Core Technology Principle, Key Types and Application Research on the Reproduction of Mudslide Animation

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Abstract: Mudslide animation can present the dynamic process of mudslide disaster to people through virtual way, this paper classifies the composition type of mudslide from the cause of mudslide disaster, and then makes the mudslide animation more efficient and concrete when it reproduces in virtual, discusses the disaster warning, real-time reproduction of disaster for mudslide animation, Reflect the loss situation and the positive significance of knowledge dissemination.

1. The Significance of The Study of Mudslide Animation

Mudslide flow is a sudden natural disaster phenomenon, mostly in the valley deep in the mountains or hillside areas, has a strong destructive, each year in China's mountains caused huge casualties and property losses, its characteristics include the strong, fast, destructive, huge flow, the occurrence of short time and high frequency. The reasons for its composition are produced under the combined effect of geological structure, topography, human economy and meteorology, and usually contain huge solid rock blocks and high-concentration sediment mixtures, showing the flow of the viscous layer flow and the sparse layer flow mixture. The motion form of mudslide includes a mixture of landslides and water-based sediments, which is a state of special material fluid movement of complex mixtures. The characteristics of the high intensity of mudslide eruption struck from the accumulation of the amount during the formation process to reach a zero boundary point, and after the occurrence of periodic, mass hair and the same hairstyle and other characteristics, so in the short term, a large number of rock blocks, sediments and trees from the ground height from top to bottom, and the formation of a stacking area, Where it goes, it causes great damage to the human production environment, poses a great threat to the safety of human life and property, and causes great damage to the construction of human infrastructure. And in the rapid development of modern computer film and television animation technology today, we can through the mud flow disaster computer simulation animation reproduction to study it, let it in the form of animation simulation rendering, so that we can more intuitive and specific analysis of it, which is in society, campus, In particular, it is of great significance to carry out popular science education in mountainous areas prone to mudslide disasters.

2. Key Types of Causes of Mudslide Disasters

Collapses and landslides are usually caused by the loss of stability of geological slope rock and soil, and the causes are often inextricably linked, which can be considered as a large category in the key types of mudslide animation. Based on the leading factors to subdivide it, it can be divided into blasting vibration-induced, permeable irrigation-induced type, reservoir immersion-induced type, engineering load-trigger type, cut slope discharge type, underground excavation-induced type, freeze-thaw osmosis-induced type, natural evolution-induced type, earthquake-induced type, rain-induced type.

The composition of the mudslide is a complex special fluid formed by the mixture of loose rock and soil and liquid water and other debris, which is considered as another type in the key type of

mudslide animation, and the mudslide disaster can be initially divided into the type of landslide erosion, the ice lake dam collapse type, the tailings dam collapse type, the project abandoned collapse type, the landslide dam collapse type, the landslide dam collapse type, Slope liquefaction type, valley evolution type.

Accumulation slide erosion type: natural or man-made landslides or loose geology due to sharp rainfall, slope surface due to infiltration of rain caused by liquefaction, the formation of plastic flow of slip or landslide, and then along the depression caused by landslides repeatedly washed erosion, resulting in the formation of ditch shaping and trench erosion type of mudslides.

Ice Lake Dam Collapse Type: A special type of mudslide formed in the high-cold mountain area, the advance of the glacier, the ice tongue fracture, the collapse or landslide on the slope of the ice lake, the melting acceleration caused by the rise in temperature, the collapse caused by the lake mouth to the lower part of the ice dam caused the ice lake to collapse, resulting in millions or even hundreds of millions of cubic meters of water immediately tilted down, During the period will be wrapped in a large number of sediment and rocks, the formation of ferocious, huge flow, short time, strong destructive landslide disaster.

Tailing dam collapse type: because the mixture of tailings, slag and water body gradually over time makes the tailings dam deformation penetration, collapse formation, tailings reservoir due to artificial supervision and maintenance loopholes, may breed mudslide disaster, but also pollution of land and water resources.

Engineering abandoned collapse type: in the process of construction due to surface excavation or underground excavation of slag in the ditch unreasonable emission accumulation, hindering the surface runoff or flash flood channel, accompanied by heavy rainfall under the formation of temporary lake, the rapid rise of water level and permeation deformation of geological rock and soil rapid liquefaction, subsidence and break the embankment to form a mudslide.

Landslide dam collapse type: a landslide caused by rainfall, earthquake or engineering activities, due to the gradual rise of water level, loose rock and soil penetration deformation or new factors lead to landslides or the formation of a dammed lake breakwater the embankment of the mudslide.

Slope liquefaction type: Slope rock and soil caused by regional typhoon rain or continuous local heavy rain in mountainous and hilly areas due to rain erosion, rapid saturation of rock and soil, and suddenly flow downward.

The evolution of the valley type: In the evolution of the geological environment of the natural valley, the phenomenon of the effect of saturation, erosion, transportation and accumulation of rock and soil accumulation, the mudslide slower of the valley can be divided into three parts, namely, the source area, the circulation area and the accumulation area. Its basic characteristics are large water area, long movement path and strong destructive ability, often accompanied by landslides, showing a certain periodicity.

3. The Core Principle of Mudslide Animation

3.1 Key Parameters of Mudslide Special Effects Technology

The main object of mudslide is the mixture fluid, which contains a variety of elements, such as liquid, solid and hybrid, in the process of mudslide, the accompanying fluid phenomenon is pour, collapse, break the embankment, collision, parcel, etc., has the basic characteristics of variability and mobility.

In the physical parameters of the fluid and the parameters of the model algorithm, the parameters of fluid physics mainly include the number of particles of the fluid, particle mass, particle radius, static density, gravity acceleration and viscosity coefficient of the fluid, the radius of the particles determines the degree of fluid thinning, the static density determines the fluid mass, gravity acceleration determines the motion speed of the fluid. The above is the basic unit of computer computing behind the software simulation in the simulation mudslide animation.

The representative software for simulating mudslides, such as RealFlow, 3dsMax, Rayfire, etc., can virtually different types of fluids and different elements of fluid strapped to the fluid, which can

calculate the motion of fluids in the real world. Take RealFlow as an example, a fluid dynamics simulation software from Next Limit, Spain, to analyze the key parameters of the technique of simulating mudslide effects.

The first is the measurement tool Measure Utility and the scale settings Scale options in the software. Create an object as a fluid collision body in the RealFlow related software. Use the measurement tool to measure the size of the object, calculate the ratio of the object to the real world, and import it into RealFLow. Operation. The key in the zoom setting is to scale the intensity of the basic position of the fluid. Through the measurement tool, you can roughly understand the proportional relationship between the object in the software and the object in the real world. By scaling the intensity scale of the basic force field of the fluid, we can adjust the whole to achieve the real Speed relationship of the world. Then the resolution of the key physical properties of the particle panel is the most important parameter in the particle panel. The number of particles can be adjusted. The larger the number of particles, the larger the weight of the particles. Density refers to the mass in the unit volume of the substance, normal temperature and pressure. Below, the unit of density is g/cm^3. Int Pressure refers to the interaction force between particles, so that the particles will not overlap each other, and there can be gaps in each other to fill a space. The effect of Ext Pressure is opposite to that of Int Pressure. Limit the space in which particles can stretch, compress the volume of fluid or gas; Viscosity is measured by the resistance of an object moving inside the liquid, that is, the greater the resistance of an object moving at a certain speed inside the liquid, the greater the viscosity of the liquid, and vice versa; Surface Tension represents in physics the special stress state of molecules that are located in a thin layer on the surface of a liquid, such as soap bubbles. The last is the important parameter Filter. After adding a mesh to the particles, we can choose whether to use a filter. For the viscosity of general liquids, the effect of Filter after opening is ideal. Adjusting the value can prevent unrelated nets.

3.2 Mudslide Animation Simulation

The high complexity, high degree of freedom and great destructiveness and variability of debris flow elements determine that no algorithm can fully represent all aspects of debris flow. For the different proportion of its elements, some of its rheological characteristics are subject to Newtonian body due to the comprehensive viscosity of its slurry in the process of debris flow, while others are not satisfied with it From Newtonian body, when using software to simulate fluid animation, these two kinds of fluids belong to two completely different categories. In a fluid subject to Newtonian body, there is a continuous medium that is easy to flow and not easy to compress. In a fluid not subject to Newtonian body, under the action of external force, thixotropic fluid will have elastic deformation, and when the external force is large to a certain extent, it will flow.

In simulating such large-scale and large-scale fluid motion, it can be basically divided into two levels: core simulation and surface detail simulation. Core simulation refers to the large-scale fluid's main collision of particles, which does not require too much detail, and focuses on the correct mass relationship of the scene. Surface simulation refers to simulating fluid surface details or fluid-solid collisions such as splash particles, water, etc., focus on enriching the overall scene's fineness and fluid reality. No matter what scale fluid simulation requires a lot of computer calculations, the grid resolver Hybrido provided by Real Flow combines a grid-based and particle-based approach, which can both simulate the core fluid and create surface details of the fluid.

The specific operation first establishes the core fluid, in the scene of mudslide outbreak, the transmitter is a large number of fluid particles of fluid source, a steady stream of particles down the terrain from high to low, the continuous emission of particles and the randomness of the emission speed, concentrated control in the fluid grid in the Right Grid domain, Parameters that key lying factors, such as Density and Viscosity, affect particle effects. Then there is the secondary surface detail simulation, in order to more realistically show the state of the movement of the mudslide, the simulation of the surface details of the mudslide is very important, the mudslide is a transsexual fluid, with elastic and plastic characteristics, in the process of the mudslide tilt down will cause the destruction of material along the way to cause the fragments, such as house fragments, tree

branches, Animal carcasses, etc. Finally, the grid needs to add Grid mesh, used in the scene of mudslide dumps, to grasp the texture of the core fluid and fluid surface details, through the mesh in the core fluid and fluid surface details of different particle fields, so that the mesh content looks more like a natural state of the mudslide, more realistic, Increase the grid fine-cut on the domain particle control to make the fluid smoother, and Control Relaxation, which can produce a high-quality mesh with a lower-resolution emitter, use the tension value parameter on a case-by-case basis, and adjust the parameters for the composition of the mudslide. For example, high concentration mudslides require a high surface tension value.

3.3 Methods Based on Physical Simulation

Physically, mudslides are simulated by solving the physical equations of the fluid's motion state, in which the famous Navier-Stokes equation, although proposed hundreds of years ago, is a nonlinear partial differential equation with a huge amount of computation, which was difficult for people to use at the time. However, with the development of modern computers, the speed of computing has been qualitatively improved, people can study the Navier-Stokes equation by numerical method, and the motion of fluid can be calculated by computer, compared with computer simulation of computational fluid mechanics, the requirements in the field of computer fluid animation will be much lower. The computer is less difficult and relatively fast to calculate it. The three methods based on physical fluid animation are Lagrange method, Euler method and Lattice Boltzmann method, in which Lattice Boltzmann method is the most popular method in recent years because its algorithm is simple and easy to parallelize. In addition, in the rendering and drawing of fluid surface performance, there are traditional graphical assembly lines to render the surface method, implicit surface representation method, density field sampling cumulative rendering of light stepping method.

4. Classification of Mudslide Animation

Debris flow animation can be divided into three types according to the material characteristics of debris flow: debris flow type, water stone type and debris type. According to the different types and proportions of their respective components, classified animation simulation is carried out on the basis of the causes of disasters.

4.1 Mud Flow Type Mud-Rock Flow Painting

The main component of mudslide-type debris flow is a fluid that is more uniformly mixed with sand and fine-grained clay. It has the characteristics of slurry rheology and high viscosity properties that make it physically disobedient to Newtonian bodies. This kind of debris flow is simulated in animation. The animation focuses on high concentration flowing slurry, which is wrapped in a large amount of fine-grained clay and sediment. The flow speed is fast, and it often causes damage such as overlaying and impact wherever it goes. In terms of the causes of disasters, irrigation infiltration, engineering surcharge, slope cutting and unloading, rainfall induced, and slope liquefaction can be classified into these types.

4.2 Water-stone Mudslide Animation

The water and sediment of water rock debris flow are in a state of separation, in which the solid matter is mainly composed of stone and coarse-grained sediment, which has the rheological characteristics of slurry and obeys Newtonian body. In the animation simulation of this kind of debris flow, the mixed fluid with liquid water, coarse-grained sediment and stone in a state of significant separation is mainly displayed, and its flow potential is relatively fast and the fluid changes greatly, In the process of flow, rocks do not always move with the fluid at the same speed. On its disaster causes, the blasting vibration type, reservoir immersion type, underground excavation type, earthquake-excited type, the ice lake dam collapse type and tailings collapse type in the type of mud flow cause can be classified into this category.

4.3 Mud-rock Mudslide Animation

The properties are between the above types, and the proportion of solid matter is very large. According to the geological and soil properties of the place where it occurs, the rheological properties of the slurry may or may not obey Newtonian body. In the simulation of mud rock flow, because of its uniform content and high concentration, the characteristics of the whole mud rock and a small number of trees are mainly displayed. The causes of disasters can be classified as freeze-thaw seepage type, natural evolution type, accumulation body collapse erosion type, engineering waste slag collapse type, landslide collapse type and gully evolution type.

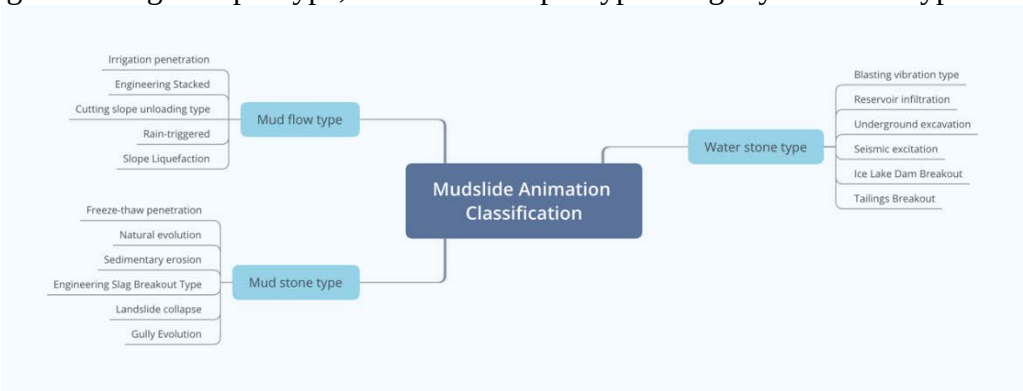

Fig.1 Mudslide Animation Classification

Tab.1 Characteristics of Various Types of Debris Flow Disasters

Number	Types	Sticky	Speed	Kinematics	Harm Mode
1	Mud flow type	Large	Faster	Landslide, collapse	Impact, lamination
2	Water stone type	Small	Extremely fast	Pouring, falling rocks	Drop, impact
3	Mud stone type	General	General	Debris flow, landslide	Impact, destruction, blockage

5. Research on the Application of Mudslide Animation

The animation of debris flow can vividly represent the type, flow size and damage degree of debris flow. It can provide more specific analysis data for the early warning and judgment of debris flow disaster and the loss after debris flow disaster. On the popularization of knowledge of debris flow disaster, the way of video animation can greatly deepen people's impression of debris flow disaster.

5.1 Virtual Reproduction of the Early Warning Effect and Loss of Mudslide Disaster

Debris flow animation through the prediction of the situation before the occurrence of debris flow, according to the type of debris flow disaster, simulate the corresponding types of debris flow model, water rock model, debris flow model, to provide the decision-makers with vivid information when analyzing the disaster, to provide clear effect display for the relevant departments to carry out early warning, disaster prevention, disaster relief. Before the occurrence of debris flow, the image and trend of debris flow are predicted by simulation to provide reference for disaster prevention and evacuation of residents; during the occurrence of debris flow, the loss information along the debris flow is counted to reflect the degree of debris flow in real time, which is conducive to the observation and judgment of decision makers; after the occurrence of debris flow disaster, the terrain change caused by debris flow transit is simulated The regional map of post disaster loss can clearly reflect the loss of debris flow disaster and provide more clear information for the next rescue and repair work.

5.2 The Application of Debris Flow Knowledge Popularization

People in the community to understand the knowledge of learning mudslide disaster populators often or through learning "knowledge on books" or pictures, video animation simulation can greatly deepen people's understanding and understanding of mudslide disasters, through the broadcast to watch simple animated videos, vivid images to show people the destructive power of mudslides and related knowledge, One can quickly understand the shape and destructive power of mudslide disasters in a relatively short period of time. Especially in the mountainous areas prone to mudslide disasters, such knowledge popularization is particularly important, video science will bring better results.

On campus, through the popular science video simulating mudslide disaster, students can quickly form a clearer concept of mudslide disaster, compared with traditional picture and text teaching, video animation simulation is more vivid and clear concrete, will greatly improve the cognitive efficiency of students, but also facilitate the deepening of students' understanding of mudslide disaster.

6. Conclusion

Through the analysis of the core technology principle, key types and applications of the simulation of mudslide animation, the innovation of the article is based on the causes of debris flow disasters, animating them, and further classifying them based on the content and shape simulation of debris flows. It is divided into mud flow type, water stone type and mud stone type, which simplifies the problem of too complicated types of mud flow simulation. This paper discusses the application and significance of mudslide animation simulation in reality, and on the popularization of knowledge of natural disasters, the way of animation simulation is undoubtedly very direct and concrete, can be more efficient to bring people a profound and clear understanding.

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