SIMULATING LIQUID SOUNDS

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GOAL

• Simulating liquid sounds. All the following involve bubbles:
  – Pouring
  – Splashing
  – Solid-liquid interaction
  – Boiling
  – Shooting water from a nozzle

• Examples
  – Liquid sound from nature: Waterfall http://www.youtube.com/watch?v=DRt3Cy8icsM
    River http://www.youtube.com/watch?v=E0uZjViZUw
  – Live demos during the class.

MOTIVATION

Liquid simulations have gained great popularity in recent years due to their visual appeal and the prohibitive cost and difficulty of simulating many scenarios involving water. In a recent paper by Greenwood and House [3], they suggest that the addition of bubbles creates more compelling and realistic imagery. Although the quality of graphical simulations is important in providing realism, recent work in audio simulation has shown that the addition of audio can provide further realism to physical simulations. The work on O’Brien [10] and then Raghuvanshi [11] has show promise for rigid body sound synthesis; however, there is no viable simulation method for liquid sounds in physical simulation. Although the parametric model proposed by van den Doel, et al. [12] provides the user with the ability to create audibly realistic liquid sounds, the average user in incapable of estimating the size, frequency and energy of bubbles created in a standard physical situation (pouring, splashing, solid-liquid interactions, etc.). To that end, if a physically motivated process (most likely a fluid solver) can be used to generate the distribution of bubbles created by a physical scenario, the user can be absolved of the responsibility of knowing the about the bubbles created in the process and can simply set up a physical scenario and enjoy the resulting sounds.

PREVIOUS WORK

Synthesizing sounds from physically based motion was first addressed by brute force simulation [10]. In a subsequent publication [6], the precomputed rigid body vibrations produce realistic modal models, and are able to be used in real-time system. For sounds produced by fluid, Dobashi, et al. simulate vortex-generated sound with full computational fluid dynamics simulations [1, 2]. Their model is accurate but suffers from the slow computation. In contrast, a parametric approach runs much faster, a sound model for isolated single bubbles is developed [12], which
in turn, is plugged into a stochastic model for the real-time interactive synthesis of complex liquid sounds.

The simulation of fluids has a long history in graphics field. Recent development of fluid simulation has taken into account the bubble formation [3, 4, 5], splash and foam [7] and the boiling of water [8]. Some schemes of simulating fluids such as particle based [9] and Cubic-Interpolated Pseudo-particle method (CIP) [13, 14], are particular suitable for simulating interactions between different phases of matter, therefore allow phenomena most relevant to sound, such as air trapping and solid-liquid interaction, to be handled naturally.

MILESTONES

• Generate sound using parametric model
  - Heuristic/feature guided distribution of bubbles
  - Fluid solver based distribution of bubbles

• Investigate better bubble sounds
  - Better sound model
  - Non-spherical bubbles

REFERENCES