

# WAX

*Project: Physically Based Simulation*

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# Overview

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- Introduction
- Physics
- Graphics
- Demo



# Introduction

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- Idea: Simulate a burning candle, especially the melting and dripping down of the wax



# Phyxel

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- Particle Based System: Object is simulated using a large number of Phyxels

- Properties of a Phyxel:

- Density
- Position
- Deformation
- Temperature
- Force



# Material

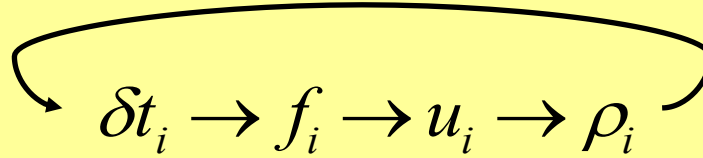
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- Each object has a number of materials assigned
- Properties Material:
  - Stiffness
  - Compressibility
  - Viscosity
  - $T_{min}$
  - $T_{max}$
- Interpolate between materials to get properties for a specific temperature



# Simulation Loop

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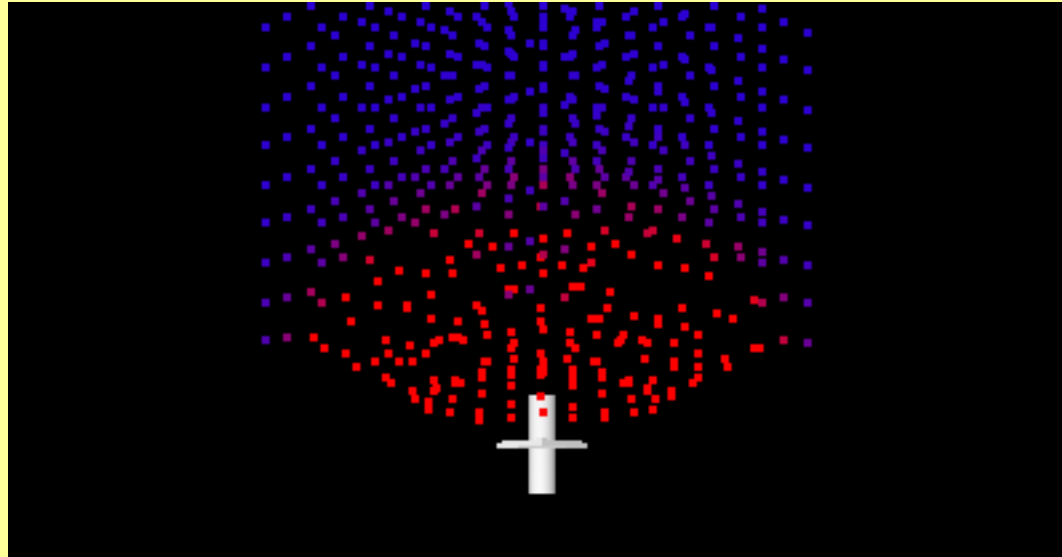
1. Heat propagation within the system
2. Compute forces between phyxels:
  - pressure force: volume conservation, based on density
  - viscosity force: damping, based on velocity difference
3. Compute deformation: integration using leap frog
4. Update densities: due change of positions



# Visualization

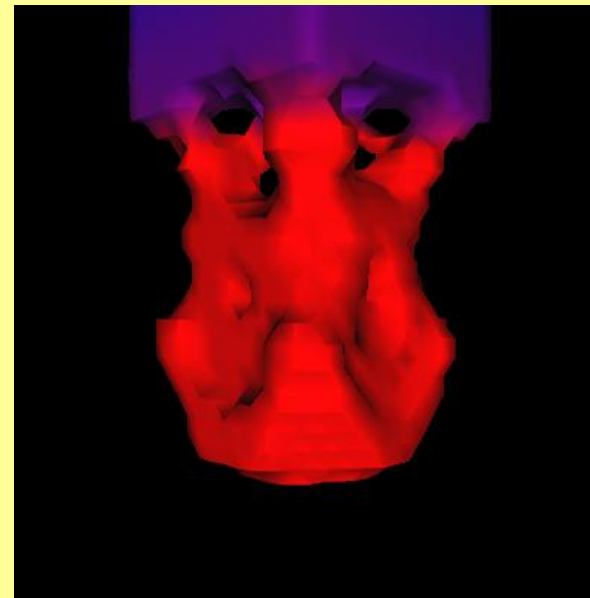
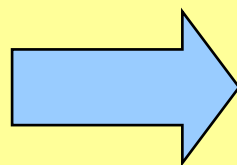
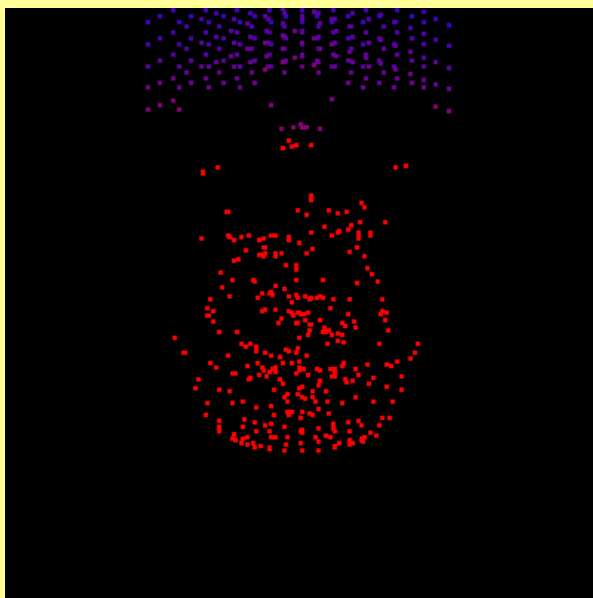
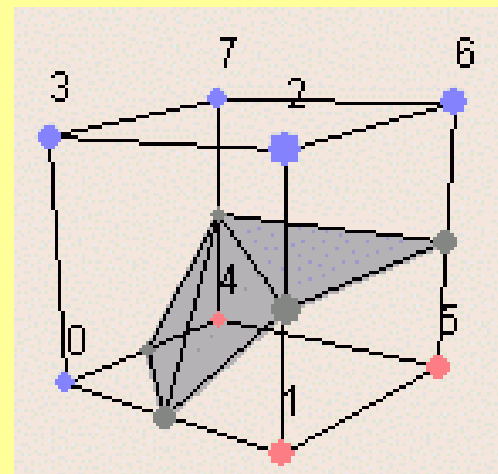
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- Phyxel view
  - Simple but ugly
- Visualize temperature as color



# Surface Visualization

- Isosurface
- Marching-Cubes
  1. Volume is subdivided into small cubes
  2. Calculate density at each corner
  3. Create Triangles and Vertex Normals





# Demo

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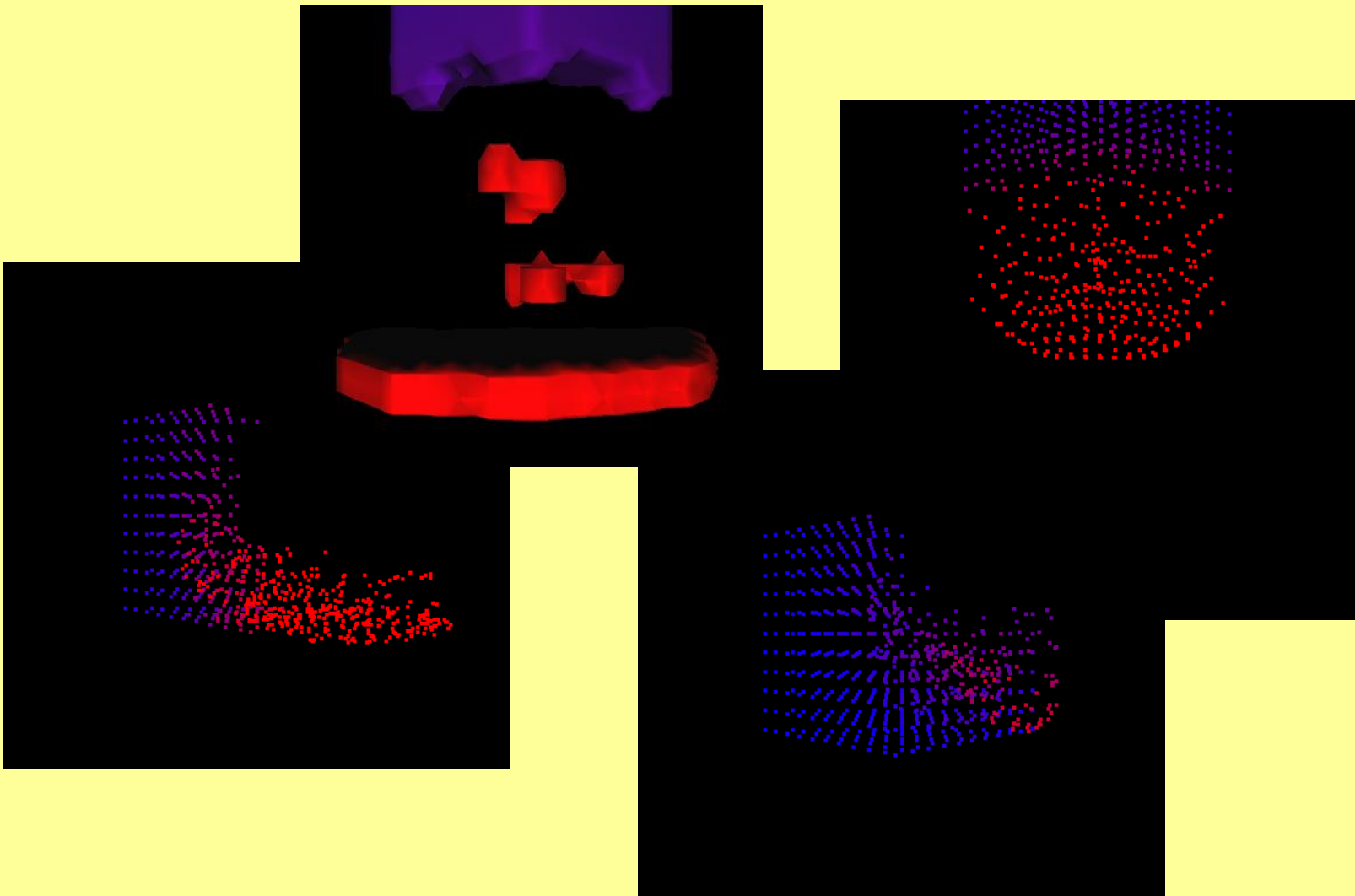
Overview

Intro

Physics

Graphics

Demo



# Further Information

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- Work is mainly based on the following papers:

R. Keiser, B. Adams, D. Gasser, P. Bazzi, P. Dutré, M. Gross 2005  
*A Unified Lagrangian Approach To Solid-Fluid Simulation*

M. Müller, R. Keiser, A. Nealen, M. Pauly, M. Gross, M. Alexa 2004  
*Point Based Animation Of Elastic, Plastic and Melting Objects*

M. Müller, D. Charypar, M. Gross 2003  
*Particle-Based Fluid Simulation for Interactive Applications*

