A Vibrotactile Synthesis Framework for Haptic Feedback in Live-Electronic Music Performance

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CLEF: CIRMMT Live-Electronics Framework

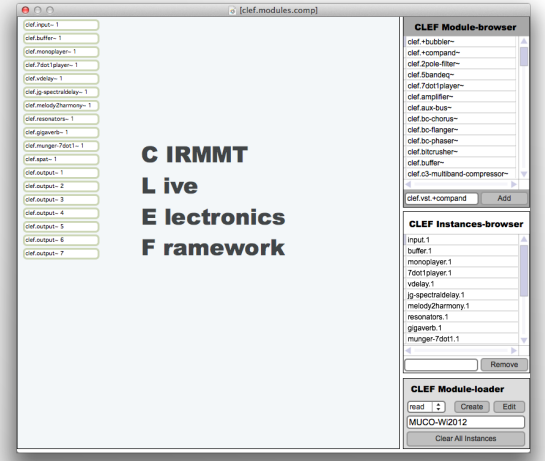
- Initial design inspired by prototype of the graphical interface developed for the Integra project [Bullock, Coccioli 2009]

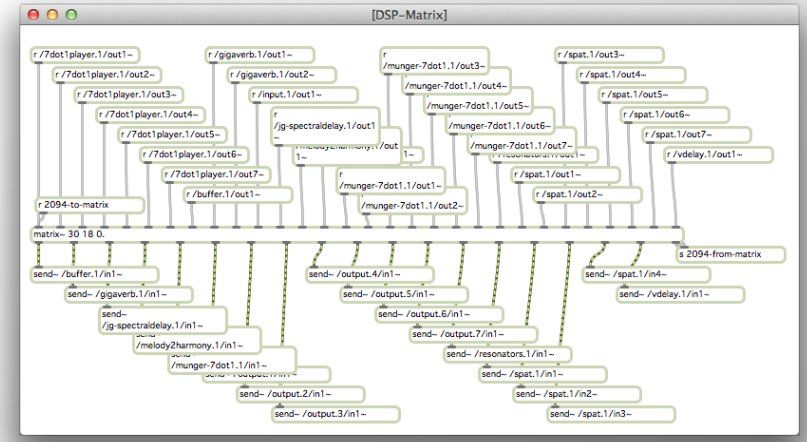
- Goal to develop a compositional framework which is easily customizable and extensible by music students & composers without advanced programming skills

- Used for teaching/research purposes and production of live-electronic pieces at McGill University since 2009 (www.music.mcgill.ca/dcs)

CLEF: System components (Instruments)

- MODULES (Audio, Video, MIDI, ...)
  - Native Max/MSP/Jitter, VST~ or AU~ modules
  - Connected in a MxN global routing matrix
  - Model-View-Controller (MVC) pattern
  - Auto-generated (generic) or Dedicated UIs
  - All parameters accessible via OSC and pattr



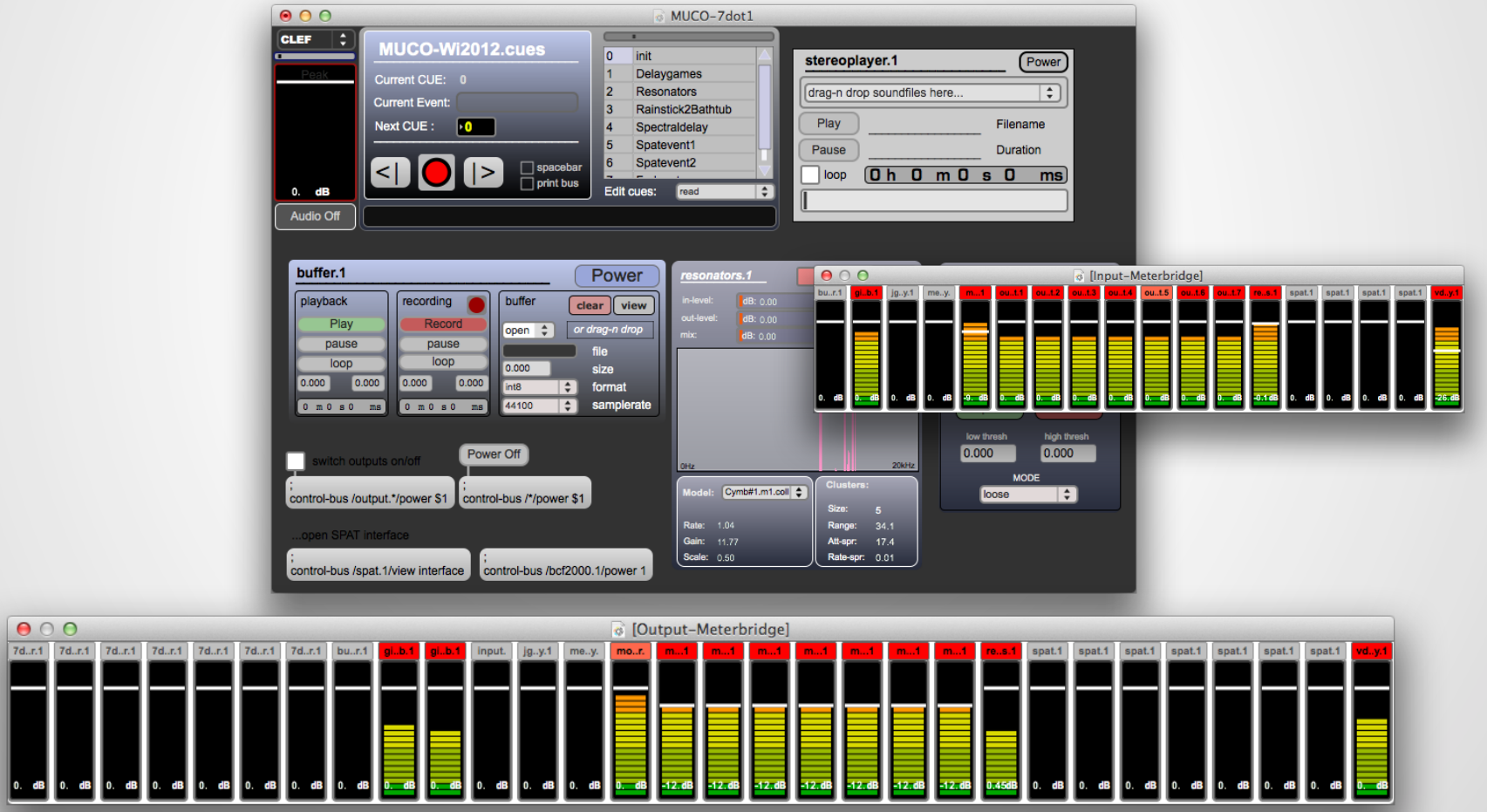


CLEF: System components (Score data)

- Hierarchically structured into CUEs and EVENTs
  - CUE
    - triggers execution of events
    - overlapping/simultaneous events possible
    - cyclic/acyclic graphs possible
  - EVENT
    - routing of audio signals (dsp-graph)
    - discrete triggers & continuous control parameters
    - arbitrary algorithms (events are small programs)

CLEF: System components (GUI)

- Performance view

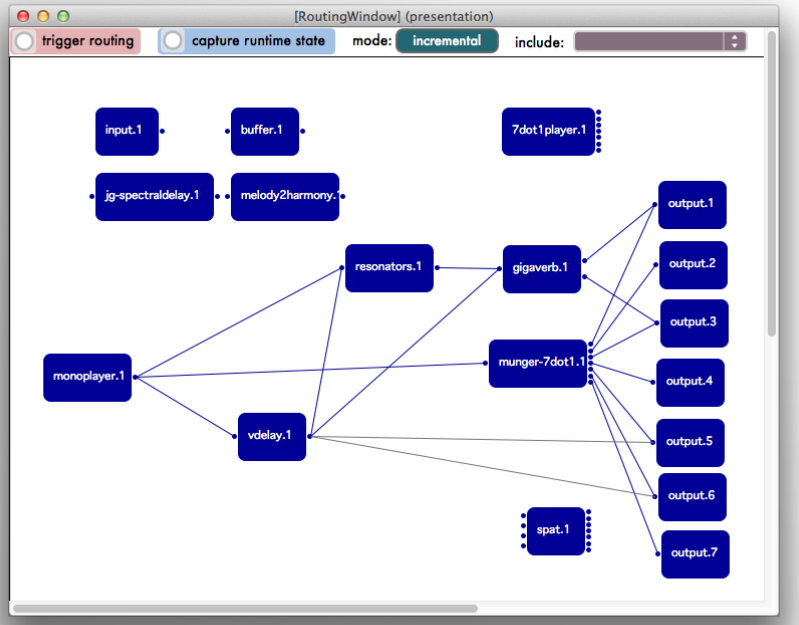


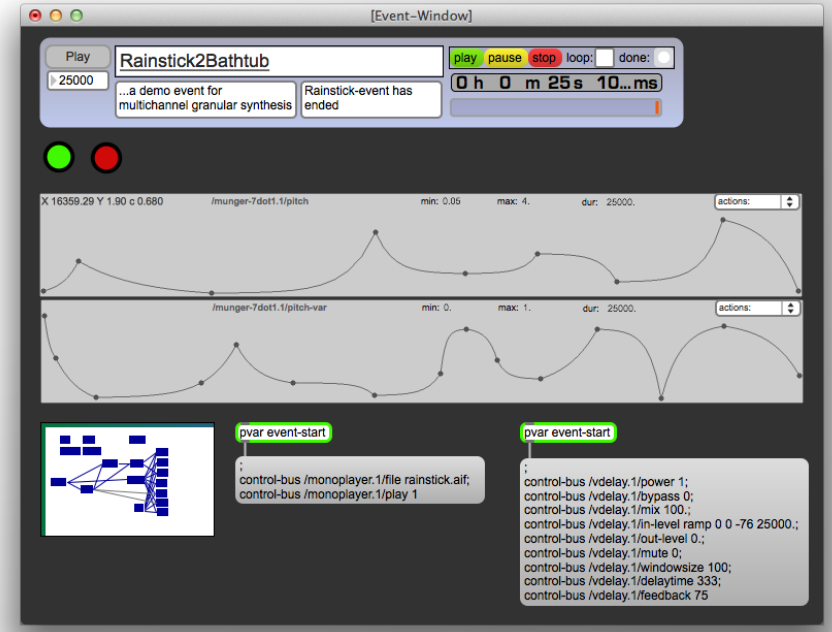
CLEF: System components (GUI)

- Event view

signal routing

triggers,
breakpoint functions



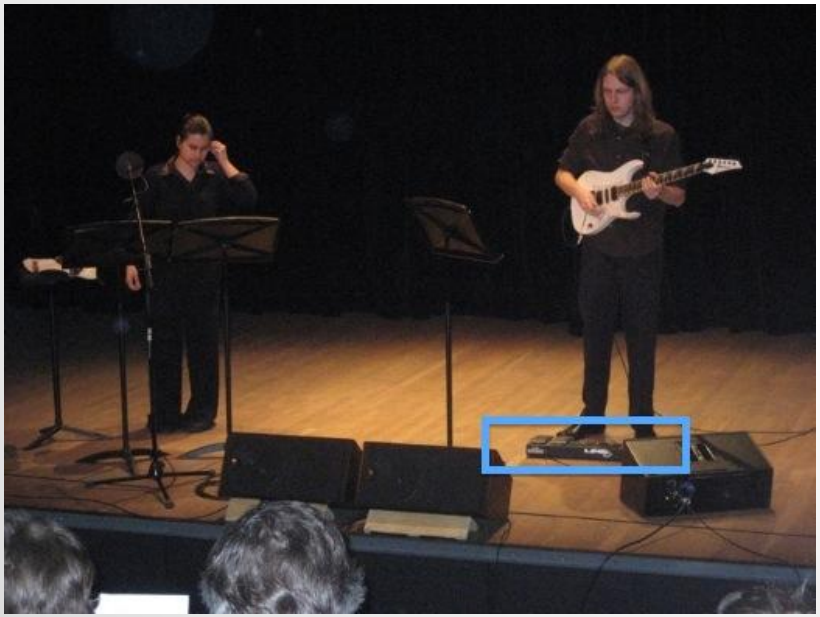


The Problem:
Feedback in Live-Electronics systems

- A common problem in live-electronics performance is the lack of feedback to the performer about the state of the system;
- This results in a sort of "limbo" in which the performer may have no primary feedback about the live-processing;
- Possible solutions include the use of visual and/or auditory feedback, but this is often distracting for the performer;
- An assistant can be in charge of interacting with the live-electronics system, but this makes the performer's interactions almost obsolete.

The Objective:
Primary Feedback in CLEF

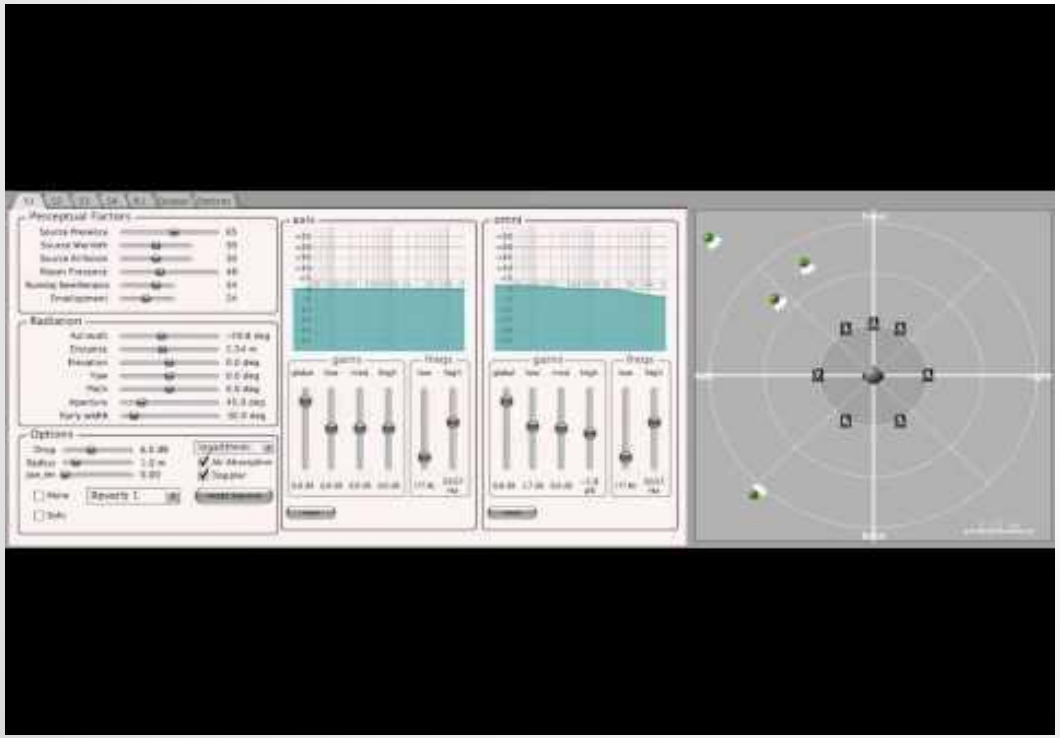
- CUEs and Events are often triggered by performers on-stage (e.g. via foot pedals)
- no primary feedback about result of action / state of system

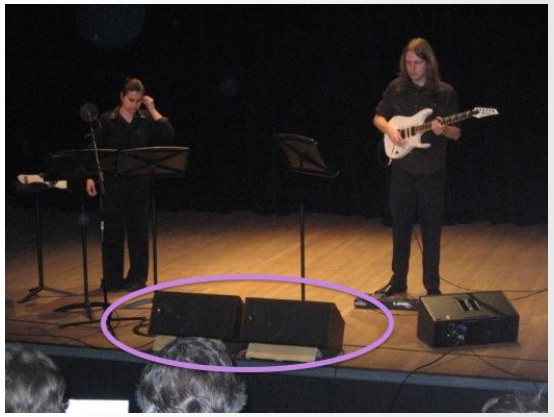


The Objective: Primary Feedback in CLEF

- Certain types of processings difficult to monitor via secondary feedback (audio)

Example: Spatialization

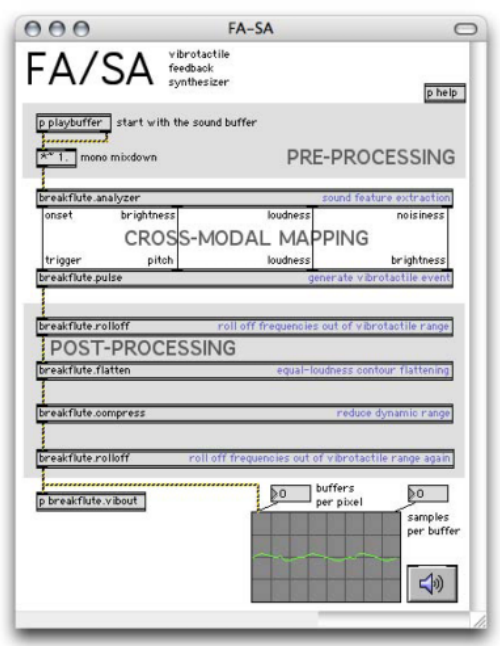




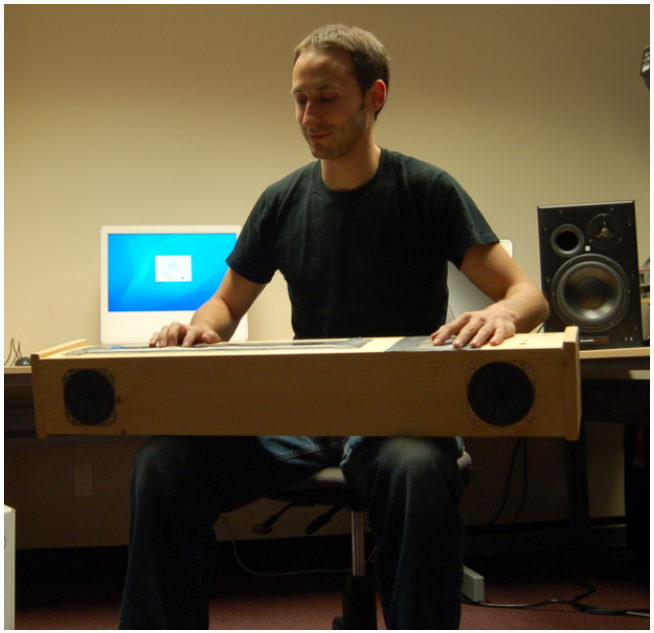
Tactile Feedback in Music Performance

- Haptic feedback has been proven to be fundamental in the process of "embodiment" of a musical instrument;
- Tactile feedback in particular is the only one fast enough to convey information about timing and articulation [Puckette, 1993];
- Previous work at the IDMIL [Birnbaum, 2007; Marshall, 2008; Giordano 2011] has focused on the use of tactile feedback for enhancing music performance;
- Various synthesizers of tactile events have been developed, together with prototypes that make use of vibrating actuators.

Tactile Feedback in Music Performance



FA/SA, a tactile translation environment [Birnbaum, 2007]



The Viblotar, a tactile-enhanced DMI [Marshall, 2008]

A whole-body tactile display for novice guitar players [Giordano, 2011]

Tactile Feedback in CLEF

- **Our approach** is to explore the possibilities given by tactile feedback:
  - Previous work has showed that tactile feedback can be proficiently used in a performance using live-electronics [Michailidis, 2011];
  - A synthesizer of tactile events will be built (in Max/MSP or Pure-data) to convey specific information about internal variables in CLEF;
  - Vibrating actuators will display these tactile events onto the skin of the performer;
  - We believe that this approach can be transparent to the performer, both in terms of physical obtrusiveness and cognitive load.

Tactile Feedback in CLEF:

- **Several options** could be considered to map CLEF internal variables to the parameters of the Tactile Synthesizer:
  - Direct mapping of existing variables to tactile synthesis parameters. E.g. by simply re-routing OSC-addresses
  - Explicit control tactile synthesis parameters. E.g. to display abstract/symbolic parameters, such as tempo and/or contextual information

Tactile Feedback in CLEF: Research Questions

- Can tactile feedback become part of a rehearsal/ performance routine?;
- Evaluate the appropriateness of each tactile event, according to the represented internal variable in CLEF (i.e. tactile impulses for discrete events vs. rhythmic patterns for more complex events);
- Evaluate different types of vibrating actuators in terms of displaying-capabilities, obtrusiveness and impact on performers' attention;
- Find the best positioning strategies for the actuators;
- ... ...