

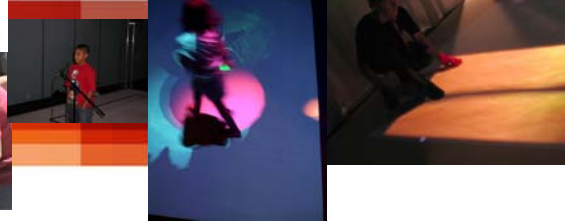


New Retrieval Strategies for Natural Sounds in a Mediated Learning Environment



Arizona State University | Arts, Media and Engineering

Students: Gordon Wichern, Alex Fink, Brandon Mechtley, Jiachen Xue
Faculty: Harvey Thornburg, David Birchfield, Andreas Spanias



K-12 Mediated Education with the Situated Multimedia Arts Learning Lab (SMALLab)

Theory

- Multiple Intelligences
- Active & collaborative learning

Practice

- A new student-centered learning environment
- Constructive learning in an embodied setting
- Design of integrated arts, science, engineering curricula
- Formal and informal settings (Whittier, Herrera, Metro Arts, SUSU)
- Teacher training
- Perception/action studies



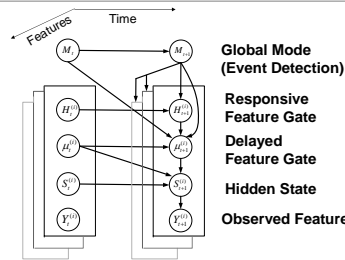
SMALLab – Innovations

- Open hybrid physical/digital architecture
- Foster human-to-human interaction
- Defining new interfaces for computing and embodied learning
- Scenarios that adapt over time to individual learners needs based on multi-modal sensed activity
- Support embodied interaction
 - physical environment
 - mixed reality

Sound in SMALLab

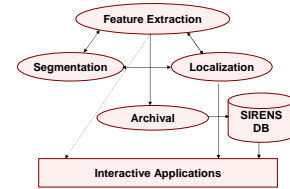
- Oral retrieval of audio files for interactive story telling
- Movement-sound mapping
- Acoustic ecology
- Environmental sustainability issues
- Music synthesis and interactive composition
- Technology: The SIRENS database (Segmentation, Indexing and Retrieval of Environmental and Natural Sound)

Bayesian Data Fusion



SIRENS Research Components

- **Action-based Event Segmentation:** Automatically transform long-term continuous recordings into a series of distinct events or clips
- **Action-based Search and Retrieval:** Multi-modal human produced queries are used to facilitate search of large databases
- **Array-based Localization:** Dynamically localize moving sound sources in reverberant environments
- **Environment Characterization:** Learn automatically the categories of sound and human activity within a given space



SMALLab – Hardware

- 4-channel surround audio
- Visual floor projection
- 15' x 15' x 12' frame
- 6-element camera based tracking
- Physical interaction objects
- All off-the-shelf components
- Portable, freestanding structure



An Open, Extensible Framework

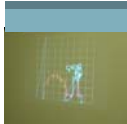
Teachers and students can develop scenarios in SMALLab that proliferate throughout the network

Why?

Tools and outcomes reflect the needs of our students and our Arizona communities

How?

- Partnerships with teachers
- Workshops with our development team
- Onsite activities at schools and community centers



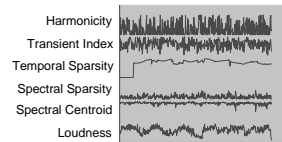
Case Study: Whittier Elementary

- 15-week after school program
- Downtown Phoenix school with primarily underserved student population
- Combination of onsite and ASU campus activities
- Integrated curriculum focusing on the logic of movement, sound, and storytelling: *Peter and the Wolf*

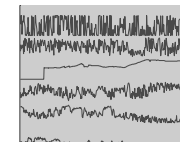


Oral Retrieval

What features of natural and environmental sounds can be imitated with the human voice?



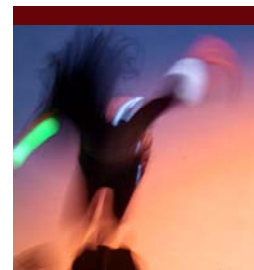
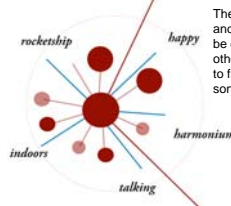
Sonic Characteristic Trajectory of Ice Crusher Sound



Sonic Characteristic Trajectory of Human Imitation of Ice Crusher Sound

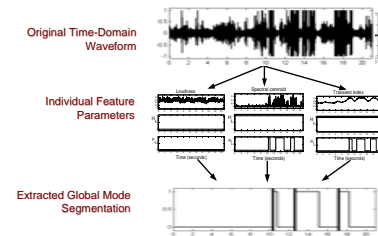
SIRENS Sound Exploration for Interactive Storytelling

The locations, times, sonic characteristics, and user tags of selected sound clips can be displayed along with relationships to other sounds in the database in order to facilitate interactive storytelling in a sonic medium.



Feature Fusion Segmentation

The Bayesian segmentation framework proves robust to real-world flexibility of what constitutes an "event", diversity of sources, and the presence of overlapping sounds.



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