Physically Based Sound for Computer Animation and Virtual Environments

ACM SIGGRAPH 2016 Course
Wednesday, 27 July, 2:00 pm - 5:15 pm, Anaheim Convention Center, Ballroom A

Doug James
Stanford University

Changxi Zheng
Columbia University

Timothy Langlois
Cornell University, Adobe Research

Ravish Mehra
Oculus Research
Course Description

Physically based sound is an important emerging approach to computer synthesis of realistic synchronized sounds for physically based animation and real-time virtual environments. A major challenge for learning and implementing these sound techniques is the wide range of physically based models and sound phenomena involved, as well as the need for optimizations. Many publications on physically based animation and sound rendering assume mathematical background that many in the graphics community lack. The result is that learning physics-based sound techniques is unnecessarily difficult for many interested students and practitioners.

The main goal of this course is to make the principles and methods of physically based sound accessible to a broader computer-graphics audience. The course covers sound-source models for sonifying important phenomena from physics-based animation: rigid bodies, brittle fracture, thin-shells, cloth, deformable collisions and contact, fluids, and fire. Material related to rigid-body sound is covered in greater detail in the first half of the course, which addresses fundamental topics such as modeling modal vibrations and sound radiation from surfaces. Further readings are suggested throughout the course notes. Several recent SIGGRAPH papers also serve as supplemental notes for more advanced topics.

With supporting software and implementation short-cuts, attendees can start using physically based sound immediately after completing the course.
Physically Based Computer Animation

[Chadwick et al. 2009]
Silent Algorithms

[O’Brien and Hodgins 1999]
Silent Algorithms

[O’Brien and Hodgins “1899”]
Physics-based Sound Rendering
## Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Topic</th>
<th>Instructor</th>
</tr>
</thead>
<tbody>
<tr>
<td>2:00 pm</td>
<td>Introduction</td>
<td>James</td>
</tr>
<tr>
<td>2:05 pm</td>
<td>Modal Vibration</td>
<td>Zheng</td>
</tr>
<tr>
<td>2:25 pm</td>
<td>Acoustic Transfer</td>
<td>James</td>
</tr>
<tr>
<td>3:00 pm</td>
<td>Implementing Rigid-Body Sound</td>
<td>Zheng</td>
</tr>
<tr>
<td>3:15 pm</td>
<td>Break</td>
<td>-</td>
</tr>
<tr>
<td>3:30 pm</td>
<td>Acceleration Noise</td>
<td>James</td>
</tr>
<tr>
<td>3:45 pm</td>
<td>Brittle Fracture</td>
<td>Zheng</td>
</tr>
<tr>
<td>4:00 pm</td>
<td>Thin Shells</td>
<td>James</td>
</tr>
<tr>
<td>4:10 pm</td>
<td>Liquids</td>
<td>Langlois</td>
</tr>
<tr>
<td>4:35 pm</td>
<td>Fire</td>
<td>James</td>
</tr>
<tr>
<td>4:50 pm</td>
<td>Sound in VR</td>
<td>Mehra</td>
</tr>
<tr>
<td>5:15 pm</td>
<td>Close</td>
<td>-</td>
</tr>
</tbody>
</table>
Course Materials on Website

http://graphics.stanford.edu/courses/sound

- Slides
- Course notes
- Code & demos