Firepower Distribution Method in Wargame System Based on Machine Learning and Wavelet Analysis

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Abstract. It is the key to the success or failure of military operations to formulate practical and feasible operational plans quickly and in a timely manner. Aiming at the development and analysis of the auxiliary action plan of the computer chess system, the machine learning and wavelet analysis are used to analyze the research of the war game system from the planning and drafting process, which provides a reference for the fire distribution of the war game system.

1. Introduction
The war game simulation in the war game system can provide combat commanders with decision support assistance in line with the characteristics of war. As a new methodology, modern chess has been applied to many fields and played an important and irreplaceable role. This paper first uses machine learning to derive the firepower distribution method in the war chess system, and then uses wavelet analysis to study the striking wave and gap in the joint fire attack process. The simulation results prove the feasibility of the method.

2. Machine Learning
Machine learning uses a lot of data to train and learn how to accomplish tasks from data through various algorithms. In model training of machine learning, the objective function to be optimized can generally be expressed as the following form: \( \min J(x, \xi) \) or \( \max J(x, \xi) \), where,

\[
J(x, \xi) = f(\{x_i, y_i\}_{i=1}^{N}; \xi)+r(\xi)
\]  \hspace{1cm} (1)

![Figure 1. Local interpolation curve](image-url)
Among them, the function takes $J(\xi)$ as the objective function, $f$ is the loss function which represents the difference between the true value and the fitted value, and $r(\xi)$ is the regular term (to prevent the parameter over-fitting problem). Various optimization algorithms solve the equation in different ways to obtain parameters that are optimal for research, Local interpolation curve as Fig. 1.

3. Wavelet Analysis

Let $n$ be a non-negative integer, if there are two constants and, and a polynomial, so that for any $n$, there are:

$$|f(x_n + h) - P_n(b)| \leq A|h|^n$$

(2)

Then in the case of Lipschitz. If equation (2) holds for all, and is said to be consistent with Lipschitz. The Lipschitz characterizes the regular shape of the function at that point, called the function at Point, which is Lipschitz. The larger the Lipschitz exponent, the smoother the function; the function is continuously differentiable at one point, then the Lipschitz exponent at that point is 1; the function is derivable at one point, and the Lipschitz exponent is still 1 when the derivative is bounded but not continuous; if Lipschitz $<1$, the function is called singular at the point. A function that is discontinuous but bounded, the Lipschitz exponent of this point is zero.

The wavelet coefficients depend on the characteristics of the neighbourhood and the scale chosen by the wavelet transform. In the wavelet transform. Definition: If, for wavelet is satisfied and continuously differentiable, and has a order vanishing moment (which is a positive integer), there are:

$$Wf(s, x) \leq Ks^\alpha$$

(3)

It is called the singularity index (also known as the Lipschitz index).

The wavelet transform can extract the singular points of the signal through multi-resolution analysis. When the Lipschitz exponent near the singular point is $>0$, the modulus maxima of the continuous wavelet transform increases with the increase of the scale. When $<0$, it follows The scale increases and decreases. Since the white noise is almost singular, the Lipschitz exponent corresponding to the noise is much smaller than 0, and the Lipschitz exponent corresponding to the signal edge is greater than or equal to 0. As the scale $s$ increases, the modulus maxima of the white noise will rapidly decrease. Therefore, wavelet transform can be used to distinguish between noise and signal edges, effectively detecting signal edges (gradual or sudden). The singularity can be determined by using the relationship between the singular point in the wavelet transform and the modulus maxima of the wavelet transform. The modulus maxima of the wavelet transform occur in the place where the signal has a sudden change, and the high-frequency part of the high-frequency part at the sudden change point is more, so the singular point of the function can be greatly changed from the high-frequency part of the wavelet. The value is detected.

$$C_\nu = \int_\omega \left| \frac{\psi(\omega)}{|\omega|} \right|^2 d\omega < \infty$$

(4)

4. Wargame System Firepower Derivation Method

The machine learning and wavelet analysis data are sorted in descending order according to the number of fire strike events. Initialize the root node Root of the connected tree C-Tree. The first hex grid $q$ is taken from the set $Q$ in order, inserted into the C-Tree as a child node, and $q$ is removed from $Q$. Find the adjacent hex lattices of all $q$ in $Q$, add them to the C-Tree as children of $q$, and remove them from $Q$. Take the first child of $a$, $a$. Find all members of $Q$ that are adjacent to $a$, join the C-Tree as a child of $a$, and remove those members from $Q$. If $a$ has no children, jump to the previous step. For the first child node $a_1$ of $a$, take $q$ the next child node $b$. If $q$ has no next child node, the next hexagonal lattice in $Q$ is taken as the next child node $p$ of Root, and if $Q$ is empty, it ends.
5. Simulation Analysis
The application of wavelet analysis is illustrated by taking the firepower distribution of a certain wargame system as an example. According to the firepower change of the wargame system, selecting the appropriate decomposition scale and applying the good local analysis ability of the wavelet can easily solve the fire distribution optimization problem: including the mutation time, type and amplitude. As shown in Fig.1, we use the Daubechies1 wavelet and take the decomposition scale \( J=3 \) to achieve a satisfactory result. Take the decomposition scale \( J=3 \), the original firepower layout is shown in the Fig.3, and the relationship is as follows:

![Figure 3. Firepower distribution optimization value detection](image)

The method implementation process in this paper is a method to adjust the firepower of the wargame system. The choice of the specific problem model is better, and the learning effect is also ideal. However, due to the lack of theoretical guidance, the choice of model can only rely on experience or prior knowledge in most cases, resulting in instability of promotion ability, which is particularly evident in the selection of firepower distribution parameters of the wargame system.
6. Conclusion
The paper proposes a firepower distribution method that uses machine learning and wavelet analysis to derive the war chess system. This method can use the conflict check function provided by the wargame system to improve the combat area and fire safety line of each unit when the exercise plan is formulated. The emphasis and application of synergistic factors such as firepower strikes highlight the characteristics of the perception and reality of the wargame exercises, and provide reference for the study of conflicts in other combat simulation systems.

7. References
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