Research on Intelligent Signal Processing System Framework based on Particle Swarm Optimization

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Abstract: In order to improve the traffic efficiency of the intersection, the intersection state is divided based on the phase saturation, and the vehicle delay and the number of stops are calculated according to the division state. The vehicle delay, the number of stops and the traffic capacity are optimized functions. A new cross is proposed. The port traffic signal timing method is based on cat mapping and cloud model to improve the standard particle swarm optimization algorithm. The chaotic cloud particle swarm optimization algorithm is used to establish the numerical simulation results based on the optimized intersection signal timing model and the specific intersection traffic statistics. It shows that the new model can control the traffic intelligently according to different traffic flow conditions, reduce the vehicle delay and the number of stops, improve the traffic capacity of the intersection and verify the effectiveness and advancement of the model to deal with the traffic timing optimization problem.

1. Introduction

In the broad sense, the ITS includes the planning, design, implementation and operation management of the transportation system, and in the narrow sense, it mainly refers to the intelligent management of transportation management and organization. In general, ITS is the advanced information technology, sensor technology, data communication technology, automatic control technology, positioning technology, geographic information system technology, map database technology, spatial network analysis technology, operations research, image analysis technology, computer network and After the artificial intelligence technology is effectively integrated, it is applied to the entire traffic management system, and a comprehensive, real-time, accurate and efficient transportation system that functions in a wide range and in all directions is established.

With the development of urban traffic, the traffic volume will increase, and the signal control of multi-phase intersections will gradually become the mainstream. Therefore, the focus of future research will be multi-phase control. The basic principles of multi-phase control can be obtained by modeling the experience of an experienced traffic police commanding multi-phase intersections. In traffic control, the optimization of the timing scheme is a very critical step. From the development history of urban traffic control and the requirements of the future society to the city's traffic, it is inevitable that the intelligent control of the city's overall transportation network will be realized.

2. Particle Swarm Optimization Algorithm for Single Intersection

The particle swarm algorithm was first proposed by Bu Quart and Kenndey in 1995. Its basic concept stems from the study of artificial life C seven vitalUef) and bird predation behavior. Imagine a scene where a group of birds are searching for food randomly, there is only one piece of food in this area, and all the birds don't know where the food is, but they know how far the current location is from the food. So what is the optimal strategy for finding food? The easiest and most effective way is to search for the area around the bird that is currently closest to the food. The PSO algorithm is inspired by this biological population behavior and used to solve optimization problems. In PSO, the potential solution of each optimization problem can be imagined as a point in the d-dimensional search space. We call it "paritde". All particles have an adaptation value determined by the objective function (Fitnessvaute).), each particle has a speed that determines the

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direction and distance of their flight, and then the particles follow the current optimal particle search in the solution space. The detailed steps will be introduced in a later chapter. It can be seen that the particle swarm optimization algorithm is also based on individual collaboration and competition to complete the search of the optimal solution in the complex search space. It is an evolutionary computing technology based on the group intelligence method. Pso is similar to genetic algorithm and is a group-based optimization tool. However, PSo does not have operations such as crossover r and mutatoin for genetic algorithms. Instead, the particles search for the optimal particles in the solution space, so they have the advantage of being simple and easy to implement and without many parameters to be adjusted. The PSO algorithm has been proposed for less than a decade, but it has received widespread attention. The basic PSO is a powerful tool for function optimization. Its advantage is that the convergence speed is fast and there are fewer parameters to be set. The disadvantage is that it is easy to fall into local minimum points and the search accuracy is not high. On the basis of basic PSO, various meaningful improved PSO algorithms have emerged, such as adaptive PSO algorithm, cooperative PSO algorithm, hybrid PSO algorithm, etc., which can be seen in more detailed introductions in later chapters. . The PSO algorithm is very suitable for solving the optimization problem of continuous functions. It is mainly used in neural network training, multi-objective optimization and other application fields. It also has related research on using Pso to solve some discrete optimization problems, such as solving TsP. Optimization problem; because there are many optimization problems in signal processing, many scholars have recently introduced Pso into the problem of signal processing, such as solving image signal processing problem 7l], used to solve the filter design, used for Solve the problem of blind signal processing, and solve the problem of multi-user detection. However, PSO has just started in China, and there are not many documents to be seen, and there are many problems to be solved.

Particle Swarm Optimization (PSO) algorithm is a population-based optimization algorithm proposed by Kennedy and Eberhart in 1995. It is a new evolutionary algorithm with some characteristics of evolutionary algorithms, such as it was originally a The set of random solutions, and then the search optimal solution by updating the descendants. But each of its particles is a feasible solution to the problem to be solved, and the particle trajectory of each particle in the search space is controlled by the information sharing between the particles. Compared with the general evolutionary algorithm, it is more efficient and has a smaller amount of computation. It has been widely used. The mathematical language is used to describe: It is assumed that in an m-dimensional target search space, there are n populations of particles representing potential problem solutions. Then the basic particle swarm model consists of a group of n particles (position, velocity) = (Xti, Vti) in an m-dimensional variable space.

The PSO-based single-crossing signal control method proposed in this paper is related to the signal phase setting. In this paper, the four-phase signal control of single intersection is taken as an example. The traffic flow is divided into four directions: east, west, south and north. There are three lanes of traffic in each direction: left turn, straight ahead and right turn. No control is applied to right turn vehicles. . The four phases of traffic flow are things going straight, east and west, north and south, north and south. In this paper, the minimum vehicle stagnation is the performance index at the single intersection, and the green time of each phase of the signal is obtained by searching. Set the signal period to a fixed value, and set P to indicate the signal state of all traffic in the controlled direction, P = {pij}, where i = 1, 2, 3, 4 is the signal phase number, j = 1, 2, ..., 8 indicates the direction of the eight car flow entrances, indicating eastward straight, westward straight, westward left, eastward left, southward, northward, southward, and northward. Pij= indicates that the i-th phase and the j-th direction green light indicate the i-th phase and the j-th direction is red.

3. System design and structure

Discrete Fourier transform is one of the important contents of the digital signal processing course. Many of its properties have been widely used. The design idea of this demo module is to graphically and dynamically simulate the application of several important properties of discrete

Fourier transform. Demonstrate to the students and enable students to achieve verification and understanding of relevant knowledge points by transforming the corresponding parameters. Specifically, it includes six parts: DFT of extended sequence, circumferential shift, circular convolution, circumferential correlation, filter characteristics, frequency domain sampling and interpolation. Each of the experimental demonstration interfaces is designed into four areas: parameter selection and input area, experimental result graphic demonstration area, experimental result data display area, and knowledge key explanation area. The presentation form includes the default presentation and design demonstration. When entering an experimental content, the demonstration system automatically enters the default presentation interface first, giving typical experimental parameters, experimental results and corresponding concepts. Because the presentation system is interactive, students can choose the input parameters to verify the nature. For example, when demonstrating the circular convolution content in the discrete Fourier transform properties, we dynamically display the time series of the circumferential shift process, the convolution calculation process, and the convolution result in a graphical manner to the student through the screen. The students can understand the concepts of circumferential shift and circular convolution at a glance, grasp the difference between them and linear convolution, and control the speed of the shift, the type and length of the convolution sequence. In addition, on the right side of the interface, relevant knowledge points related to the experimental content are displayed to help students consolidate and review.

Window functions have very important applications in filter design, power spectrum estimation, and processing long sequences. Commonly used window functions are rectangular window, triangular window, Hanning window, Hamming window, Brakman window, etc. Different window functions have different time domain and frequency characteristics. This demo module is designed with various common window functions in the time domain and frequency domain waveforms (amplitude and phase frequency). In the display window, the spectral characteristics of various window functions are compared by selecting the window width and window type analysis. In addition, we add the typical application of the window function (the window function design method of the finite-length impulse response filter) to the demo module. Under the given technical specifications, the filter design is completed by selecting different window functions. Compare the effect of window function and window width on filter characteristics. Design results are displayed in the same graphical interface in different colors, allowing students to clearly compare the characteristics of various window functions. Digital filters play an important role in digital signal processing courses. This demo module includes several common filter design methods and typical filter types. Filters for low-pass, high-pass, band-pass, band-stop, etc. filters can be implemented. Types of filters include Butterworth, Chebyshev, and elliptical filters. Students can define the filter indicators, select the filter type and design method to complete the design, and the design results are directly displayed in the presentation interface through graphics (time domain, frequency domain) and data mode. In order to allow students to have a more intuitive understanding of the role of the filter, we also designed a filter application module in this part, mainly to filter the actual speech signal containing noise. In the experiment, we respectively form the noise signal, the noise-free speech signal and the mixed signal to form a data file, which is stored in the system. The demo module can display the spectrum of the above three signals, and design the filter by adjusting the parameters of the filter to complete the filtering noise. At the same time, the demo module also transmits each signal through the speaker, and feels the actual filtering effect, so that students have a more intuitive understanding of the role of the filter. The demonstration interface includes a filter parameter input area, a signal spectrum and a filter spectrum characteristic display area, an actual speech signal input, a filter design area, and a correlation-only explanation area.

4. Conclusion

The signal processing technology involves many fields of information science. It is a comprehensive application of modern signal processing, artificial neural networks, fuzzy system theory, evolutionary computation, including artificial intelligence and other theories and methods.

In recent years, it has become a research in the field of information science. hot spot. Among them, evolutionary computing, as an important branch of intelligent signal processing technology, has become a remarkable development direction in recent years.

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