Research on the Application of Artificial Intelligence Technology in Animal Embryo Transfer

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Abstract. Animal embryo transfer technology can show strong practical value, and its use in the animal husbandry industry is particularly prominent. It should be because this technology can significantly increase the birth rate and survival rate of animal pups within a period of time. This technology can also further improve the animal's own reproductive ability. With the popularization of this animal embryo transfer technology, the animal husbandry industry can achieve rapid development in a short period of time, enabling farmers to obtain higher and better economic benefits. Since animal embryo transfer technology entered the field of animal husbandry in the 1970s, the role of animal embryo transfer technology has become increasingly apparent. This technology has penetrated into biological reproduction technologies such as animal breeding, gender control and animal cloning. Animal reproduction technology has become leading the cutting-edge scientific reproduction technology of the livestock industry in the 21st century. Nowadays, artificial intelligence technology combines the research results of many disciplines such as theoretical science, technical science, and applied science. As a practical technology leading a new generation of technological revolution and industrial reform, artificial intelligence technology has a significant impact on human social progress, economic development, and biotechnology. However, the transformation of artificial intelligence technology has also brought some huge challenges to social stability. How to treat artificial intelligence and animal embryo transfer technology, how to integrate and coordinate these two technologies, and how to solve these technical design problems have become the urgent problems that need to be solved.

Keywords: Artificial Intelligence Technology, Animal Embryo Transfer, Animal Husbandry Industry, Biological Science

1. Introduction
Nowadays, with the rapid improvement of the development level of science and technology, animal embryo transfer technology has gradually emerged in some animal and plant breeding industries such as national animal husbandry. The application scope of animal embryo transfer technology has continued to expand, especially in animal husbandry production and reproduction. Field [1]. This technology shows great and rapid sustainable development and practical value. This technology
improves the reproduction rate and survival rate of animals, and provides a scientific, sustainable and effective way to improve the economic benefits of animal farmers. Kind of biotechnology [2]. At present, it seems that this rapid and universal development trend will continue. At least this is the case in China’s animal embryo transfer technology work. This situation is still understandable. An emerging technology must be applied from theory to production. Practice needs to face many unknown challenges, but no matter what the result is, the role of animal embryo transfer operators is very critical. It is especially important to establish a strict animal embryo transfer operation system. The same applies to animal embryos. In the process of transplantation, the control and investigation of potential diseases are equally important [3].

At present, a new round of scientific and technological revolution led by artificial intelligence technology has been fully launched. Artificial intelligence technology has promoted the optimization of human resources and structural reforms in various industries, and has promoted the rapid convergence of various industrial resources, thereby realizing the aggregation of industrial resources. In addition, after the resources of various industries are gathered together, more new industries will be derived [4]. For this reason, countries around the world have formulated scientific and reasonable plans for the development of artificial intelligence technology under the goal of national sustainable development [5]. And with the rapid development of artificial intelligence technology, animal embryo transfer has been successful in clinical trials in a variety of animals, and currently foreign countries have obtained multiple types of genetically modified cattle, sheep and pigs through this technology experiment. Waiting for animals [6]. Not only that, domestic animals such as genetically modified sheep and genetically modified cattle have also been obtained. The production of genetically modified livestock based on the principle of animal embryo transfer technology has become the most efficient way to increase the birth rate and survival rate of animal pups [7].

Thirty years ago, animal embryo transfer technology was still a very technological term, and it is still the case today, indicating that the development process of animal embryo transfer technology is unimaginable [8]. No matter how the animal embryo transfer technology develops and in which direction it is used, in fact the survival rate and birth rate of the animal embryo itself and the pups reproduced after the transfer, as well as the quality of the bred animals, are still testing whether the animal embryo transfer technology is The main factors for the success of the experiment [9]. Animal embryo transfer technology will be used in practice as an important means of breeding and reproduction from the beginning of breeding work. And the use of animal embryo transfer technology to expand the breeding core group has carried out a purposeful and targeted exploration: determine the fresh embryo transfer technology route of repeated superovulation in donor animals every 5 weeks; and implement artificial insemination and surgical fertilization, etc. The embryo harvesting effects of different breeding methods are compared [10]. Therefore, the research progress of animal embryo transfer technology can be used to measure the success of animal embryo transfer technology by how reproductive biologists produce and apply embryos, and the theoretical knowledge that needs to be imparted on how to make female animals pregnant and reproductive.

2. Discrete Wavelet Transform Algorithm and Analysis Modeling method

2.1. One-Dimensional Discrete Wavelet Transform

The specific algorithm of one-dimensional discrete wavelet transform can be seen below:

Let the function I(x) ∈ L²(R), the wavelet function be ψ(x), and the scale function be φ(x), I(x) the expansion of the wavelet series is as follows:

\[ I(x) = \sum_{k} C_{l0}(k) \phi_{l0,k}(x) + \sum_{j=1}^{\infty} \sum_{k} d_{j}(k) \psi_{j,k}(x) \tag{1} \]

In the extended formula, any starting scale, \( j_0 \) approximate coefficient, \( C_{l0}(k) \) detail coefficient, and \( d_{j}(k) \) are the finite wireless protocol integer winners.
Twitter extension defined by the above series expansion of formula (1) may be continuously variable as a function of a series of mapping coefficients. If you are waiting for the expansion of functions are discrete, the result coefficient is called discrete Twitter conversion coefficient [27] [30], Equation (1) can be converted into Equation (4), wherein the formula (2) and (3) is Conversion pair.

\[ W_{\phi}(j_0, k) = \frac{1}{\sqrt{M}} \sum_{x} I(x) \varphi_{j_0,k}(x) \]  

\[ W_{\psi}(j, k) = \frac{1}{\sqrt{M}} \sum_{x} I(x) \psi_{j,k}(x), j \geq j_0 \]  

\[ I(x) = \frac{1}{\sqrt{M}} \sum_{x} W_{\phi}(j_0, k) \varphi_{j_0,k}(x) + \frac{1}{\sqrt{M}} \sum_{k} W_{\psi}(j, k) \psi_{j,k}(x) \]  

Among them, k is the integer subscript of finite sum or infinite sum, and \( I(x), \varphi_{j_0,k}(x), \psi_{j,k}(x) \) is a function of discrete variables.

2.2. Two-Dimensional Discrete Wavelet Transform

Suppose given \( I(x,y) \in M \times N \), the scale function is \( \varphi(x,y) \), and the other three two-dimensional wavelet functions are \( \psi^H(x,y), \psi^V(x,y), \psi^D(x,y) \). These three two-dimensional wavelet functions have very drastic changes in direction \( \psi^H \), and can be used to measure changes in the development of animal embryo transfer in different directions—measuring changes in the horizontal direction \( \psi^V \), measuring changes in the vertical direction \( \psi^D \), and measuring the diagonal Variety. Therefore, the discrete wavelet transform pair in the two-dimensional case is shown in formulas (5) and (6):

\[ W_{\phi}(j_0, m, n) = \frac{1}{\sqrt{MN}} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} I(x,y) \varphi_{j_0,m,n}(x,y) \]  

\[ W_{\psi}^i(j, m, n) = \frac{1}{\sqrt{MN}} \sum_{x=0}^{M-1} \sum_{y=0}^{N-1} I(x,y) \psi_{j,m,n}^i(x,y) \]  

Among them, is the starting position of any place, i represents different directions, \( W_{\phi}(j_0, m, n) \) is the \( I(x,y) \) approximate coefficient under \( j_0 \) the condition of any starting position, and is the detail coefficient of the i direction under the condition of scale j. Usually let the starting position of any place \( j_0=0 \), and choose \( M=N=2^l \), so there are \( j=0,1,2,\ldots,J-1 \) and \( m=n=0,1,\ldots,2^l-1 \). Therefore, the expression of the two-dimensional image can be expressed by the following formula (7):

\[ I(x,y) = \frac{1}{\sqrt{MN}} \sum_{m} \sum_{n} W_{\phi}(j_0, m, n) \varphi_{j_0,m,n}(x,y) \]

\[ + \frac{1}{\sqrt{MN}} \sum_{l=H,V,D} \sum_{j=j_0}^{J-1} \sum_{m} \sum_{n} W_{\psi}^i(j, m, n) \psi_{j,m,n}^i(x,y) \]  

2.3. Discrete Wavelet Transform Analysis
In the process of animal embryo transfer, continuous wavelet transformation is required. Generally speaking, binary processing is used to realize artificial intelligence. This wavelet is transformed into discrete wavelet transformation. In fact, DWT decomposes the scale and change of continuous wavelet transform according to the repeated square of 2. The importance of DWT is that signals of other scales can be decomposed, and the choice of different scales can be determined according to other goals. In many signals, low-frequency components are very important, generally including signal characteristics, high-frequency components provide signal details or differences. Remove the high-frequency components, people's voice may be different from before, but they can still know what they are saying. If the low frequency components are sufficiently removed, meaningless sounds will be heard. Approximations and details are often used in wavelet transform analysis. The general performance of high-difference signals is low-frequency information. The detailed information shows the high difference signal, that is, high frequency information. Therefore, the original signal passes through two mutual filters to generate two signals.

3. Modeling Method

3.1. Artificial Intelligence Technology for the Establishment of Animal Embryo Transfer Models

In the operation of animal embryo transfer using artificial intelligence technology, it is necessary to design and preview the detailed process of the experimental operation in advance to ensure the success of the experiment. However, the prerequisite for solving these problems is to design a complete model. After the low-frequency \( I_0 \) sub-image \( I_{0LL} \) obtained above, the next step is to use the SIFT feature extraction method to extract feature points, which mainly includes the following steps:

1. Extremum detection in scale space. Suppose \( L(x,y,\sigma) \) it is a scale space function of the image, which is generated by \( G(x,y,\sigma) \) convolution of the Gaussian function and the image \( I_{0LL}(x,y) \), as shown in formula (8):

\[
L(x,y,\sigma) = G(x,y,\sigma) * I_{0LL}(x,y)
\] (8)

Among them, * is the convolution operator, \( \sigma \) which is a spatial factor that determines the degree of smoothness during animal embryo transfer. The larger the value, the more it can describe the overall content of the animal embryo transfer process. The smaller the value, the more detailed information about the animal embryo transfer process. Detailed description. The expression of the Gaussian \( G(x,y,\sigma) \) function is shown in formula (9):

\[
G(x,y,\sigma) = \frac{1}{2\pi\sigma^2}e^{-(x^2+y^2)/2\sigma^2}
\] (9)

Then, the Gaussian difference function and the image \( I_{0LL} \) convolution are used to obtain the scale difference function \( D(x,y,\sigma) \), which is calculated by the difference between two nearby scale space functions separated by a constant multiplication factor \( k \), see formula (10).

\[
D(x,y,\sigma) = (G(x,y,k\sigma) - G(x,y,\sigma)) * I_{0LL}(x,y) = L(x,y,k\sigma) - L(x,y,\sigma)
\] (10)

2. Positioning of key points of embryo transfer. The position and scale of the key points of embryo transfer are accurately determined by fitting formula (11). First, the formula is derived once to make it 0 to obtain the precise position \( x \), and then the Hessian matrix is used to remove the key points of low contrast and The unstable edge response points are used to determine the points that are invariant to the scale and direction of the embryo transfer process.

\[
D(x,y,\sigma) = D(x,y,\sigma) + \frac{\partial D^T}{\partial x}x + \frac{1}{2}x^T\frac{\partial^2 D^T}{\partial x^2}x
\] (11)
\[ x = \frac{\partial^2 D^{-1} \partial D}{\partial x^2} \quad (12) \]

(3) Direction distribution. For the feature point \((x, y)\), the scale image with the scale of the feature point is:

\[ L(x, y) = G(x, y, \sigma) \ast I_{0, p}(x, y) \quad (13) \]

The gradient amplitude \(m(x, y)\) and \(\theta(x, y)\) direction can be approximated by the difference operation of adjacent embryo cells, as shown in formulas (14) and (15):

\[ m(x, y) = \sqrt{(L(x + 1, y) - L(x - 1, y))^2 + (L(x, y + 1) - L(x, y - 1))^2} \quad (14) \]

\[ \theta(x, y) = \tan^{-1}[(L(x, y + 1) - L(x, y - 1))/(L(x + 1, y) - L(x - 1, y))] \quad (15) \]

In the neighborhood window centered on key points, every 10 angles are merged into one direction, a total of 36 directions. The number of each direction is counted through histogram statistics, and the direction with the largest number is used as the main direction of the key point. In order to enhance the robustness of the direction expression, the direction with 80% of the main directions is used as the secondary direction of the key point.

4. Evaluation Results and Research

Artificial intelligence technology is used for animal embryo transfer, and the mice that have lived for 25 days are anesthetized and not anesthetized respectively. The anesthetics used in the anesthetized mice are averitn, tetracaine, and 1% pentobarbital. Anesthetics such as sodium, ether and lidoca. Tetracaine and Lidoca are anesthetics for local anesthesia of mice, so before embryo transfer of mice, it is necessary to instill 20ul in the vagina of the recipient female mice, and then perform the small Mouse embryo transfer. In the process of anesthetizing the mice, it will be found that the pentobarbital sodium is more toxic, which will cause the mice to be poisoned and lethal after the anesthesia, and the incomplete effect of the ether anesthetizing the recipient mice will cause the mice to be incomplete. Woke up in the middle of the experiment, so there is no statistics for these two sets of data. The experimental results of each group are shown in Table 1.

| No need to deal with | Number of embryos transferred | Number of receptors | Number of pregnancy | Pregnancy rate (%) | Number of cubs produced | Productivity (%) |
|----------------------|-------------------------------|---------------------|---------------------|--------------------|------------------------|-----------------|
| Not anesthetized     | 200                           | 30                  | 22                  | 73.3               | 110                    | 55              |
| Avertin              | 420                           | 55                  | 50                  | 90.9               | 250                    | 59.5            |
| Tetracaine           | 220                           | 30                  | 24                  | 80                 | 120                    | 54.5            |
| Lidocaine            | 275                           | 36                  | 30                  | 83.3               | 150                    | 54.5            |

As shown in Table 1, there is little difference in the success rate of embryo transfer between the recipient mice anesthesia group and the non-anesthetic group, and the difference in embryo transfer rates between different anesthetics under anesthesia is not big, but the averitin anesthetic anesthesia group The embryo transfer efficiency of mice was 59.5%, and the pregnancy rate of mice anesthetized with averitin was 17.6% higher than that of mice without anesthetic. It shows that the application of
avertin anesthetic to anesthetize the mice can help increase the pregnancy rate of the recipient and reduce the emptying rate. In addition, the use of anesthetic anesthesia facilitates the stability of the mice. During the embryo transfer process, the embryo transfer tube through the cervix is more smooth. The difference between the local anesthetics tetracaine and lidocaine group and the no anesthetic anesthesia group is not significant. These two local anesthetics are slower than avertin, and cannot be intuitively judged for its anesthetic effect, and cannot improve the efficiency of embryo transfer. It is toxic, so these two methods of anesthesia are not suitable for non-surgical embryo transfer.

According to the experimental results in Table 1, in order to conduct a deeper study on the effect of avertin anesthetic, an embryo recovery experiment was designed, which is to transfer the embryos into the uterus of mice. After 5.10 minutes, the mice were put to death by cervical dislocation. Cut out the complete uterus of the mouse, flush out the transplanted embryos, and observe the number of flushed out and transferred embryos. The experimental group was anesthetized with Avertin and the control group was not anesthetized.

![Figure 1. Retrieval of embryos transferred into the uterus in the anesthesia group](image1)

![Figure 2. Retrieval of embryos transferred into the uterus in the non-anaesthetic group](image2)

The results from Fig. 1 and Fig. 2 show that embryo transfer was carried out in the mouse under anesthesia, and 160 mouse embryos were transferred to the uterus of 21 recipient mice, and 85 embryos were retrieved. The recovery rate was 53.1%; 120 mouse embryos were transferred into the uterus of 15 recipient mice when the mice were not anesthetized with anesthetic, and 32 embryos were retrieved, the recovery rate was 26.7%. This experiment shows that the number of embryos in the mouse embryos is lost during the process of transplantation. There is a significant difference between the anesthetic anesthesia group and the non-anesthetic anesthesia group. It is easier to find the embryos after the anesthetic anesthesia. This shows that the anesthetic anesthesia is conducive to the deposition of embryos and reduces the loss of embryos.

5. Conclusion
With the rapid development of modern science and technology, the term animal embryo transfer technology has gradually appeared in people's vision. At the same time, this technology has also been used in the process of livestock production. This technology has not only improved livestock production and Reproductive capacity and success rate can also create more economic value in animal husbandry and lay a solid foundation for the development of my country's animal husbandry economy. Animal embryo transfer technology is a mature biotechnology for professional and technical personnel. At present, further research is needed to explore how to improve the pregnancy rate and birth rate of recipients after embryo transfer. Of course, this issue involves a wide range of aspects, including the selection of donors and recipients, the treatment effects of superovulation, simultaneous estrus treatment, embryo collection methods, embryo division operations, etc., animal embryo transfer recipients and embryo preservation And other important links. Animal embryo transfer technology has also led to the continuous development of other embryo bioengineering technologies. Embryo transfer technology is a basic technology for sex identification and sampling of embryos by observing sex chromosomes. It is also a basic science and technology for embryo mosaic, transgenic and clonal reproduction. Although the development history of animal embryo transfer technology is only a short period of more than ten years, satisfactory experimental results have been initially obtained.

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