Research on the Image Orientation Bridge Structural Stability Testing Platform Based on Feature Point Recognition and Genetic Algorithm

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Abstract

In this paper, we conduct research on image orientation bridge structural stability testing platform based on feature point recognition and the genetic algorithm. The pseudo-dynamic test in structural seismic test requires a step-by-step solution to the differential equation of motion of the whole structure. In each solution step, the calculated displacement is applied to the specimen, and then the measured feedback force is put into the differential equation. One-step displacement, and so on. As the number and capacity of a single laboratory equipment and test site is limited, often only one substructure tests. To deal with this challenge, this paper proposes the feature point recognition and the genetic algorithm based methodology to construct the image orientation bridge structural stability testing platform. The theoretical basis and numerical performance are proved.

Keywords: Image Orientation, Bridge Structural, Point Recognition, Genetic Algorithm.

Introduction

As gentle as well as structural style and function long span bridge design day by day complicates, the security of long span bridge operates into the key issue that is worth paying attention. The theory and method of the state assessment of bridge structure are developed along with the theory of reliability assessment of building structure. The development of bridge structure can be divided into the three stages. (1) In the exploratory stage from the 1940s to 1950s, it mainly focused on the analysis of the causes of structural diseases and the study of repair methods. (2) In the 60s to 70s, mainly for building detection techniques and the evaluation methods, the overall assessment, sub-evaluation of different methods, which control the method of assessment is relatively simple and easy, this method is easy to make a macro group buildings evaluation. (3) Since the 1980s, research and general development of the evaluation criteria have been initiated.

The engineering design personnel based on summarizing the practical experiences, and combining the perceptual knowledge, in the arrangement of the bridge embankment with solid, usually by way of strengthening the concave obtapezoid, but the lack of appropriate theoretical support, how will the bridge transition section design of subgrade treatment by way of "sensibility" to "rational", to meet the technical feasibility of the implementation of the material at the same time, the most reasonable use and to better guide engineering practice has important significance. The development and structural testing of structural engineering are inseparable, especially in aseismatic structure performance study while the structural testing has very vital

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function and along with the day-by-day popularization of development and intranet of the computer network technology, the civil engineering structural testing starts to develop to the network. The network experiment carries on the large complex combination structure remote collaboration experiment through the Internet access the remote laboratory can serve the purpose that the promotion experimental capacity and realizes the experimental resource sharing that can be separated into the listed technique principles.

- Analytic hierarchy and expert evaluation-based change the power comprehensive evaluation method. For the grass-roots maintenance personnel, according to the basic requirements of the bridge damage to make a correct and reasonable judgments still have some difficulty, once the division of the important division of the hierarchy in the comprehensive evaluation of the calculation will have a greater error while the impact of assessment results.

- Reliability theory. The method is based on the structure function obeys normal distribution as the foundation, but in engineering practice, the structure function is often nonlinear function, most of the basic random variables obey normal distribution, and in this case, the structure function generally do not obey the normal distribution, then as the method cannot directly calculate the reliability index of structure.

In this paper, to deal with the mentioned challenges, we conduct research on the image orientation bridge structural stability testing platform based on feature point recognition and genetic algorithm. In the later sections, we will discuss the issues in detail, and to begin, in the figure one, we show the visualized modelling result of the bridge.

**The Proposed Methodology**

**The Genetic Algorithm and the Optimization.** The genetic algorithm establishes in the natural selection and in the people genetics mechanism foundation that has the widespread compatible reconnaissance method. The genetic algorithm search unified Darwin survival of the fittest thought of the stochastic exchange of information, the survival of the fittest eliminates in the understanding not to adapt to the factor, the stochastic exchange of the information has used in the original solution the known knowledge, thus sped up the search
process powerfully. Along with the difference as well as the expansion of issue of scale issue type, must seek one type to be able at the limited price to solve the universal method that the search and optimizes, the genetic algorithm for an effective way that we provide which can be listed as the following aspects.

(1) Self-organizing, adaptive and self-learning habits.

(2) The intrinsic parallelism of genetic algorithm.

(3) Genetic algorithm not derivative or other auxiliary knowledge, and only affect the direction of the search function and corresponding fitness function.

(4) The genetic algorithm emphasizes the rule of probability transition, but not rule of transition.

(5) Genetic algorithm can be applied more directly.

(6) The genetic algorithm can generate a lot of potential solutions to a given problem, and the final selection can be determined by the user.

In many problems solving, the coding is the most important problem in the genetic algorithm, which has important influence on the performance of the algorithm. Holland proposed binary coding is the most commonly used genetic algorithm encoding method, which uses the principle of minimum character encoding. Encoding/decoding operation is simple and easy to cross, mutation operation to achieve while we can also use the schema theorem on the algorithm theory analysis. Insufficiency that in order to overcome the binary coding has when the continuous function discretization, the people proposed carries on the code with the gray code the method, it is the distortion of binary coding, then we revise the coding paradigm as the formula one.

\[ y_i = x_{i+1} \mid x_i \]  

In the process of the genetic algorithm, the new individuals can be generated continuously by the operators of the crossover and mutation of the population. Although more and more fine individuals will be produced as the population evolves, as the selected individuals are randomly paired and then used to perform crossover and mutation operations according to the preset crossover and mutation probabilities. In the figure two, we show the procedures.
Therefore the randomness of this process is very big, may in the destruction current community the sufficiency good excellent individual, thus reduced the average sufficiency of community, and to the operating efficiency and astringency of genetic algorithm has the disadvantageous influence. To this end, the crossover and mutation fitness probability are designed to meet the individual fitness as follows.

\[
 p_{\text{revised}}(i) = p_c \left[ 1 - \left( 1 - f(i) / \sum_{i=1}^{\text{size}} f(i) \right)^2 \right]
\]

(2)

When using parallel computing, on the one hand because of the retention of multiple populations, each explore different solution domain, and then together to seek the overall optimal solution, can inhibit premature phenomenon. On the other hand, using the parallel computing can significantly improve the speed of general genetic algorithm. Genetic algorithm parallel computing method is to decompose the whole group into several sub-groups, while each sub-groups are assigned to different processors, their serial running on the processor where the basic genetic algorithm, and then at the appropriate time, the processor exchange some information.

**The Feature Point Recognition.** Object recognition is one of the most important and challenging topics in the field of computer vision. In computer vision, the concept of feature points is widely used to solve the problem of object recognition, image matching and visual tracking. It makes no longer look at the whole image, but rather selects some special points, and then they are local analysis. This method is effective if enough points can be detected and their discrimination is high, and the stable features can be precisely located. The domain-based image deformation and view deformation are effective methods to obtain the intermediate image between two images by linear interpolation.

Based on the method of the mesh deformation, the transform function between two images is generated by spline interpolation using a non-uniform control mesh, and the control and manipulation as the grid are complicated. A set of characteristic line segments is obtained by interpolating linearly between the pair of characteristic line segments in order to generate an intermediate transition image between the starting and terminating the images. According to the feature set of the transformation function and the period as the gradient image sequence of the original image is calculated.

For the bridge application, the mark recognition is the most essential one. The target recognition is transformed into the process of finding the pixel or image region of the corresponding glyph in the image acquired by the robot. With the image segmentation, it is more desirable to obtain the certain point on the symbol such as geometric center and so on, in order to carry out the marking accurately which can be then analyzed as the follows.

- The glyphs are used to form an image area around a certain pixel in the image to facilitate computer recognition, and to satisfy the invariance of a certain computing feature when the distance and the angle of view are limited.
- Duty of target identification was the fast and that accurate found the mark central point correspondence in the image the pixel, processing can regard as a strong sorter.
- Considered that similarly thick or thin emission spoke strip thick or thin will also change with the distance change in the image, after the research discovery, by to the spoke strip central point surrounding image that thins gradually has good distance invariability in the image from center of the general around.
The Image Orientation Bridge Structural Stability Testing Method. What (optimized dimension design) is different from the traditional optimization design, satisfies the structure analysis situs of certain functional requirement to have many even infinite many forms, moreover this analysis situs form being hard quantitative description or the parametrization. Meanwhile, region that because needs to design in advance unknown, has increased the difficulty of problem solving, but on the other hand can obtain the optimum position of structure through the structural topology optimization.

Finite element is a numerical method, that a structure can be seen as a finite mechanics unit connected to each other by the composition of the unit; characterization of the mechanical properties of the stiffness matrix can be compared to buildings in the brick, assembled together Can provide the mechanical properties of the entire structure that can be treated as the new methodology of obtaining the stability testing reference. The existing tool is primarily the general large-scale procedure, its function is formidable, has very big superiority in the computational accuracy and speed, but makes concrete on the application to bridge, then can see it to be insufficient.

The modeling process is relatively complex to using the personnel the request is high. We need to develop the bridge special-purpose analysis. Commonly used that continuous topology optimization methods include variable thickness method, homogenization method and variable density method, in this paper, we use the variable density method with pseudo-density as the design variable to carry on the topology optimization. The variable density method is a common method of continuum topology optimization, and belongs to the material description method based on the base structure. From the material perspective, we propose the listed factors for considering.

- Quality of raw materials on the durability of concrete structures is essential, such as strict control of the raw materials as will lead to chemical reactions between certain components, especially alkali aggregate reaction, the durability of the structure is very detrimental. Chloride ion content of raw materials exceeded, but also easily leads to corrosion of steel.
- Construction process is an important link to ensure the durability of concrete structure, the correct and reasonable mixing, pouring shock as maintenance of concrete structure durability is very favorable.
- In practical engineering, there are many reasons for the decline of the durability of concrete structures, and they interact and influence each other, eventually leading to the destruction of structure. Therefore, in the assessment of structural durability, we must consider the impact of these factors, so that the establishment of the model is more practical significance.

Figure 3. The Image Orientation Bridge Structural Stability Testing Illustration.
Conclusion

In this paper, we conduct research on image orientation bridge structural stability testing platform based on feature point recognition and genetic algorithm. Entrusts with the heavy responsibility the design knowledge of bridge design enterprise to raise the rated capacity, the optimization design plan, because lacks effective gain design knowledge the way is unable to achieve effective entrusting with heavy responsibility of knowledge. This article in analyzes after the bridge data has established the object-oriented bridge structure data organization way. Under this basis, we propose the feature point recognition and genetic algorithm based bridge structural stability testing platform. In the future, we will apply the proposed system into the real-world applications for testing.

References


