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Sedimentation of Sediment Particles in the Ocean Based on Dynamic Programming Algorithm

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Abstract: It is an important subject of sediment production machinery to study the production development process and sediment transport law of cohesive fine-grained sediment flocculation. At present, many scholars have learned how to break out of the water under pressure on the basis of theory and practice, but there are still many unsolved problems. This paper aims to study the sedimentation of sediment particles in the ocean based on a dynamic programming algorithm. In this paper, the microscopic images of flocs are analyzed and studied by using Ipp graphics software and fractal method for the motion of offshore seawater such as beaches. The traditional calculation method is relatively simple to calculate the effective density of flocs. The fractal dimension of flocculation was calculated using the box dimension calculation method of two-dimensional digital images and MATLAB software. The changing laws of effective density, porosity, diameter and fractal dimension of flocs under different sediment content and electrolyte conditions were discussed from the microscopic point of view. From a macroscopic point of view, the flocculation and recrystallization processes of fine-grained viscous powders were experimentally evaluated. If you consider that most natural water contains cations, and cations have a great influence on the flocculation and distribution of fine sediments, for this reason, this paper develops the ion concentration parameter based on the principle of Goncharov, which is suitable for the flocculation rate formula. Experiments have shown that the floc density of different cationic valences changes significantly. There is a transitional stage, called transitional settlement stage.

1. Introduction

The movement of viscous sediment is complex, and flocculation, flocculation, and agglomeration will occur during the stabilization process, and the flow of suspended water at the bottom between particles will be affected and restricted by various factors, resulting in changes in the water system and water system. Coastal sedimentation of water lakes and destruction and destruction of aquatic ecosystems. At present, many scholars have used different methods to study the regeneration process of good thick dough under the influence factors, and achieved some results, but many conclusions are drawn under the influence of one factor, which is inconsistent with the actual situation. Therefore, it is necessary to fully understand the properties and structures of the best flours based on the following studies [1-2].

In the study of sedimentation of sediment particles in the ocean based on the dynamic programming algorithm , many scholars have studied it and achieved good results. For example , Kumar C believes that flocculation refers to the interaction between viscous and fine The surface charge of sand particles is reduced, the cohesion is reduced, and a unique agglomerate structure is formed [3]. Hocking TD found that with the further development of observation equipment and imaging technology, the changes of floc morphology and structure during the coalescence process can be studied more deeply, but the existing theories cannot accurately explain the changes of floc structure [4].

This paper studies a DP-TBD algorithm (ACS-DP-TBD) based on the current statistical model (CS). Through the fractal theory of the fractal dimension of sediment distribution in multiple hydrological measurement sections, the linear relationship between the particle size of marine sediment particles and the fractal dimension of distribution and the changing law are explored. Plot the sediment gradation curves of different measurement sections in the wet season and the flat water period, calculate the gradation index, and evaluate the marine sediment gradation. The characteristic parameters of the ocean (average geometric size, sorting degree, skewness value and kurtosis value) are calculated through the statistical analysis of sediment, so as to describe the distribution characteristics of sediment in different geographical locations in detail, and by calculating the characteristic parameter results Grading evaluation of marine features, analyzing the relationship between feature parameters and fractal dimension.

2. Research on Sedimentation of Sediment Particles in the Ocean Based on Dynamic Programming Algorithm

2.1. Application of Dynamic Programming Algorithm in Sedimentation of Sediment Particles in the Ocean

The optimization problem refers to the problem of determining the optimal value of a function and the corresponding independent variables that make the optimal function reach the optimal value under certain constraints. When using DP to solve an optimal problem, the optimization problem is first decomposed into several related levels, and then state variables are introduced to describe the state change process between levels. At each level, when a situation is defined, one or more decisions must be made. These decisions depend on the current department or conditions. After a decision is made, the situation evolves to the next level according to the decision, and a hierarchical indicator function or value function is used to measure the merits of the decision. The decision-making process with decision-making at each layer is a process, and the idea of doing a better job of the whole process is called the best process, that is, the best solution to the problem [5-6].

2.2. The Sediment is Dense

The sediment movement process is the last stage of the deposition process. This phase is very different from the previous water distribution phase.

Because the particle size of fine sediment is very small, flocculation will occur under the action of seawater, which will significantly change the shape and structure of the sediment. When the sediment content reaches a certain concentration, under the combined effect of flocculation, the sedimentation rate decreases with the increase of the sediment content. With the flow of pore water, the sediment will become cohesive, and the flow state gradually evolves from a plastic state solid state [7-8].

At this stage, due to the movement, the fine powder is connected to form flocs during the deposition process, the flocs and flocs are connected to each other to form agglomerates, and the agglomerates overlap each other to form a skeleton and a network structure. Flocculent sediments have little shear strength or cohesive strength and will eventually reach density equilibrium under the influence of their own weight or other external forces.

The sediment compaction process involves the seepage of pore water between particles and the compaction of the soil skeleton of sediment deposits. These two processes are carried out simultaneously, and the pore water comes out faster than the compaction of the soil skeleton. When all the pore water is released and the soil skeleton bears the full weight of the sediment, the sediment compaction process basically ends. In the coagulation process, the two processes cooperate with each other and change each other, and the speed of the change will affect the speed of sedimentation. The initial soil pressure is small, and the pore water between the particles is easily released. With the release of pore water, the pressure is transferred to the soil bone and begins to compress the soil bone. When the pore water is released, the soil skeleton exhibits the full pressure of the mud [9-10].

When fine sediment accumulates in water, many mud structures are often formed due to particle separation and flocculation, which are generally divided into single-grain structure, sponge structure and cell structure. With the prolongation of time and the increase of upper layer pressure, the original structure of the two end claws was destroyed and developed into a single-grain structure. In the process of pressure change, the change of mud density also happens to change from fast to slow.

The weight system has a natural order. During the deposition process, the large sediment particles generally settle to the bed surface first, and the fine sediment particles settle slowly. During the sorting process, the particle size of the base powder is larger. However, what is the gradient change of the specific particle size of the sediment remains to be studied [11-12].

2.3. Algorithm Selection

The test method for viscous sediment is generally the settlement analysis method, and the cumulative gravimetric method is mainly selected in this paper.

According to the continuous equation of sand volume, it can be obtained [13-14]:

$$\frac{\partial S}{\partial t}+\frac{\partial\left(\overline{\omega}S\right)}{\partial z}=0 \tag{1}$$

In the formula, t is the time, and ω is the wavelength.

Integrate the water depth z to get,

$$\left(\overline{\omega}S\right)_{z=h}=-\frac{\partial}{\partial t}\int_0^h Sdz \tag{2}$$

By measuring the distribution of sediment content in the water body along the water depth h at different subsidence times, the instantaneous sedimentation velocity of the sediment at different time and water depth sections can be obtained by using the image integration method or the finite difference method. , the total value of each part can be obtained, and the subsidence velocity is generally calculated as the sum of the subsidence time t0.5 when the sediment content reaches 50% of the initial sand content and the average subsidence velocity of the section. Causes [15-16] at water depth h :

$$(\omega_{50\%})_{mc} = \frac{1}{t_{0.5}} \int_0^{0.5} \omega_i dt \tag{3}$$

3. Research and Design Experiment of Sedimentation of Sediment Particles in the Ocean Based on Dynamic Programming Algorithm

3.1. Selection of Experimental Equipment

The hypothesis test in this paper adopts the large-scale temperature-controlled rapid prototyping test tube independently designed and developed by "Shanghai Estuary Research Institute and Regional Science Center". The settling cylinder is made of plexiglass, the height of the cylinder is 1.5 meters, and the bottom diameter is 1 meter. Equipped with small optical turbidity meter, water level meter, small concentration (weight) meter - fork rotation, automatic heating and heat treatment equipment and high nitrogen machine, etc. According to the working principle of the OBS3+ turbidity probe, for different sand samples (gradation, composition, etc.), each probe needs a strict indoor parameter calibration process to find the corresponding relationship between the turbidity value directly measured by the instrument and the sand concentration . In this paper, the methods and instruments for indoor turbidity calibration are studied. There is a magnetic automatic stirring rod in the center of the barrel, which can ensure that the sand concentration in the barrel is basically uniform and unchanged during the calibration period. The measurement of sediment content adopts the drying method of water samples [17-18].

For the measurement of sediment settling velocity by means of settling cylinders, it has been used for many years, and several empirical formulas have been established. However, the previous settling drum has the following shortcomings:

(1) The sedimentation law of fine-grained sediment is far more complicated than that of coarse-grained or single-grained sediment. Due to the limitations of observation methods and technologies, it is difficult to measure a sufficiently accurate vertical sediment gradient in the previous sedimentation cylinder;

(2) In the past, when measuring the sediment concentration with a dirt roller, a dipstick or measuring method was often used to measure the sediment content. Measurement of sediment content.

(3) When the diameter of the sedimentation cylinder is small, the error caused by the loss of water quantity due to continuous sampling of water samples cannot be simply ignored.

3.2. Experimental Design

In this paper, an experiment is first designed for the large effect of different cationic valences on floc density, and cationic compounds with the same capacity are selected to compare the floc density in different amounts of water. Secondly, three different sediment types were selected for sedimentation experiments.

4. Experimental Analysis on Sedimentation of Sediment Particles in the Ocean Based on Dynamic Programming Algorithm

4.1. The Effect of Different Cation Valences on Floc Density

In this paper, the catkins density changes of three different cations and those in different capacity, including three different chloride compounds, Na, Ca, and Al, are shown in Tables 1 and 2.

Table 1. Figure of catkins density in different electrolytes over time (70g / L)

	0	10	20	30	40
Nacl	2547	2100	2213	2300	2600
Cacl2	2612	2413	2311	2414	2512
Alcl3	2659	2415	2214	2250	2300

Table 2. Figure of catkins density in different electrolytes over time (150g / L)

	0	5	10	15
Nacl	2189	2413	2151	2143
Cacl2	2143	2283	2211	2196
Alcl3	2345	2356	2295	2280

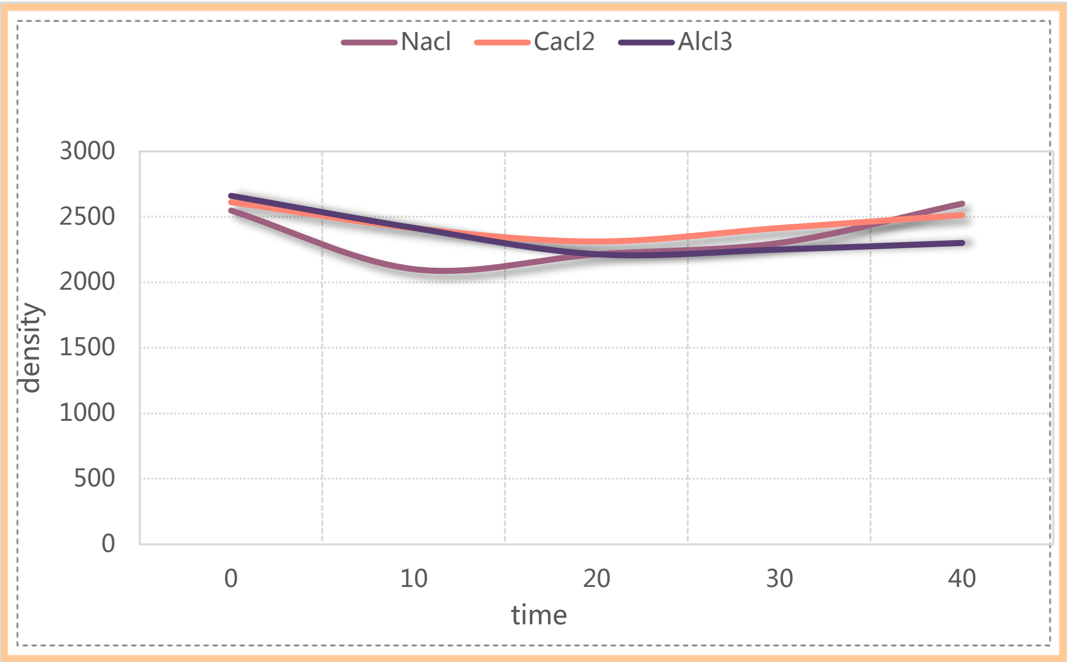

Figure 1. Three different electrolyte density changes Figure 70g / L

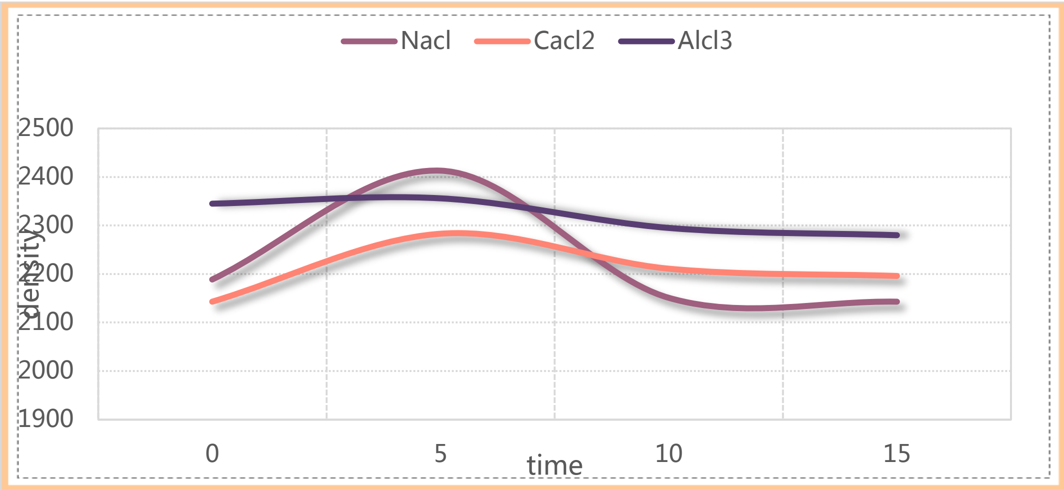

Figure 2. Three different electrolyte density changes Figure 150g / L

Compared with Figure 1 , it can be found from Figure 2 that under the condition of the initial sediment content of 150 g/L and the electrolyte strength of 5 mmol/L, the change trend of floc density with time is to increase first, then decrease, and then increase again. The possible reason for the second increase: In the case of suitable conditions, the free water inside the floc network is continuously excluded during the growth process of the floc network, and the floc network and the floc network bond with each other during the settling process, and finally develop from a plastic state to a solid state.

4.2. Sediment Settlement

In this paper, three different types of sediment were selected for sediment settling experiments, and the changes of sediment density with time and depth were recorded. The initial state of sediment is shown in Table 3.

Table 3. Median particle size and density of the initial state sediment

	A	B	C
d50	8	16	58
Sediment Suspension Sand Content	203	205	208

In A with finer particles, the sand content increases with the increase of water depth and time, and the surface of the sediment content after sedimentation reaches the limit of seaworthy water depth (the sand content is about 400 kg/m3). It takes the longest time for the bottom subsidence to reach the weakly consolidated state of sediment (sand content is about 700 kg/m3), about 9 days, and the sediment settlement process is the most uniform.

In B with medium grains, the sediment density at the bottom increases rapidly, and the sediment content of the bottom layer can reach more than 700 kg/m3 after 40 hours, and then the bottom densification process tends to be slow. With dense drainage, the sediment surface decreases and the overall density continues to increase.

In C with the coarsest particles, at the beginning of the experiment, the coarse-grained sediment quickly settled and the surface became clear. It has reached a state so dense that the detector cannot penetrate deep into it and can only measure from above the surface. With the continuous compaction of fine-grained sediment, the sand content of the upper and middle layers increases continuously, and the growth mode is to develop upward from the middle layer.

Sediment settlement with high sediment content is mainly divided into two stages: group settlement and dense drainage. However, the two stages from group settlement to dense drainage are not completed abruptly. There is a transition stage in the middle, which is called the transition settlement stage.

5. Conclusion

This paper studies the principle and optimization method of tracking-pre-detection algorithm using dynamic programming algorithm. First, a radar target detection and tracking model is established. Then, the determination method of the state transition region in the iterative process of DP and the construction method of the two-level value function of energy accumulation in different scenarios in the DP process. Through simulation analysis, the advantages and disadvantages of the two methods are introduced in detail, the limitations of the traditional DP-TBD algorithm are analyzed, and the basis for the improvement of the tracking algorithm is provided. Through experimental research and theoretical analysis, the morphological structure and settling velocity of flocs under different influence factors are discussed.

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Data Availability

Data sharing is not applicable to this article as no new data were created or analysed in this study.

Conflict of Interest

The author states that this article has no conflict of interest.

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