iDEA

Large-scale Sound Synthesis

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Acoustics and Fluid Dynamics Group/Music

OVERVIEW

Physical approaches to audio synthesis and effects modeling…using mainstream simulation techniques.

Suitable for:

•virtual musical instrument modeling
• modular synthesis evironments
• speech synthesis
• virtual analog effect modeling
• spatial audio rendering

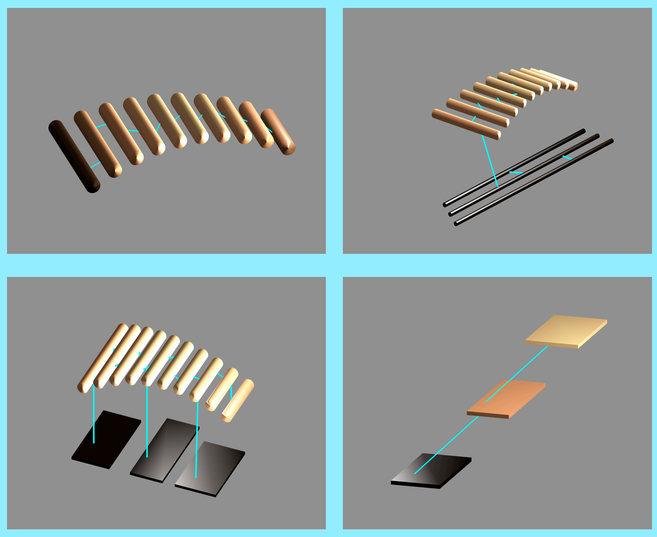
Advantages over traditional sampling-based techniques:

•Very high-fidelity audio output
•Simplified (physical) control
•Direct spatialization

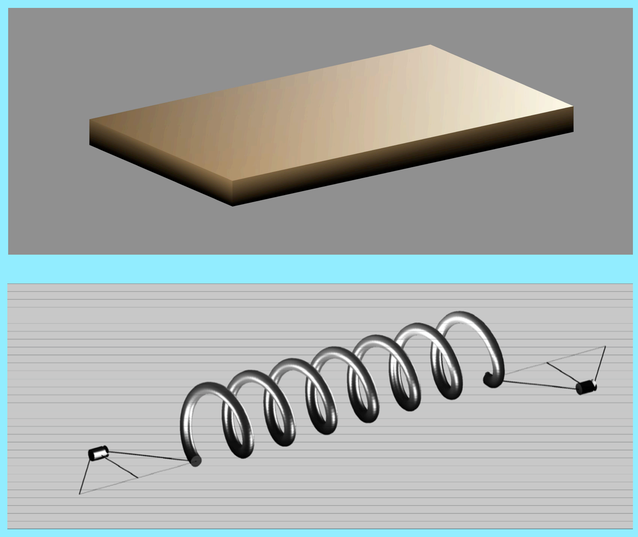
Difficulty:
•High computational expense

Solution: exploit parallelism and GPU architectures?

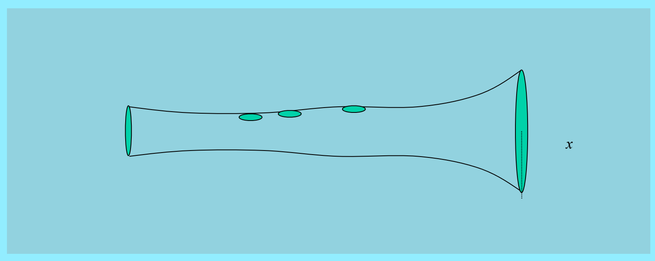
Time-domain Acoustic Simulation



Modular synthesis environments for composers.



Virtual analog effects modeling: electromechanical effects, such as plate and spring reverberation, distortion, amplifier modeling

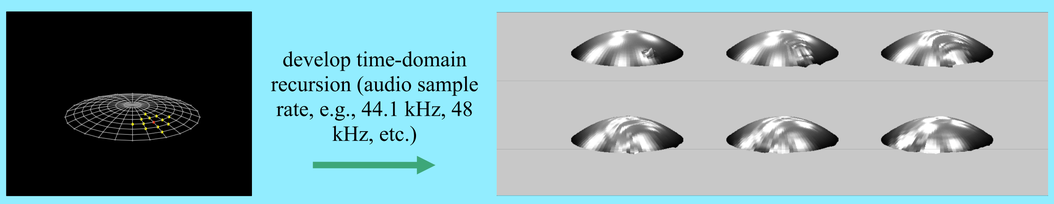


Musical instrument modeling: brass, strings, percussion, keyboard instruments

Other applications: Spatial audio rendering, room acoustics simulation, speech synthesis

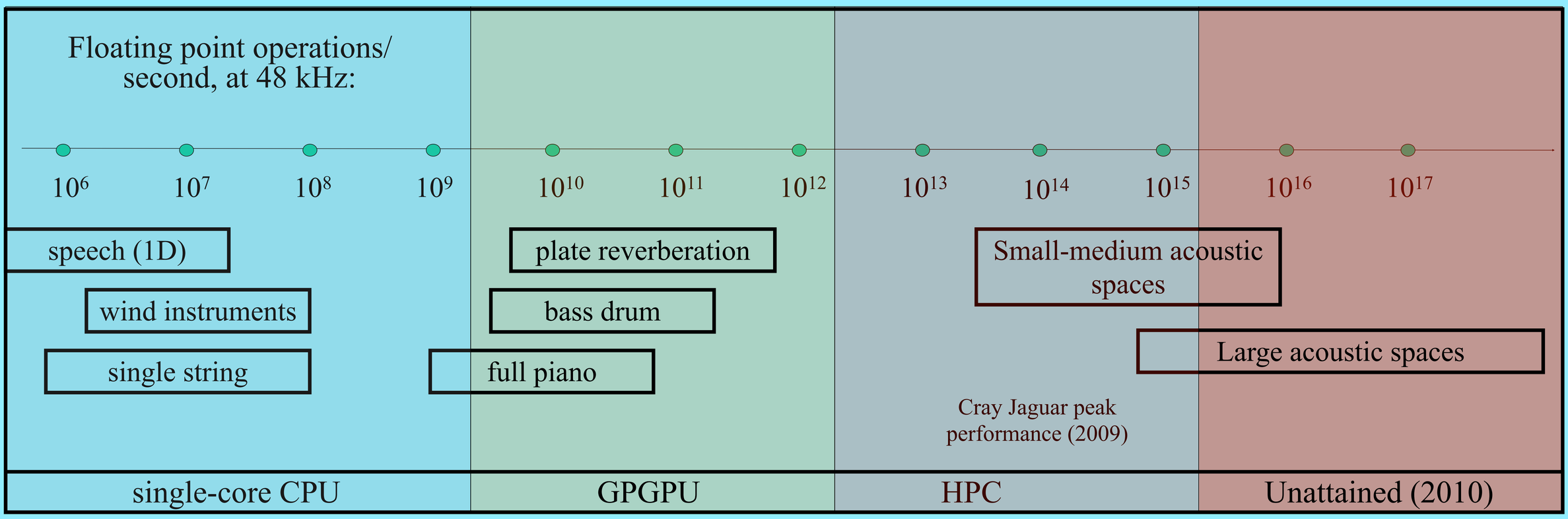
Time-domain Methods

- Suitable for all problems in musical acoustics
- An especially good match to nonlinear problems…



Computational Complexity

- Generally scales strongly with: nD volume, dimension, audio sample mode density
- General lower bounds on complexity follow from basic physics:



GPU Solution

- Time-domain updates can almost always be written in terms of matrix multiplications/linear system solutions
- Matrices are in general sparse (banded) and exhibit a high degree of structure…suitable for parallel implementation.
- This project: investigate the possibility of high throughput in physical audio applications, and develop general-purpose audio tools for GPUs.