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The influence of social network on innovation and entrepreneurship of economic and management college students based on adaptive particle swarm algorithm

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Abstract

Exploring the influence of social networks on innovation and entrepreneurship of economics and management college students to help them better enhance their innovation consciousness to face the future social workplace. In this paper, the particle swarm algorithm is optimized according to the strategy and parameter adaptive mechanism, and the SPS-PSO algorithm is used to initialize and update the population. The social network and innovation and entrepreneurship ability of university students in economics and management are introduced, and feature selection based on strategy and parameter adaptive particle swarm algorithm is utilized. The index mining of social network and innovation and entrepreneurship ability of college students is conducted, and the data analysis of innovation and entrepreneurship ability of college students in economics and management is carried out with the example of the University of S. From the social network, the percentages of those who agree with the validity of social network centrality, heterogeneity, dynamics and linkage strength are 71.56, 71.69%, 72.55% and 71.16%, respectively. From the perspective of innovation and entrepreneurship, the overall percentage of college students in economics and management who agreed was 69.27%. This indicates that the higher the integrity of the social network structure of economics and management college students, the more it can enhance innovation and entrepreneurship abilities and promote the cultivation of observation and judgment ability and divergent thinking abilities of economics and management college students.

Keywords: Particle swarm algorithm; Feature selection; SPS-PSO algorithm; Social network; Innovation and entrepreneurship

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1 Introduction

Over the years, China has transformed the old elitist education and gradually entered into quality education, which has made remarkable achievements. However, in recent years, the number of college graduates has been increasing year by year, and the headline “the most difficult employment season ever” appears every year, and it shows a serious trend of “no most difficult, only more difficult” [1]-[3]. In the structural contradiction between education and the economy, we should vigorously carry out innovation and entrepreneurship education activities and cultivate high-end and high-quality innovation and entrepreneurship talents [4]-[5]. It is conducive to the overall improvement of college students’ ability and the quality of higher education and a fundamental guarantee to realize the guarantee of employment by entrepreneurship and the road to a strong innovative, and entrepreneurial country [6]-[7].

To better enable college graduates to achieve their employment goals, government departments at all levels are required to take the initiative to implement policies on entrepreneurship protection, to do a good job in the employment of the young generation, to reduce the social anxiety caused by the increasingly serious difficulties in choosing a career and employment, and to improve the employment and entrepreneurial abilities and skills of workers [8]-[9]. It is also necessary to vigorously cultivate students’ innovative spirit and knowledge skills, innovative and entrepreneurial practical skills, and the ability to adapt to new forms of social and economic development [10].

For the cultivation of innovation and entrepreneurship ability of college students, literature [11] believes that colleges and universities can improve the quality of innovation and entrepreneurship competence of college students majoring in economics and management by teaching innovation and entrepreneurship knowledge, improving innovation ability and entrepreneurship quality, and promoting college students in economics and management to understand and master the laws of identification, evaluation, and utilization of entrepreneurial opportunities. The literature [12] pointed out that “Internet+” has put forward certain requirements for the entrepreneurial quality of college students and studied the dilemmas faced by college students’ entrepreneurial quality improvement from the level of students, institutions, society, and “Internet+”, and put forward the effective path of college students’ entrepreneurial quality improvement. In the literature [13], innovation ability refers to the ability to provide new ideas and inventions with social and commercial values to society by using new technologies in social practice activities, which is comprehensive, innovative, and pioneering, and is the highest expression of individual comprehensive quality and development potential.

In addition, the literature [14] argues that the composition of the current faculty of dual-innovation education is similar among universities, and the economics and management majors, because of their professional characteristics, can appropriately increase the proportion of external tutors such as business managers and entrepreneurs, such as inviting entrepreneurs, successful entrepreneurs, and investors to campus to open lectures. Literature [15] argues that economics and management majors should not only focus on the teaching of theoretical knowledge and cultivate students’ theoretical depth but also focus on practical aspects and cultivate students’ analytical ability, application ability, innovation, and entrepreneurial ability to follow the requirements of the information society on the ability of economics and management talents. The literature [16] discusses the construction of cross-disciplinary courses across majors and disciplines through the assessment of different entrepreneurial needs of different types of entrepreneurial talents and the use of special education resources within the university for collaborative innovation, thus serving entrepreneurship education and the training of innovative talents.

To clarify the influence of the social network on the innovation and entrepreneurship of economics and management college students, this paper analyzes and argues in three parts. The first part is the algorithm analysis, which explains the particle swarm algorithm's basic principle, operation process, and fitness function. The particle swarm algorithm is optimized based on the strategy and parameter adaptive mechanism, and the population initialization and solution update strategy of feature selection are illustrated using the SPS-PSO algorithm. The second part elaborates on the social network and innovation and entrepreneurship ability of economic and management college students, including the centrality, heterogeneity, dynamics, and linkage strength of the social network, and the thinking ability, knowledgeability, and practical ability of innovation and entrepreneurship ability are illustrated. The third part is an example analysis, using the SPS-PSO algorithm to mine the evaluation indexes of social network and innovation and entrepreneurship ability, respectively, by using the SPS-PSO algorithm as the example of the University of S. The evaluation grading is done by using the Likert 5-level scale. These three components are used to analyze the influence of social networks on the innovation and entrepreneurship ability of economics and management college students to provide effective guidance for entrepreneurship and employment economics and management college students.

2 Feature selection based on strategy and parameter adaptive particle swarm algorithm

With the advent of big data, processing large-scale, high-dimensional data has become an inevitable problem in developing feature selection algorithms. In this chapter, we choose a particle swarm algorithm based on the foraging behavior of bird populations for the large-scale feature selection problem, which can effectively iterate through the data to obtain the optimal solution that satisfies the termination condition. Combined with the research content characteristics of the influence of social networks on the innovation and entrepreneurship ability of university students in economics and management, we focus on applying strategy-based and parameter-adaptive particle swarm algorithms.

2.1 Particle swarm algorithm

2.1.1 Basic principles of particle swarm algorithm

The optimization mode of the particle swarm algorithm can be regarded as a collaborative and symbiotic evolutionary mode, in which each particle is more or less disturbed by other nearby particles on its way to search for a target, but each particle will continuously accumulate its individual experience as a guide for its next action.

In this specific search mechanism, the algorithm first needs to randomly set an original population, i.e., initialize the speed and position of the particles in the optimization space. Each particle is first searched in the individual region according to the initial conditions, and the optimal solution of the individual region is sought and stored in memory by continuously changing the speed and position of the individual search. Then, it compares, competes, and inherits the optimal solutions of other neighborhoods in the space according to certain rules. Finally, the optimal solution of the whole problem space is achieved, and the optimal global position is obtained [17].

The mathematical modeling idea of the particle swarm algorithm is briefly described as follows:

Assume that there exists a population containing N particles in a n -dimensional space, each particle in this population represents a vector, and the vector dimension of the i rd particle is noted as n -dimensional, i.e.:

$$X_i = (x_{i1}, x_{i2}, \dots, x_{im}), i = 1, 2, \dots, N \quad (1)$$

The velocity of the i st particle is:

$$V_i = (v_{i1}, v_{i2}, \dots, v_{im}), i = 1, 2, \dots, N \quad (2)$$

The best position of the individual that can be searched by the i st particle so far, i.e. the individual optimal solution is:

$$P_{best} = (P_{i1}, P_{i2}, \dots, P_{im}), i = 1, 2, \dots, N \quad (3)$$

Then the best position that the whole particle swarm can search for so far, i.e. the population optimal solution is:

$$G_{best} = (G_1, G_2, \dots, G_n) \quad (4)$$

When two optimal solutions are found, the particle iterates through the velocity and position updates according to the following equation:

$$\begin{cases} v_{in}^{t+1} = v_{in}^t + c_1 \text{rand}_1(P_i^t \text{ best} - x_{in}^t) + c_2 \text{rand}_2(G_i^t \text{ best} - x_{in}^t) \\ x_{in}^{t+1} = x_{in}^t + v_{in}^{t+1} \end{cases} \quad (5)$$

v_{in}^t is called the “inertia” part of the algorithm, which reflects the motion of the particle t at the moment and indicates the ability of the particle to maintain its current velocity. $c_1 \text{rand}_1(P_i^t \text{ best} - x_{in}^t)$ is called the “cognitive” part of the algorithm, which indicates the ability of the particle to inherit the previous exploration experience and keep the particle at the best position in the individual history at all times. $c_2 \text{rand}_2(G_i^t \text{ best} - x_{in}^t)$ is called the “social” part of the algorithm, which reflects the ability to share experience and information among individual particles to help each other, indicating that individual particles can track and gather to the optimal solution position in the group or neighborhood through information sharing.

2.1.2 The operation process of the particle swarm algorithm

The operation of the particle swarm algorithm is as follows:

- 1) Initialize the particle swarm, using a uniform distribution for the initial particles to take random values of position and velocity. The initial P_i is the starting position of the particle swarm and $P_i^t \text{ best}$ is the current best fitness value of the swarm.
- 2) Solve for the fitness value of each particle at x_i at moment t .
- 3) Compare the fitness value of the particle with $P_i^t \text{ best}$ at this moment, and if the current fitness value turns out to be the best, replace $P_i^t \text{ best}$ with that value and replace P_i with the current position of x_i , otherwise continue with the original value.
- 4) For the particle that obtains the best fitness value in the neighborhood, its position is noted as $G_i^t \text{ best}$.
- 5) After that, the particles are updated with position and velocity iterations according to the formula.

- 6) The steps between (2) and (5) are repeated until the termination condition of the algorithm is met, which is usually limited by the optimal fitness value or the maximum number of iterations of the algorithm.

The flow of the particle swarm algorithm is shown in Figure 1.

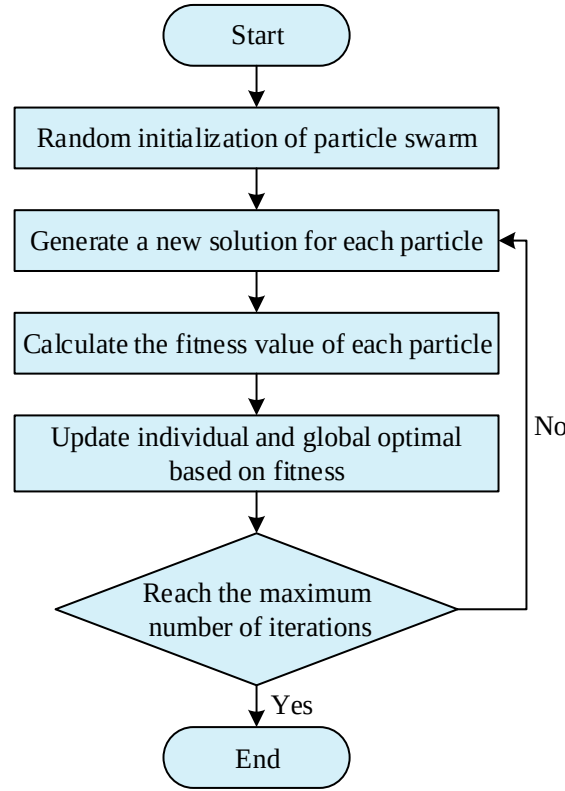


Figure 1 Operational flow of particle swarm algorithm

2.1.3 The fitness function of the particle swarm algorithm

Every algorithm is bound to have criteria to measure its performance, and particle swarm algorithms are no exception. In algorithm research, researchers usually use the fitness function to judge the performance of particles, and the particles with strong fitness will be preferentially retained and inherited, while the particles with poor fitness will naturally be eliminated. In the particle swarm algorithm discussed in this thesis, the absolute error integral is used as the algorithm's fitness function [18].

The functional expression of the absolute error integral is as follows:

$$IAE: J = \int_0^{\infty} |e(t)| dt \quad (6)$$

where $|e(t)|$ represents the absolute value of the error between the original input and the simulation output at moment t .

2.2 Adaptive particle swarm algorithm

To further improve the optimality of the PSO algorithm, we propose a new SPS-PSO algorithm on its basis. SPS-PSO introduces both parameter adaptive mechanism and strategy adaptive mechanism based on the original PSO algorithm and selects multiple effective candidate solution generation strategies to form a strategy pool, thus further enhancing the ability of the algorithm to adapt to different problems and different evolutionary stages.

2.2.1 Policy Adaptive Mechanism

The adaptive strategy mechanism can randomly select candidate solution generation strategies based on the strategy selection probability, which controls the magnitude of the probability of each candidate solution generation strategy being selected. In the strategy adaptive mechanism, we increase or decrease the selection probability of each candidate solution generation strategy based on its performance in the evolutionary process: “Are the generated particles better than the original?” to increase or decrease the selection probability of each candidate solution generation strategy.

We set an update cycle for all candidate solution generation strategies, and the selection probability of each candidate solution generation strategy is fixed in each update cycle. If the candidate solution generation strategy successfully optimizes the particles, i.e., the new particles generated by that candidate solution generation strategy have better fitness than the old particles, the policy selection probability of that candidate solution generation strategy will be increased, otherwise, it will be decreased. The new strategy selection probability will be adopted in the next update cycle. At the beginning of the algorithm, we set the same initial selection probability for each candidate solution generation strategy. The initial selection probability of each candidate solution generation strategy is set to $\frac{1}{N_q}$, and the sum of the probabilities of all candidate solution generation strategies is 1, where N_q is the number of candidate solution generation strategies in the strategy pool and p_q is used to represent the selection probability of q^{th} ($q = 1, 2, \dots, N_q$) strategies.

The roulette wheel method is used to select candidate solution generation strategies based on selection probabilities, and the current particle is used to generate new particles using the candidate solution generation strategy selected based on the selection probabilities. Then, the newly generated particles are evaluated by the classifier [19]. Subsequently, the evaluation results (whether the new solution is better than the original solution) are recorded by matrices nsFlag and nsFlag as follows:

$$\text{nsFlag} = \begin{pmatrix} 0 & 0 & \cdots & 0 \\ 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 0 \end{pmatrix}_{N_{ps} \times N_q} \quad \text{and} \quad \text{nsFlag} = \begin{pmatrix} 0 & 0 & \cdots & 0 \\ 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 0 \end{pmatrix}_{N_{ps} \times N_q} \quad (7)$$

After completing one cycle, i.e., N_g generation of evolution, we calculate the total number of successes and failures of all candidate solution generation strategies during N_g generations, and update the selection probability of each candidate solution generation strategy accordingly.

First, we compute the sum of each column of S and F to obtain the total number of successes or failures of each candidate solution generation strategy during N_g generations, and the results are recorded as S_q^1 and F_q^1 . If the number of successes of a candidate solution generation strategy yielding better particles is zero, i.e., the value of S_q^1 is zero, we give S_q^1 a sufficiently small value of ε to avoid a zero divisor in the next computations.

$$S = \begin{pmatrix} 0 & 0 & \cdots & 0 \\ 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 0 \end{pmatrix}_{N_g \times N_q} \quad \text{and} \quad F = \begin{pmatrix} 0 & 0 & \cdots & 0 \\ 0 & 0 & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & 0 \end{pmatrix}_{N_g \times N_q} \quad (8)$$

$$S_q^1 = \sum_{k=1}^{N_q} S_{k,q} \quad (9)$$

$$S_q^2 = \begin{cases} \varepsilon, & \text{if } S_q^1 = 0 \\ S_q^1, & \text{otherwise} \end{cases} \quad (10)$$

Then, the processed S_q^2 is divided by the total number of times the corresponding strategy was selected in the previous cycle, and the calculation process is shown in equation (11). This step aims to obtain the probability of success of each candidate solution generation strategy in one evolutionary cycle. This probability will determine the magnitude of the probability of selecting each candidate solution generation strategy in the next generation of evolution. At the same time, in order to ensure that the sum of the selection probabilities of all candidate solution generation strategies is 1, we need to normalize S_q^3 . The normalization is calculated as shown in equation (12).

$$S_q^3 = \frac{S_q^2}{(S_q^2 + S_q^1)} \quad (11)$$

$$P_q = \frac{S_q^3}{\sum_{q=1}^Q S_q^3} \quad (12)$$

Finally, the particle swarm algorithm flow with policy adaptive mechanism is given as shown in Figure 2.

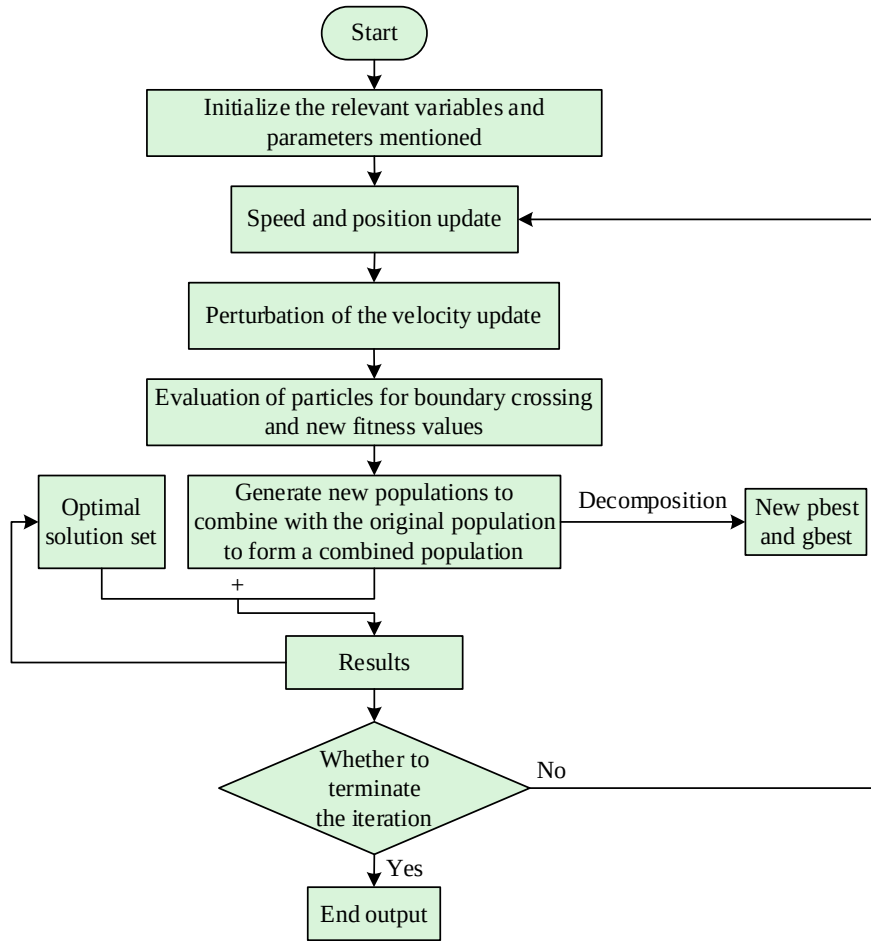


Figure 2 Strategy-based particle swarm algorithms

2.2.2 Parameter adaptive mechanism

Traditional PSO algorithms and a class of derivative PSO algorithms with a policy adaptation mechanism use fixed parameter values for all candidate solution generation strategies. In the parameter adaptation mechanism, a set of parameters that can be adjusted adaptively when encountering different problems and at different stages of evolution can improve the algorithm's performance and make each candidate solution generation strategy perform better during the evolution of the particles. In the SPS-PSO algorithm, we use Gaussian transformations to gradually approximate the parameter values to the optimal values that enable the candidate solution generation strategies to perform optimally.

In the SPS-PSO algorithm, in order to have a good initial value for the parameters so that the corresponding candidate solution generation strategies can produce solutions with higher classification accuracy and fewer features faster, we use $PVM_{N_p} = [P_1, P_2, \dots, P_{N_p}]$ as the initial value, where N_p is the total number of parameters contained in all candidate solution generation strategies that need to participate in the adaptive mechanism. Before the start of each evolutionary generation, a matrix consisting of all parameters is first constructed:

$$PVMemory = \begin{bmatrix} P_1 & P_2 & \dots & P_{N_p} \\ P_1 & P_2 & \dots & P_{N_p} \\ \dots & \dots & \dots & \dots \end{bmatrix}_{N_{ps} \times N_p} \quad (13)$$

The rows in this matrix represent the particle numbers in the population and the columns represent the parameter numbers. This matrix is used to store/update the values of the newly generated parameters in a generation.

When a candidate solution generation strategy is selected by the parameter adaptation mechanism to be used to generate new particles, the parameters required for that candidate solution generation strategy are taken from the corresponding positions in $PVMemory_{N_{ps} \times N_p}$. After one generation of evolution, we compute the mean value of each column of $PVMemory_{N_{ps} \times N_p}$ and record it in $PVMemory_{N_{ps} \times N_p}$. That is:

$$TempPVM = \begin{bmatrix} TP_1 & TP_2 & \dots & TP_{N_p} \\ TP_1 & TP_2 & \dots & TP_{N_p} \\ \dots & \dots & \dots & \dots \end{bmatrix}_{N_g \times N_p} \quad (14)$$

After every N_g generation, new parameter values are generated for use in the next cycle by counting all the values in $TempPVM_{N_g \times N_p}$, i.e., by averaging each column in $TempPVM_{N_g \times N_p}$. These new parameter values generated by the calculation will replace the original parameter values in $PVM_{N_p} = [P_1, P_2, \dots, P_{N_p}]$ and will be used in the next evolutionary cycle [20].

The flow of the parameter-based adaptive particle swarm algorithm is shown in Figure 3.

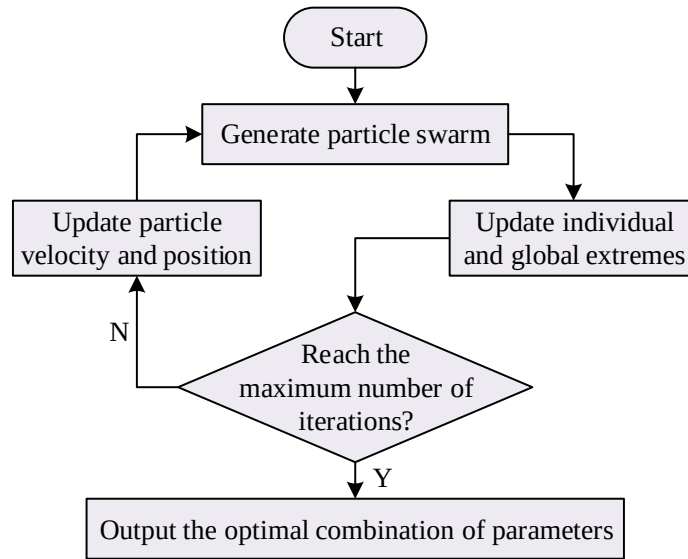


Figure 3 Parameter-based adaptive particle swarm algorithm flow

2.3 Feature selection

2.3.1 Representation of Feature Selection Solutions

Feature selection methods can reduce the training time and improve the algorithm's performance by filtering as many more effective features as possible from the original set of features. In the feature selection problem, we continuously generate new solutions (feature subsets) by the optimization algorithm and select the optimal subset by evaluating these feature subsets.

Thus, each feature in the dataset contains 2 states: selected and unselected. The selected or unselected states of all features form a selection scheme for constructing a subset of features. To conveniently represent the selection scheme for a subset of features, we use a D -dimensional vector B to represent the solution of feature selection, i.e.:

$$B = [b_1, b_2, \dots, b_D] \quad (15)$$

The value $b_i (i = 1, 2, \dots, D)$ of each dimension in B belongs to the set $[0, 1]$. If the value b_i of the i th dimension (feature) in B is 1, then the i th dimension feature is selected, and if the opposite is 0, then it is not selected.

To make it easier to generate new solutions by evolving and mutating the solutions through the optimization algorithm, we first generate a D -dimensional vector BI , namely:

$$BI = [bi_1, bi_2, \dots, bi_D] \quad (16)$$

The vector consists of consecutive values in the range $[0, 1]$. Then using a threshold θ to complete the mapping from BI to B , the:

$$B_i = \begin{cases} 1, & BI_i \geq \theta \\ 0, & BI_i < \theta \end{cases} \quad (17)$$

That is: For a dimension, if the value in BI is greater than θ , then the value of that dimension in B corresponds to 1, otherwise it corresponds to 0.

2.3.2 Strategies for initialization and renewal of populations

The initialization method of the population and the update strategy of the solution are important elements that determine the algorithm's performance. The initialization method determines the performance of the algorithm's initial population, and the initial population's performance affects the algorithm's speed in searching for the optimal solution in the solution space, i.e., the convergence performance. The update strategy determines the ability of the algorithm to search the solution space. In this paper, the initialization and updating of the adaptive particle swarm algorithm based on the strategy and parameters are described as follows:

1) Mixed initialization

When using the PSO algorithm to optimize the feature selection problem, the solution is initialized with most particles selecting a small number of features for initialization and a small number of remaining particles selecting a large number of features for initialization. The hybrid initialization method can make the initial population more diverse.

2) Particle update method

The previous section updates the candidate solution generation strategy of particle swarm arithmetic based on the strategy and parameters, and the historical best candidate solution $pbest$ for a single particle and the best candidate solution $gbest$ in the population are updated according to the following two cases.

First, the classification performance of the new particles is better than $pbest / gbest$.

Second, the new particle classification performance is the same as $pbest / gbest$, but the corresponding feature subset has a smaller number of features and a smaller solution size.

As a result, the flow of solving feature selection based on the SPS-PSO algorithm is given as shown in Figure 4.

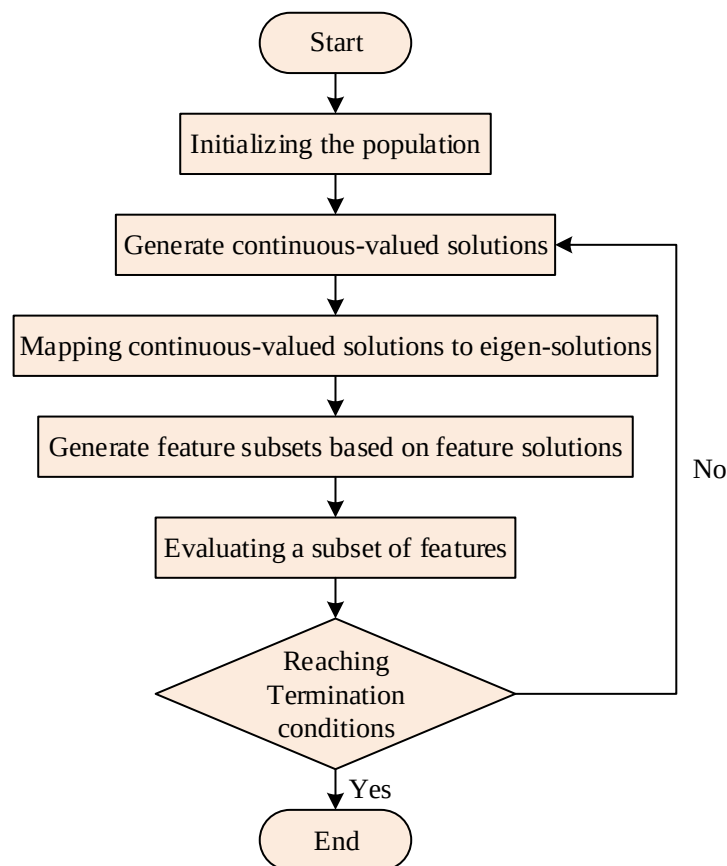


Figure 4 SPS-PSO-based algorithm for solving feature selection

3 Social network and innovation and entrepreneurship of economic and management college students

3.1 Innovation and Entrepreneurship

Innovation tends to be a creation from the point of view of thinking, pushing the envelope, being courageous, and achieving transformation. Entrepreneurship, on the other hand, focuses on the process of creating new businesses or new enterprises in various related fields, such as social

economy, politics, and culture, and launching new businesses so that opportunities for new goods or services can be identified and explored to create and produce new values and wealth for others and society. In this paper, we aim to transform the way of innovation and entrepreneurship education from the perspective of cultivating the thinking and ability of university students in economics and management to realize the true integration of innovation and entrepreneurship.

The ability of innovation and entrepreneurship refers to the comprehensive ability that individual college students should have not only certain innovative and entrepreneurial consciousness, innovative thinking ability and innovative knowledgeability but also have certain innovative and entrepreneurial practical abilities.

3.2 Undergraduates of Economics and Management

The common feature of economic and management majors is cultivating talents with comprehensive economics, business management, law, accounting, and other thinking and ability in economic operation issues oriented to economic management practice.

Economics and management undergraduates are students in higher education who receive systematic specialized education and primary scientific research training in economics and management. This study will focus on the undergraduate or graduate majors in economics and management currently offered by S University based on the review of the Catalogue of Undergraduate Majors in General Higher Education Schools promulgated by the state. The specific majors are shown in Table 1.

Table 1 Bachelor of Economics and Management

Faculty of Economics and Management	Specific professional content
School of Public Administration	National Economic Management, Labour and Social Security
School of Physical Education	Sports economics and management
School of Tourism Management	Hotel Management, Tourism Management
School of Environmental Economics	Resource and environmental economics
School of Finance and Economics	Taxation, Financial Engineering, Finance, Finance
Faculty of Economics	Energy Economics, Economics
School of Accounting and Accountancy	Financial Management
School of Business Administration	Business Administration, Marketing
School of Information Management	Electronic Commerce, Information Management and Information Systems
School of Management Science and Engineering	Trade Economics, International Economics and Trade
School of International Trade	National Economic Management, Labour and Social Security

The recipients of higher education should be the driving force of entrepreneurship and innovation, and institutions of higher education should follow the scientific concept of development and innovative strategy to improve the education content of their recipients from the essence of education. This is in line with the “entrepreneurship-led employment and entrepreneurial ability”, which aims to implement better the education goal of better employment for college students.

3.3 Social Networks

A social network is a unique set of relationships formed by a group of people or groups, and these relationships build up communication bridges that are used to convey information between members of society and facilitate the exchange of emotions and the formation of values. Taking the college student group as the research object, it is believed that its social network can be measured in four dimensions: the structural characteristics of the network, the nature of social relationship ties, the content of social relationship ties, and the dynamic process of the network. Social networks also open up new research directions with their unique research perspectives on the guiding role of innovation and entrepreneurship, effectively reducing the cost of knowledge transfer and guaranteeing its smooth circulation.

4 Impact analysis of innovation and entrepreneurship based on the SPS-PSO algorithm

This study explores the basic concepts and application methods based on social network relationship theory and takes economics and management college students as the research objects, starting from the four dimensions of their social network characteristics by sorting out their research results in innovation and entrepreneurship. The performance of innovation and entrepreneurship abilities of various economic and management college students with different social network characteristics will differ. The SPS-PSO algorithm is used to quantitatively analyze the data of the university students of S University to clarify the influence of the social network on the innovation and entrepreneurship ability of the university students of economics and management.

4.1 Impact Indicator Mining

4.1.1 College students' social network variables index mining

This section combines the four-dimensional scale on the social network of college students with the targeted mining of indicators on the variables of the social network of college students, and the contents of the indicators are shown in Table 2.

Table 2 Indicators of social networks of university students

Variable	Mining items	Coding
Centrality	I have quick and easy access to information from others.	CDHS1
	I am at the center of my social network.	CDHS2
Dynamicity	Every year I can make new friends.	CDHS3
	The friends I met three years ago are still in touch with me.	CDHS4
	I'm able to get help from others in a timely manner.	CDHS5
Heterogeneity	I am in frequent contact with people I know.	CDHS6
	Important friends have been very helpful in my professional development.	CDHS7
	It's important to me to build good relationships with the people who matter.	CDHS8
Strength of linkage	I keep in touch with many people from all walks of life.	CDHS9
	I keep in touch with people of all ages.	CDHS10

4.1.2 Innovation and entrepreneurship index mining

The cultivation of innovative and entrepreneurial abilities of college students in economics and management is an effective measure to enhance the self-employment of college students and an essential element in the construction of an innovative country. It is also essential for the construction of an innovative country. Combing the spirit of innovation in universities and promoting self-employment among college students can fundamentally solve the problem of severe employment

situations for them. In this section, the SPS-PSO algorithm is used to mine the indices of innovation and entrepreneurship ability of university students in economics and management of S University, shown in Table 3.

Table 3 Innovation and Entrepreneurship Indicators

Variable	Mining items	Coding
Thinking skills	I can identify problems more acutely and make sound judgements.	TIP1
	I am able to think in different ways and explore various answers to questions.	TIP2
Intellectual ability	My professional knowledge and operational skills have been enhanced.	TIP3
	I have acquired a certain amount of interdisciplinary knowledge and competence.	TIP4
Practical skills	I have benefited from participating in a number of practical activities.	TIP5
	I have a certain amount of creative and entrepreneurial practice to show for it.	TIP6

4.2 Analysis of impact indicators

This section uses the SPS-PSO algorithm for evaluation and analysis based on the examples of influential indicators of social networks and innovation and entrepreneurship of university students in business administration mined in the previous section. The data were evaluated on a 5-point Likert scale, and the sample's attitudes were expressed from 1 to 5 on a scale from "strongly disagree" to "strongly agree".

4.2.1 Analysis of indicators of social network variables of college students

Different dimensions of college students' social network variables lead to certain differences in college students' social relationships as well as social resources, and the results of the index analysis of college students' social network variables are shown in Figure 5.

From the index data of the social network of college students, the percentage of those who agree with the centrality, heterogeneity, dynamism, and effectiveness of linkage strength of the social network is 71.82%, which indicates that the social network of college students will have a certain degree of influence on the social life of college students, and the use of the social network for interaction and communication activities can directly or insightfully gain value-added knowledge. In turn, it makes college students in individual, interpersonal interaction and communication promote the improvement of knowledge, experience, problem-solving, and other abilities.

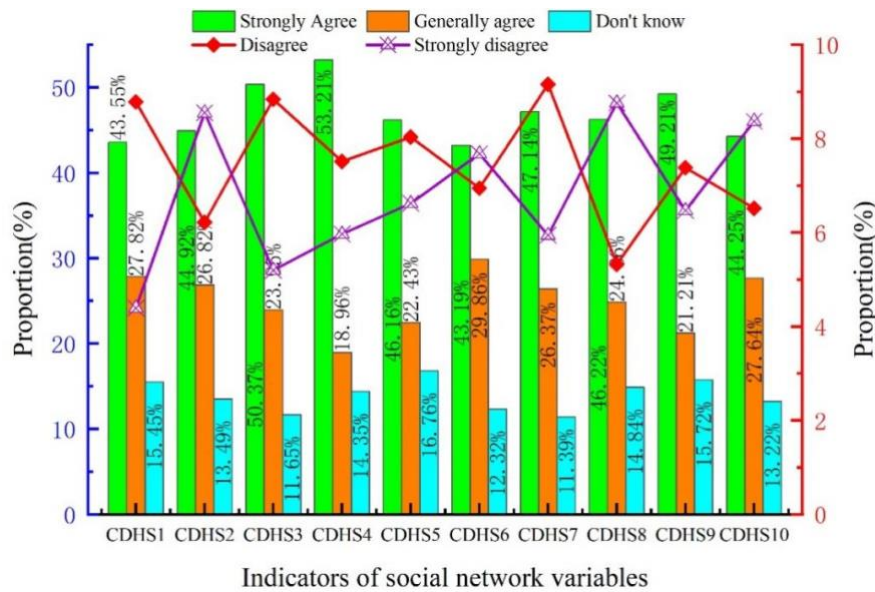


Figure 5 Indicator analysis of social network variables

Among them, 53.21% of the college students who strongly agreed with the evaluation said that they need to pay attention to the contact with friends in the social network, and they need to make the network connection closer by strengthening the contact to bring the distance between them and their friends closer. In the evaluation of general agreement, 29.86% of college students said that frequent contact with people they know could improve their knowledge and ability to solve problems through interaction. In the evaluation of don't know, 15.72% of college students said they didn't know whether they should interact with people from all walks of life, so this part of students lacked the ability and idea of innovation and entrepreneurship. In the evaluation of disagree and strongly disagree, 9.15% and 5.94% of college students think that friends are not very helpful to their career development, which shows that some college students have the problem of poor interpersonal skills and the school should conduct corresponding teaching guidance in this way.

4.2.2 Analysis of innovation and entrepreneurship indicators

College students of economics and management are equipped with basic knowledge in economics and management through their studies and have a stronger sense of innovation and entrepreneurship. Thus, they can discover entrepreneurial opportunities more keenly. The results of the analysis of the innovation and entrepreneurship ability indexes of college students in economics and management are shown in Figure 6.

From the index data of innovation and entrepreneurship ability of college students, the percentages of evaluations that strongly agree, generally agree, don't know, different and strongly disagree with innovation thinking ability, innovation knowledgeability and innovation and entrepreneurship practice ability are 41.98%, 25.32%, 16.16%, 10.22% and 6.32% respectively, from which it can be seen that college students of economics and management can, through their thinking activities, solve problems with a creative spirit and innovative meaning to solve problems, use existing knowledge and experience to seek new ways to solve problems by continuously integrating and exploring through continuous learning of other fields of knowledge. Among them, 53.21% of college students strongly agree that innovation and entrepreneurship could improve their professional knowledge and operation ability and stimulate their innovation and entrepreneurial consciousness. In the evaluation of the general agreement, 25.31% of college students said that through cultivating innovation and entrepreneurship ability, they could have certain practical achievements and make their innovation

and entrepreneurship ability stronger by participating in entrepreneurial competitions and cooperation between schools and school enterprises to obtain corresponding practical achievements. In the evaluation of don't know, the percentage of each evaluation is not much different, which indicates that this part of students are not aware of the role of innovation and entrepreneurship ability and cannot apply what they have learned to their future career planning. Under the evaluation of disagree and strongly disagree, although the proportion of both is small, there are still some students who think that innovation and entrepreneurship will not have an impact on their careers. Thus colleges and universities need to carry out career education in teaching subject knowledge to reverse such incorrect career thinking.

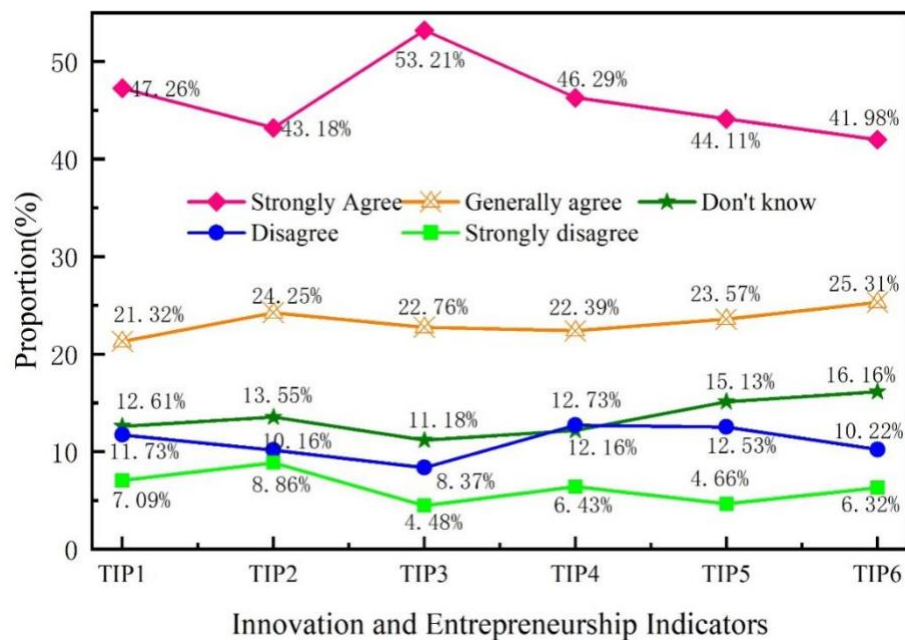


Figure 6 Analysis of innovation and entrepreneurship indicators

5 Conclusion

To investigate the factors influencing the relationship between social networks and innovation and entrepreneurship among university students in economics and management, this paper uses the feature selection based on strategy and parametric adaptive particle swarm algorithm to quantitatively analyze the data of economics and management students in University S. The conclusions are as follows:

- 1) Looking at the social network of college students, the percentage of those who agree with the validity of social network centrality, heterogeneity, dynamics, and linkage strength is 71.82%, indicating that social networks can have a certain positive influence on innovation and entrepreneurship ability. The use of social networks can enhance one's interpersonal communication ability, and the higher the degree of the structural integrity of social networks, the more it can enhance the innovation and entrepreneurship ability of college students.
- 2) From the viewpoint of innovation and entrepreneurship ability, the percentages of evaluations that strongly agree, generally agree, don't know, different, and strongly disagree with innovation thinking ability, innovation knowledgeability, and innovation and entrepreneurship practice ability are 41.98%, 25.32%, 16.16%, 10.22%, and 6.32%, respectively. University students of economics and management can take the creative spirit and innovative meaning

through their thinking activities to solve problems, use their existing knowledge and experience through continuous learning of other fields, and then improve their social network.

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