sum_{i-1}^{n} [\theta - [c + dy_i^c]]^2. \tag{5}$$

Based on the above calculation, $e$ belongs to cost assumes that the numerical, through the $c$ value calculation, obtain the parameter value is not representative, $c$, $d$ but I did not belong to finally obtain the minimum error, so, in the cost data to select multiple data, set up the parameter $c$ value for many times, calculus to obtain corresponding parameter values, $c$ and $d$ to get the most accurate cost budget data, ensure the highest accuracy of project cost budget data [11]. According to the obtained project cost budget data in the restoration construction stage of postearthquake buildings, the cost problems in the construction stage can be adjusted in real time. For example, if the cost budget is reasonable, no measures need to be taken. If the cost budget

Table 2: Comparison table between actual and budget of postearthquake industrial reconstruction cost obtained by different models.

| Region | Actual value of reconstruction industrial project cost (ten thousand yuan) | Budget value (ten thousand yuan) | | |
|---|---|---|---|---|
| | | In this paper, the model | Based on BP neural network model | ANN-based model |
| Wenchuan | 135046 | 134876 | 142013 | 128034 |
| Chengdu | 6781188 | 6762058 | 6156946 | 5931427 |
| Dujiangyan | 257505 | 254649 | 273061 | 193108 |
| Dayi | 54922 | 54019 | 60534 | 76428 |

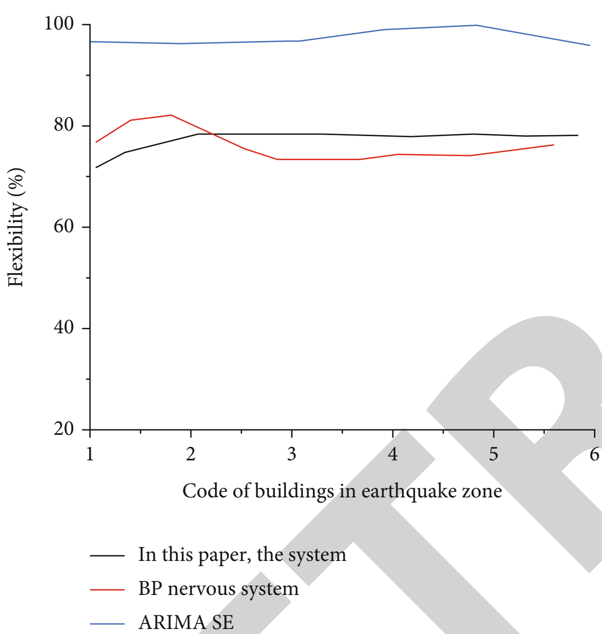


Figure 1: Comparison results of control flexibility of three.

exceeds the standard, construction materials or other cost consuming areas can be controlled.

*2.3. Precontrol System.* Regression prediction is a method to explain the functional relationship between variables based on statistical data, including the following four steps: first, select the type of function. Second, determine the parameters in the regression function. Thirdly, the regression function is tested. Fourthly, use regression function to predict [12].

*2.3.1. Select the Type of Function.* For the unitary regression problem, the correlation between independent variables and dependent variables can be roughly judged by making scatter diagram. If there is a positive correlation (or weak positive correlation) or negative correlation (or weak negative correlation), the unitary linear equation can be selected for regression. If nonlinear correlation occurs, we can see whether it is close to a known mathematical function, such as power function, exponential function, logarithmic function, and trigonometric function, according to the changing trend of the points in the scatter diagram. If it is close, we can choose the corresponding function equation for regression [13]. For multiple regression problems, it is necessary to draw scatter plots for multiple variables one by one and then guess the types of regression functions with the help of spatial imagination. Nonlinear regression can be transformed into linear regression by proper mathematical transformation [14].

*2.3.2. Determine the Parameters in the Regression Function Equation.* After selecting the type of the regression function, the next step is to determine the parameters in the function. For example, selecting unary linear equation $y = \hat{a} + \hat{b} \cdot x$ for regression is in essence to determine parameters $\hat{a}$ and $\hat{b}$ based on statistical data or known observation data [15].

*2.3.3. Regression Function Test.* After the regression function is determined, it is necessary to test the regression function. The purpose of test is to ensure the correct selection of regression function and truly reflect the internal relationship between variables, so it is necessary to use mathematical statistics to conduct significant new test on the regression effect.

## 3. Experimental Analysis

In order to verify the applicability of the postearthquake reconstruction engineering cost model designed in this paper based on the improved genetic algorithm, the cost model was used to budget 40 groups of samples and 80 groups of samples, respectively, and the obtained budget value was compared with the actual construction value to obtain the error value. The comparison results are shown in Table 1 [16].

By analyzing Table 1, it can be seen that the average error of the cost model designed in this paper is about 4% under the condition of 40 groups of samples, while the error value is reduced to about 1% under the condition of 80 groups of samples. It shows that the cost model designed in this paper can be used to effectively budget the cost of postearthquake reconstruction projects, and the error value will decrease with the increase of the number of samples. In order to ensure that the cost model designed in this paper can effectively and accurately the surface-to-surface reconstruction project cost budget, and with the optimality, in earthquake as an example, this paper was used, respectively, to model and on the basis of BP neural network model, ARIMA ES hybrid model of four different cost models such as industrial engineering reconstruction after the earthquake affected areas of cost budget, the obtained budget value is compared with the actual value, and the results are described in Table 2. According to the analysis in Table 2, the difference between the four budget values obtained by using the cost model in this paper and the actual value is smaller, indicating that the cost model in this paper is used to budget the cost of postearthquake reconstruction project with higher budget accuracy.

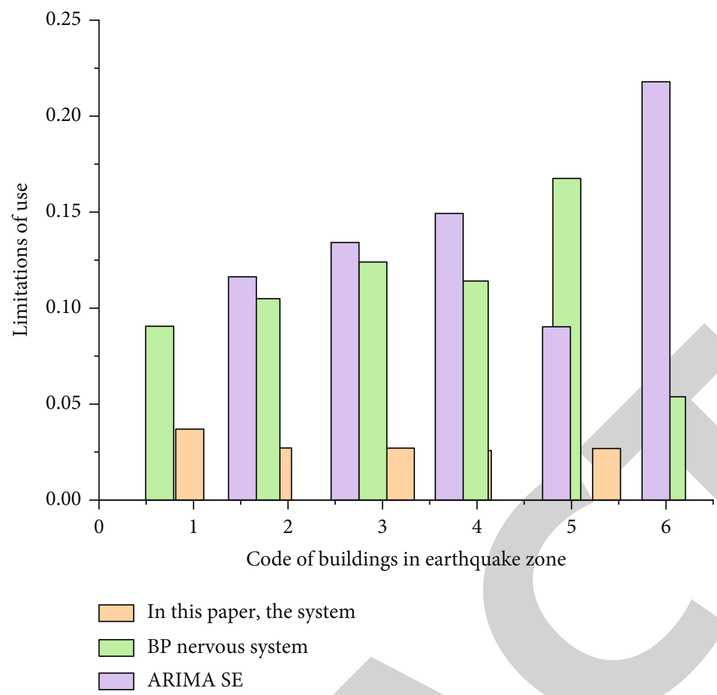


FIGURE 2: Comparison results of limitations of the three systems.



In order to verify the high practicability of the model designed in this paper, the cost model designed in this paper is compared with other cost models in terms of convergence speed, anti-interference, and application range. The results are shown in Figures 1 and 2.

It can be seen from Figure 1 that there are some differences in the limitations of the three systems. The maximum limitations of the system designed in this paper is only 0.04. As can be seen from Figure 2, the maximum limitations of the engineering cost control system based on the BP neural network and the engineering cost control system based on ARIMA ES hybrid model are 0.17 and 0.22, respectively. It can be seen that the system designed in this paper has the least limitation in use. Through the analysis of the above experimental results, it can be seen that the dynamic cost precontrol system designed in this paper in the restoration construction stage of postearthquake buildings has higher flexibility and lower limitations, so it has higher practical application value.

## 4. Conclusions

In order to solve the problem of great deviation of precontrol results caused by great variability, in the dynamic control of project cost in the restoration construction stage of postearthquake buildings. A dynamic cost precontrol system is proposed and designed in the restoration construction stage of postearthquake buildings. The improved genetic algorithm is used to complete the cost precontrol in the restoration construction stage of postearthquake buildings. Finally, the overall performance of the designed system is verified by experiments. Compared with the precontrol system based on the BP neural network and ARIMA ES model, the flexibility of the system designed in this paper is up to 97%, and the use limitation is only 0.03, which fully proves that the system has high practicability. It is proposed in this paper based on the improved the traditional BP neural network algorithm for reconstruction after the earthquake engineering cost model, combined with the reconstruction after the earthquake the influence factors of the project cost, by selection strategy to choose better cost simulation data, determine the cost of the model data, the application of cost function model, data using t coefficient computation analysis cost function model, the data parameters of the cost function are formulated by using binary or ternary algorithm, and the function theorem "binary $\sigma$" is added to make the data of the cost model more accurate. The experimental results show that the cost model designed in this paper can effectively budget the cost of postearthquake reconstruction engineering, with low error value, high precision of budget value, strong anti-interference, short operation time, wide application range, and has high practicability.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The author declares that he/she has no conflicts of interest.

## References

[1] Z. Mei, Z. X. Guo, and Y. C. Gao, "Optimization of stochastic control system of structures using an improved genetic

algorithm," *Journal of Vibration Engineering*, vol. 30, no. 1, pp. 93–99, 2017.

[2] Y. Zhou, L. Zhao, and W. J. Lee, "Robustness analysis of dynamic equivalent model of DFIG wind farm for stability study," *IEEE Transactions on Industry Applications*, vol. 54, no. 6, pp. 5682–5690, 2018.

[3] J. Xin, J. Zhong, F. Yang, Y. Cui, and J. Sheng, "An improved genetic algorithm for path-planning of unmanned surface vehicle," *Sensors*, vol. 19, no. 11, p. 2640, 2019.

[4] Z. Li, M. Pourmehrab, L. Elefteriadou, and S. Ranka, "Intersection control optimization for automated vehicles using genetic algorithm," *Journal of Transportation Engineering*, vol. 144, no. 12, 2018.

[5] P. Cao, X. Luo, and X. Song, "Modeling and identification for soft sensor systems based on the separation of multi-dynamic and static characteristics," *Chinese Journal of Chemical Engineering*, vol. 26, no. 1, pp. 137–143, 2018.

[6] P. Wang, Z. Zhu, and S. Huang, "The use of improved TOPSIS method based on experimental design and Chebyshev regression in solving MCDM problems," *Journal of Intelligent Manufacturing*, vol. 28, no. 1, pp. 229–243, 2017.

[7] C. Chen, Y. Q. Bao, X. H. Wu, B. Wang, and C. Shen, "Battery energy storage system based on incremental cost consensus algorithm for the frequency control," *Access*, vol. 7, article 147362, 2019.

[8] J. Wan and F. Zhao, "Optimization of ap1000 power control system setpoints using genetic algorithm," *Progress in Nuclear Energy*, vol. 95, no. MAR., pp. 23–32, 2017.

[9] A. Afsharinejad, A. Davy, and B. Jennings, "Dynamic channel allocation in electromagnetic nanonetworks for high resolution monitoring of plants," *Nano Communication Networks*, vol. 7, no. mar., pp. 2–16, 2016.

[10] F. Xu, W. Wu, F. Zhao et al., "A micro-market module design for university demand-side management using self- crossover genetic algorithms," *Applied Energy*, vol. 252, no. Oct.15, p. 113456, 2019.

[11] L. Li, W. Liu, L. E. Gao, Y. Zhang, and Z. Zhang, "A novel network scheduling approach based on genetic algorithm for autonomous underwater vehicle control," *Access*, vol. 7, pp. 111053–111064, 2019.

[12] G. Dhiman, V. Kumar, A. Kaur, and A. Sharma, "Don: deep learning and optimization-based framework for detection of novel coronavirus disease using X-ray images," *Interdisciplinary Sciences Computational Life Sciences*, vol. 13, no. 2, pp. 260–272, 2021.

[13] P. Ajay and J. Jaya, "Bi-level energy optimization model in smart integrated engineering systems using WSN," *Energy Reports.*, vol. 8, pp. 2490–2495, 2022.

[14] J. Liu, X. Liu, J. Chen, X. Li, T. Ma, and F. Zhong, "Investigation of ZrMnFe/sepiolite catalysts on toluene degradation in a one-stage plasma-catalysis system," *Catalysts*, vol. 11, no. 7, p. 828, 2021.

[15] P. Ajay, B. Nagaraj, R. A. Kumar, R. Huang, and P. Ananthi, "Unsupervised hyperspectral microscopic image segmentation using deep embedded clustering algorithm," *Scanning*, vol. 2022, Article ID 1200860, 9 pages, 2022.

[16] G. Veselov, A. Tselykh, A. Sharma, and R. Huang, "Special issue on applications of artificial intelligence in evolution of smart cities and societies," *Informatica (Slovenia)*, vol. 45, no. 5, p. 603, 2021.