Audio and the GPU

Sebastian Heise
Jörn Loviscach
Michael Hlatky

joern.loviscach@hs-bremen.de
Virtual Shaker
• Particle simulation: PhysX
• CPU allows 100+ particles, limited inter-collisions
• Could run on GPU, 1000+ particles? inter-collisions?
• Audio synthesis is based on filters
• Enhanced synthesis on the GPU?
Malleable Drum
• 64 x 64 mass-spring simulation on GPU

• Proprietary in DirectX
  (CUDA for Vista n/a at that time)

• Computation on 8800 GTS:
  22,050 kHz @ 12 ms block size
SoundTorch
• GPU computes level of each audio file

• Work in progress:
  • Audio mixing on GPU
  • Headphone spatialization on GPU: head-related transfer functions
  • GPU computes self-organizing map
Constraints
• **Bandwidth**
  
  • 16 bit @ 44,100 kHz  
      = 86 kB/s per channel  
  
  • 1000 channels float = 172 MB/s  
      but no issue: PCIe 8 GB/s  

• **Latency**
  
  • Buffering inevitable  
  
  • 10 ms ⇒ 11 ft distance problematic for live music  
  
  • Limits real-time synthesis;  
      much more severe than with video
GPU-based Audio via the VGA Port
GPU-based Audio via the DVI Port?
1000 Channels of Audio via the Graphics Card
Wave Field Synthesis
• Load sounds onto graphics card
• Compute filter kernels in real time
• Filter sounds in real time
• Different kernels for every loudspeaker in parallel
• Output all channels via the GPU
What else at Hochschule Bremen?
File System Tricks for Audio Production
Sound at Your Fingertips: An Electrotactile Fader
Virtual Detents

Marker Position

Lever

Motion

Track Identification

SpectrumSlider

72 Hz
129 Hz
264 Hz
651 Hz

distorted guitar
hip-hop drum
horns 05 and
pad 02.wav
reverse cymbal
splash 01.wav
synth 06.wav
synth base 10.wav
Reuniting Sound Control and Sound Creation
Programming a Music Synthesizer through Data Mining
Musical Icons: Procedural Glyphs for Audio Files
A Rhythmic Analyzer and Equalizer
Rhythmic Frequency (Beats per Minute)