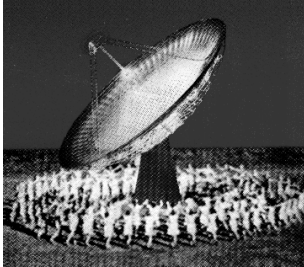


Siren: Sound and Music Tools for Squeak



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Outline

- ✧ Squeak Smalltalk
- ✧ Squeak Cross-Compiler Technology
- ✧ Siren Background
- ✧ Siren Models
- ✧ Siren Sound Synthesis
- ✧ Demonstration
- ✧ All source on the net, for more info, see:
<http://www.create.ucsb.edu/Siren>

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Squeak Smalltalk

- ✧ VI based on PARC Smalltalk-80 (v1)
- ✧ Devel at Apple, WDI, etc.
- ✧ New VM Written in Primarily Smalltalk(!) and translated to C
- ✧ Garbage Collector in Smalltalk
- ✧ Morphic GUI Framework (WIP)
- ✧ Ported to Mac, DOS/Win, UN*X, Wince, ...

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Squeak VM and Cross-Compiler (Ingalls et al.)

- ✧ Squeak Smalltalk-to-C Translator
- ✧ Accepts a Subset of Smalltalk
- ✧ Compile C functions as “primitives”
- ✧ Used to generate the VM
(except OS interface, which is in C)
- ✧ Used for DSP routines
(e.g., Sound Synthesis Classes)

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Morphic UI Framework

- ✧ Originally built as the UI framework for *Self* by John Maloney
- ✧ Display-list graphics merged with window/tool composition
- ✧ “Only objects on the screen!”
- ✧ Objects have slot inspectors, core samplers, viewers, etc.
- ✧ Tools are “composable”

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Siren/MODE Background

- ✧ (I reimplement and rename it every 6 years or so.)
- ✧ SmallSong, DoubleTalk, HyperScore ToolKit, MODE, Siren
- ✧ The Smoke Representation Language
- ✧ Siren I/O: Voices & Drivers
- ✧ Siren GUIs
- ✧ Siren Applications

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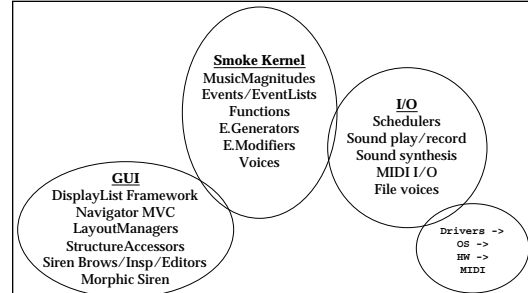
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Why Siren?

- ✦ Provide a Flexible and Extensible Environment for Musicians
 - ✦ Address Tasks of Composition, Realization, and Production
 - ✦ Support Working with Sound
 - ✦ Provide Extensible GUIs
- No Need to Support “Historical” Music

Siren Architecture



Smoke Music Representation

- ✦ Smoke Consists of Classes for:
 - ✦ MusicMagnitudes
 - ✦ Events and EventLists
 - ✦ Functions
 - ✦ Voices, Ports, and Drivers
 - ✦ EventGenerators
 - ✦ EventModifiers

Music Magnitude Models

- **Abstractions**
 - Chronos, Chroma, Ergon, Positus
- **Representation Classes**
 - Pitch, Duration, Loudness
- **Implementation Classes**
 - HertzPitch, SymbolicP, RatioP, MIDIP
 - (Pitch value: 'c3') == ('c3' pitch)
 - (Amplitude value: #mf) == (#mf ampl)
- **Mixed-mode Arithmetic**
 - (#f4 pitch + 80 Hz)
- **Extended MusicMagnitudes**
 - ConditionalDuration, Sharpness

Events

- ✦ Events are just Property Lists
(with [optional] durations but *no start times*)
- ✦ There are **Verbose** and **Terse** Formats

(DurationEvent dur: 250 msec voice: #flute)

((880 Hz, 250 msec, (#voice -> #flute),
0.7071 ampl) accent: #sfz)

anEvent color: #green; shape: #round

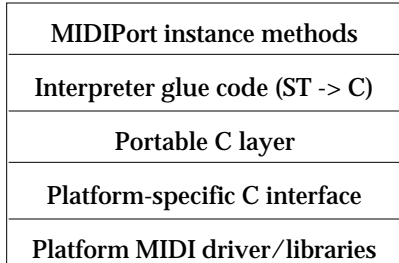
Event Lists

- ✦ **List of (Delay -> Event) Associations**
 - The delay is the event's start time relative to the start of the list (i.e., it's a duration)
- ✦ **Methods to Add, Remove, Filter Events**
- ✦ **Methods to “perform” Events on their Voices**
- ✦ **Verbose and Terse Formats**

MIDI I/O

- ✦ Instance of MIDIPort calls primitives
- ✦ Their glue code is written in ST80 and translated into C; it calls driver fcn.
- ✦ The portable driver layer implements the module defined by the primitives
- ✦ Several Back-end Driver Interfaces

MIDI I/O Layers



Siren Performance

- ✦ Scores of real-time synthesis voices on lap-tops
- ✦ Full-bandwidth MIDI I/O
- ✦ Complex structure-editing GUIs (under development)
- ✦ Smalltalk-level Scheduler can flood MIDI (msec-level timing)
- ✦ Siren 2.2 is 200 Classes, 2400 Methods

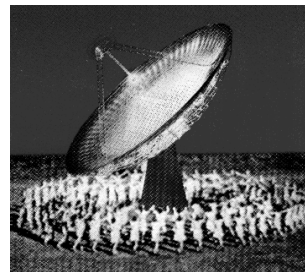
Future (1999)

- ✦ Squeak clients on many platforms talk to DB “Stones” at CREATE
- ✦ Squeak translated synthesis, DSP, mixing (should rival C-based SWSS)
- ✦ Scalable tool/instrument—central resources and distributed access
- ✦ DRIVE, Creatophone, Paleo, Time-Machine, IDIOT, and IDP Projects

Future (2000+)

- ✦ ATM-based wide-area sound/music computing with end-user nodes at many bandwidths (GIOP/ATM to 10T)
- ✦ DB queries to and operations on very large score/sound databases
- ✦ Poly-channel I/O and pluriphonic projection from synth. SW or disks
- ✦ New tool paradigm

Siren



Minimal Siren Demo Script

Read through this text, selecting the blocks enclosed in square brackets. The single character after the close-square-bracket (d,p, or i) denotes whether you should do, print, or inspect the block.

Set-up

Test the MIDI driver by playing one note.
[MIDIPort testANote] d

MusicMagnitudes

```
[440 Hz asSymbol] p          "--> "a5" pitch"
[(1/4 beat) asMsec] p       "--> 250 msec"
[#mf ampl asMIDI] p        "--> 70 vel"
```

```
["a4" pitch asMIDI] p
[["a4" pitch + 100 Hz) asMIDI] p
["mp" ampl + 3 dB] p
```

Event/EventList Creation Messages

"Create a "generic" event."
MusicEvent duration: 1/4 pitch: "c3" ampl: "mf"

"Create one with added properties."
(Event dur: 1/4 pitch: "c3") color: #green; accent: #sfz

```
[440 Hz, (1/4 beat), 44 dB] i
(#c4 pitch, 0.21 sec, 64 velocity) voice: Voice default
```

```
(EventList newNamed: #Chord1)
add: ((1/2 beat), "d3" pitch, "mf" ampl) at: 0;
add: ((1/2 beat), "fs3" pitch, "mf" ampl) at: 0;
add: ((1/2 beat), "a4" pitch, "mf" ampl) at: 0
```

Play a scale created with a class message."
[[EventList scaleExampleFrom: 48 to: 60 in: 1500)
playOn: SynthVoice default]

Advance EventList Creation

```
[(EventList randomExample: 64
  from: ((#duration: -> (50 to: 200)),
    (#pitch: -> (36 to: 60)),
    (#ampl: -> (48 to: 120)),
    (#voice: -> (1 to: 16)))) play] d
```

Create an event list of 20 notes with semi-random values and play it on a MIDI output voice.

```
[(EventList randomExample: 20) playOn: MIDIVoice default] d
```

Play two-voice "counterpoint" on the software synthesis voices.

```
[[[(EventList newNamed: #pRand)
  addAll: (EventList randomExample: 20);
  addAll: (EventList randomExample: 20)]
 playOn: SynthVoice default]] d
```

Siren Scheduler

Here's how to use the event scheduler explicitly.

```
[Schedule addAppointment: (EventList randomExample: 20)
  in: (250 msec).
Schedule runAppointments] d
```

Flush and close down the scheduler

```
[Schedule interrupt; flush] d
```

Action events have arbitrary blocks of Smalltalk code as their "actions." This example creates a list of action events that flash random screen rectangles.

```
[ActionEvent playExample] d
```

Complex Multimedia Example

```
[| el |
  el := (Cloud dur: 6
    pitch: (48 to: 60)
    ampl: (40 to: 70)
    voice: nil
    density: 5) eventList.
  1 to: el events size do:
    [ :ind |
      (el events at: ind) event voice:
        (ind odd
          "alternate between two voices"
          ifTrue: [MIDIvoice default]
          ifFalse: [SynthVoice default]).
      "add some animation events"
      el addAll: ActionEvent listExample2.
      el play] d
  "and play the merged event list"
```

EventGenerators

Chord object can give you an event list.

```
(Chord majorTriadOn: "d3" inversion: 0) eventList
```

Create and play a simple drum roll--another 1-D event generator.

```
[[[Roll length: 2000 rhythm: 50 note: 60) ampl: 80) play] d
```

Play a 6-second cloud that goes from low to high and soft to loud.

```
[[DynamicCloud dur: 6
  pitch: #((30 to: 44) (50 to: 50)) "given starting and
  ending selection ranges"
  ampl: #((20 to: 40) (90 to: 120))
  voice: (1 to: 4)
  density: 15) eventList play "edit" "inspect"] d
```

Mark Lentzner's bell peals ring the changes.

```
[[Peal upon: #((60 62 65)) play] d
```

MIDI Control

"Demonstrate program change by setting up an organ instrument to play on."
[MIDIPort testProgramChange] d

"Down-load a general MIDI patch for a 4-voice organ."
[MIDIPort setupOrgan. MIDIPort default test] d

"Down-load a general MIDI patch for a 16-voice percussion ensemble."
[MIDIPort setupTunedPercussion. MIDIPort testAScale] d

"Demonstrate control commands by playing a note and making a crescendo with the volume pedal."
[MIDIPort testControlContinuous] d

"Demonstrate pitch-bend by playing two notes and bending them."
[MIDIPort testBend] d

The Siren Graphics Framework

Display lines
[DisplayListView example1] d

Display rectangles
[DisplayListView example2] d

Open a sequence view on a random event list.
[TimeSequenceView randomExample] d

Utilities

"ANO"
"MIDIPort allNotesOff"
"Close down and clean up."
"MIDIPort cleanUp"