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A Parallel Ice Melting Simulation Based on Particle.

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SUMMARY

- A strategy based on spatial hash grid is used to identify surface particles
- in order to further accelerate the simulation of heat transfer, the phase transition between ice and water, and the direct interaction between ice and fluid

INTRODUCTION

In recent years, physics-based animation has become increasingly important in animated films, games and immersive virtual environments. Capturing the physical behavior of the real world is always the goal of computer graphics[1-2]. Phase transitions have long been an exciting challenge in animation research. The melting simulation methods are usually divided into two categories: particle based Lagrangian method [3-4] and grid-based Euler method [5-6]. The grid-based Euler method divides the simulated space into grids and calculates the physical properties of each grid cell. Although this method can simulate the motion of fluid and solid, it can not track the complex surface phenomena of melting process well.

APPROACH

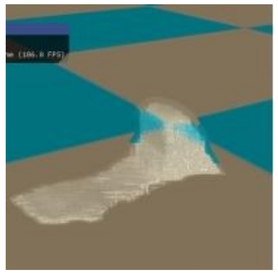
a parallel scheme is proposed to simulate the phase transition between the solid state and the liquid state based on the particle-based method. The simulation scheme in this paper has enough universality to represent all the basic first-order phase transitions continuously. Fluid simulation is based on the position-based fluid(PBF) framework because of its stability and ability to simulate physical phenomena with lower computational costs than differential equation-based approaches[3].

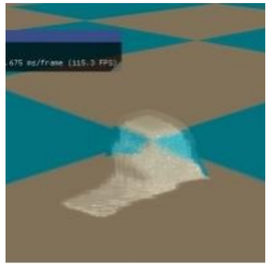
METHODS

This section describes the method of simulating the heat transfer process. In this paper, we focus on the melting simulation caused by heat transfer processes. The temperature of the particle is calculated by considering three heat transfer processes: 1) heat transfer between the particles (ice and water), 2) heat transfer from the surrounding air, and 3) heat radiation from an external heat source to the particle.

RESULTS

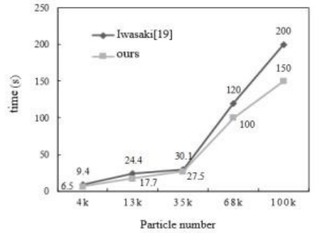
In figure7 , (a) shows that the FPS when 13k particles are simulated in literature [16] is 106, and (b) shows that the FPS when 13k particles are simulated in this paper is 115. In this paper, the surface particle search algorithm is used to improve the simulation efficiency





ANALYSIS

Figure 6 Compares the performance of the melting simulation method with that in reference [16]



DISCUSSION

One of the reasons for the efficiency and effectiveness of our method is the precise identification of surface particles The recognition method for surface particles is very concise and does not involve any complex operations

CONCLUSIONS

This article first uses an accurate and parallel surface particle recognition method that can quickly and accurately extract real surface particles On this basis, a particle based parallel ice melting method is proposed Each step of the method in this article is designed appropriately to be executed in a parallel architecture, while minimizing branching, idle threads, and race conditions as much as possible.

ACKNOWLEDGMENTS

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