

## Interfacing with sound

### Design of music controllers

## Design: music controllers

### Acoustic vs. electronic instruments

#### \* Acoustic instruments

- Sound source and interface are the same artefact
- Nature of expected sound & laws of physics dictate the instrument's form and how it is designed
- Fixed and relatively transparent mapping
- Acoustic + haptic feedback

## Design: music controllers

### Acoustic vs. electronic instruments

#### \* Electronic instruments

- Sound source and interface separated → mapping, interaction and physical attributes are free
- Need for methods and constraints in order to fulfill criteria of expressiveness, transparency, audio quality
- Need for feedback

## Design: music controllers

### Issues

#### \* Purpose of design

##### Users

Experts vs. amateurs?

##### • Uses

Composition? Performance? Education? Cognitive stimulation?

##### • Designing an...

Interface? Instrument? Composition tool?

## Design: music controllers

### Issues

#### \* Criterias

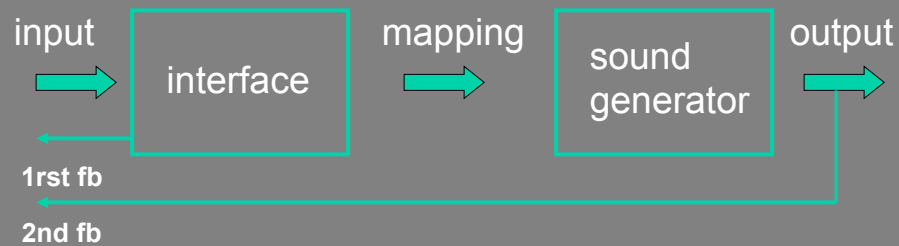
- Relationship between performer and audience
- Physical effort
- Complexity / transparency
- Ergonomics
- Cultural context

It is not just about producing sound, it is about the whole **experience** of producing sound

## Design: music controllers

### Interaction loop

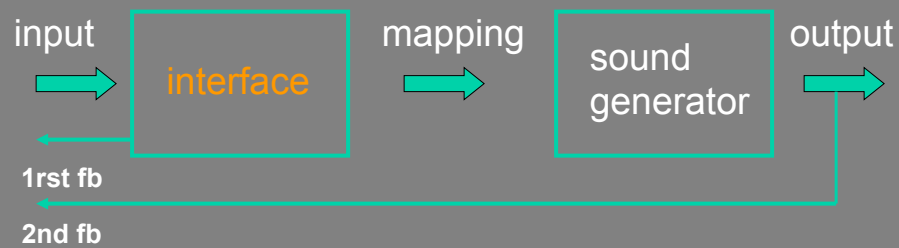
#### \* Simplified model



## Design: music controllers

### Interaction loop

\* Simplified model



## Design: music controllers

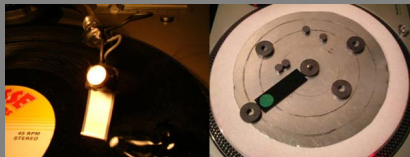
### Interfaces

\* Object-based

Starting with existing instruments

- augmented (hyperinstruments...)
- digitalised (ex: piano synth)
- interface used as controller (ex: MIDI keyboard)

Use metaphor of object



Taku Lippit, ITP/NYU, 2002-03



Machover & Ma, Hypercello, MIT, 1991

## Design: music controllers Interfaces

### \* Object-based

Repurposed everyday objects  
and materials: water, fabric,  
chemicals, vegetables ...



Daniel Skoglund, 8Tunnel2



Particles, Horio Kanta, 2003



MIDI Scrapyard Challenge,  
Brucker-Cohen & Moriwaki, 03-04

## Design: music controllers Interfaces

### \* Object-based

Take advantage of the material properties of objects f.e.x  
bendable, conducts electricity, etc

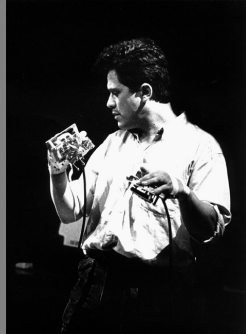
Take into consideration human activities surrounding the  
objects: build upon it and / or break from it

## Design: music controllers

### Interfaces

\* Body-based

Human body as start for design



The Hands, Waisvicz, STEIM, 1984

## Music controllers

### Interfaces

\* Body-based

Human body as start for design: Expressive qualities of human movements



copyright: mwais/crackle.org



copyright: mwais/crackle.org

The Hands, Waisvicz, STEIM, 1991

## Design: music controllers Interfaces

### \* Body-based

Human body as start for design:

- Ergonomics
- Existing gestures
- Expressive qualities of human movements
- Scale and continuity of movements

## Design: music controllers Interfaces

### \* Environment-based

Interactive environments

- Reactive floors
- Digital realm: networked audio

Everyday environments, etc



Magic Carpet, MIT Medialab, 1996



Global String, Tanaka & Toeplitz, 1998



Sonic City, Gaye et al., 02-04

## Design: music controllers Interfaces

### \* Environment-based

Take advantage of the features of space

- Interactive environments:  
many people together, control of interaction parameters...
- Everyday environments:  
rich environment, unpredictable, dynamic, heterogeneous

## Design: music controllers Interfaces

### \* Wearables

Musical jeans jacket  
(MIT Medialab, 1992)



Tgarden  
(FoAM & sponge, ~2001)



Expressive Footwear  
(MIT, 1997-2000)



ensemble (Kristina Andersen, ~2003)





## Design: music controllers

### Interfaces

#### \* Wearables

Intimate interfaces

Body movement and posture

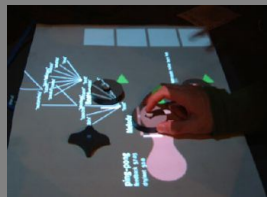
Theatrical vs. daily life dimensions

## Design: music controllers

### Interfaces

#### \* Representations

- Tangible algorithms



Audiopad, Patten, Medialab, 2001



Block Jam, Newton-Dunn et al.,  
Sony CSL, 2002

- Virtual instruments



Mulder, Simon Fraser Univ., 199?

- Screen-based (laptop musicians using MAX/MSP, Pd, etc)

## Design: music controllers

### Interfaces

#### \* Representations

Taking familiar sound manipulation metaphor and making it tangible, into space.

## Design: music controllers

### Interfaces

#### \* Circuit bending

Hacking is fun!



Modified Toy Orchestra

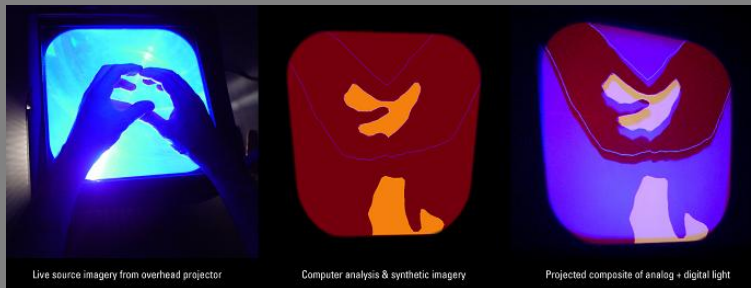
## Design: music controllers

### Interfaces

#### \* Hybrids

Controlling e.g. audio and visuals together

Balancing and adapting interaction so that both dimensions are satisfactory

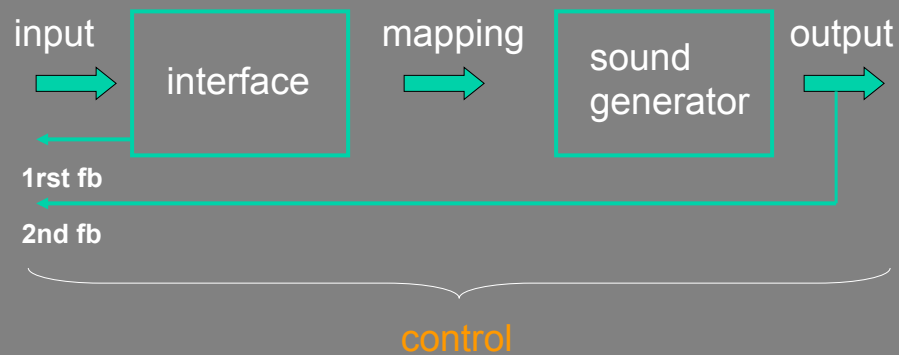


Manual Input Sessions, Golan Levin, 2005

## Design: music controllers

### Interaction loop

#### \* Simplified model



## Design: music controllers

### Control

#### Levels of indeterminacy

- Control vs. randomness (→ interactive improvisation)
- Total predeterminancy: push a button → deterministic output
- Total indeterminacy: random machines
- Unexpected vs. expected input / output

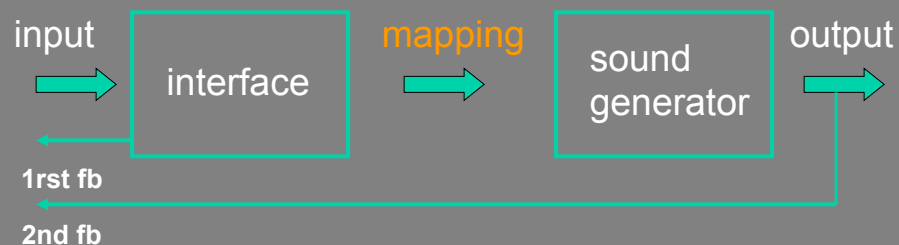
#### Control characteristics

- Continuous vs. discrete control
- Implicit vs. explicit
- Micro- to macro-level control: sound spectrum to details of articulation to overall structure

## Design: music controllers

### Interaction loop

\* Simplified model



## Design: music controllers

### Mapping

#### \* Issues

- Complexity to stimulate creativity
- Transparency to keep link between input and resulting sound (otherwise, danger of losing the audience)

## Design: music controllers

### Mapping

#### \* One-to-one

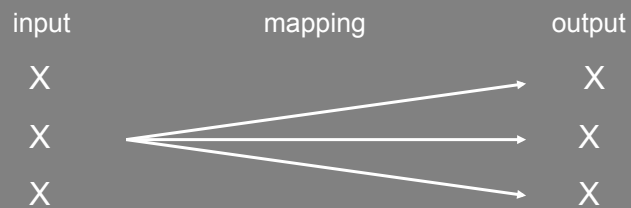


- Each independent input assigned to one musical parameter
- Simplest mapping scheme, but usually the least expressive

## Design: music controllers

### Mapping

#### \* One-to-many

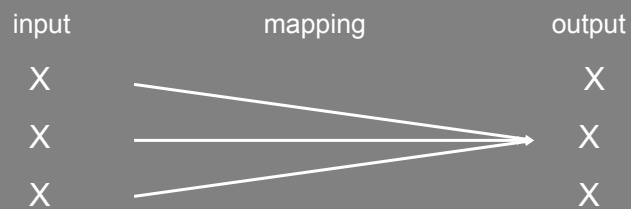


- One input controls more than one simultaneous musical parameter
- Conductor model: provides a macro-level expressivity control, but does not allow access to internal (micro) features

## Design: music controllers

### Mapping

#### \* Many-to-one

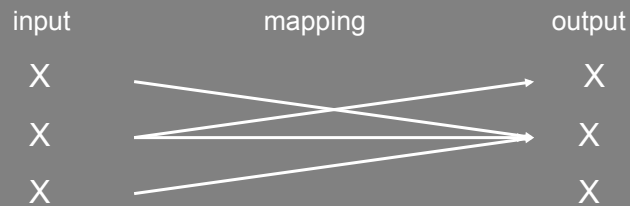


- Many inputs coupled to produce one musical parameter
- Requires previous experience with the system in order to achieve effective control
- But far more expressive than the simpler unity mapping

# Design: music controllers

## Mapping

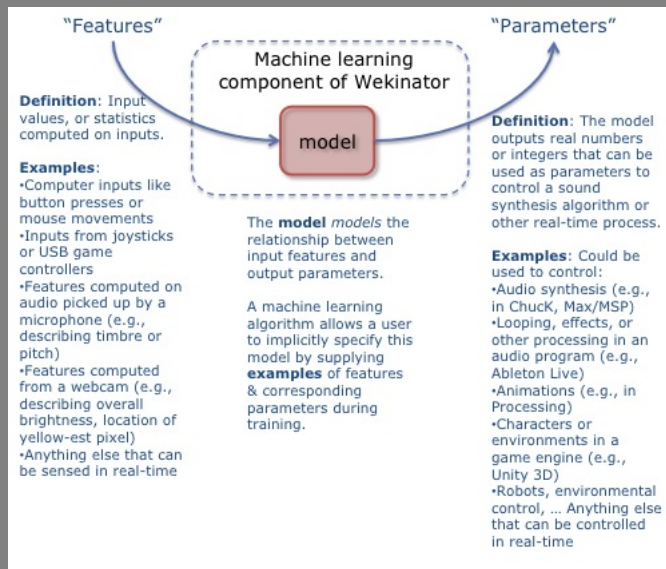
\* Many-to-many



- Many inputs coupled to many musical parameters
- Control on different levels

# Design: music controllers

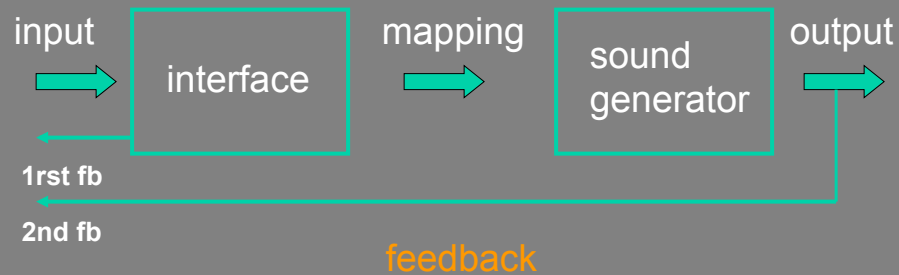
## Mapping:



## Design: music controllers

### Interaction loop

\* Simplified model



## Design: music controllers

### Feedback

#### Feedback

- Helps articulating control
- Passive vs. active
- From mono- to multi-modal (modalities: audio, haptic, visual)
- 1rst FB: from interface
- 2nd FB: audio

#### Feedforward

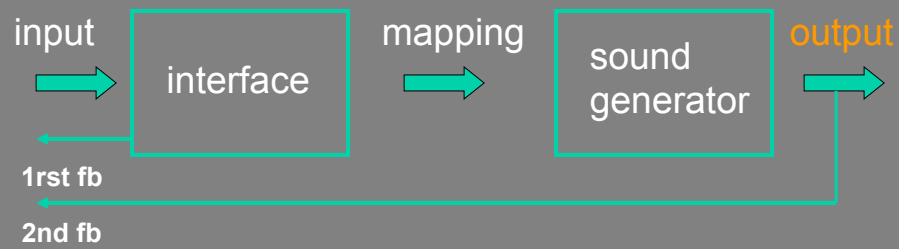
- Guides user by providing information about the internal state of the system (as opposed to information from output)



## Design: music controllers

### Interaction loop

\* Simplified model



## Design: music controllers

### Output

\* Mechanical

Guitarbot

(Eric Singer et al., LEMUR,  
2003-)



\* Tactile output (haptics)

Cutaneous Grooves

(E. Gunther, MIT Medialab, 2001)



## Design: music controllers

### Output

#### \* Alternative speakers

Soundbug™ speakers & piezos

Spherical speakers (Curtis Bahn)

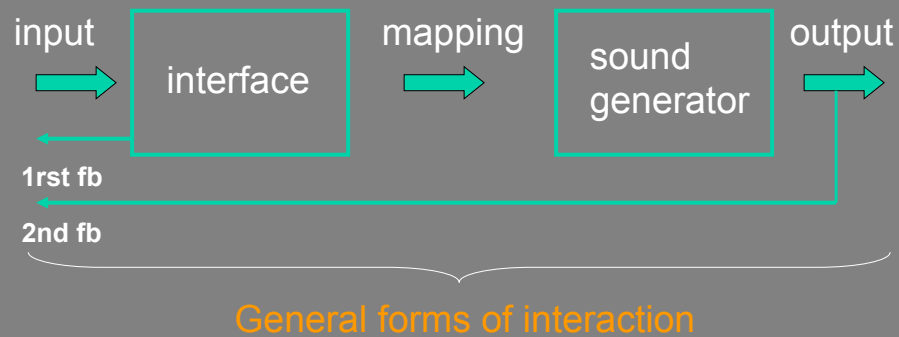
Flower Speakers (LET'S corporation, Japan, 2004)



## Design: music controllers

### Interaction loop

#### \* Simplified model



## Design: music controllers

### Interaction

#### \* User movement

- Choreographed body movement
- Traditional instrumental gesture
- Novel gestures



Dark around the Edges,  
Winkler, 1997



Machover & Yoyo Ma,  
Hypercello, 1991



The Hands, Waisvitz, STEIM, 1984

## Design: music controllers

### Interaction

#### \* User movement

- Full-handed gesture

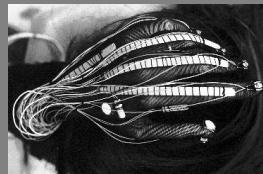


Unfoldings, Interactive  
Inst., 2003



Stranglophone,  
Sharon, ITP/NYU, 03

- Empty-handed gesture



Lady glove, Bongers & Sonami, 1991

+ Unvoluntary movements, embodied actions...

## Design: music controllers

### Interaction

\* Real-time music

Improvising new music

vs. interpreting existing one  
(conductor model)



Radio Baton, Max Mathews, 1987

vs. navigating through non-linear musical narratives

## Design: music controllers

### Interaction

\* During performance

Interaction with environment,  
audience, etc

- Performer-performer
- System-audience
- Performer-system-audience



Tooka, Fels et. Al, UBC, 01-03



Crackle-family, STEIM, 1976



Dialtones, Golan Levin, 2001

## Design: music controllers

### Interaction

\* During performance

- Audience as collaborative performer



Sine Wave Orchestra, Tokyo, 2003-04

- Private performances in public spaces  
...or over the internet



Le Placard headphones concerts

**Interfacing with sound:**  
**Performance/installations**  
**vs everyday use**

## Properties of sound in everyday life

- Ubiquitous (sometimes obtrusive)
- Dynamic and transient
- Broad yet subtle information carrier (emotions, data)
- Socio-cultural meaning
- Strong link to space and time
- Physicality (body and space)
- Additive: layers
- Foreground vs. background awareness -> implicit vs. explicit interaction

## Sound in everyday interactions

### Audio as input

Examples from art & research

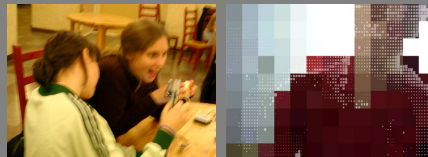
#### Blendie

(Kelly Dobson, MIT Medialab,  
2003-04)



#### Context Photography

(FAL, Viktoria Institute,  
2003-04)



-> physicality, cultural meaning...

## Sound in everyday interactions

### Outputting sound

#### \* Ambient audio displays

- Street crossing auditory displays  
etc

- Sonification of network activity:  
AmbientROOM

(Hiroshi Ishii et al., MIT, 1996-97)

-> Peripheral awareness



## Mobile music and locative audio

## Mobile music and locative audio

### Locative audio in public space

#### \* Motivations

Sound as public display

Peripheral awareness

Community re-appropriation of public space

## Mobile music and locative audio

### Locative audio in public space

#### \* Space annotation

Hear&There

(Rozier, MIT Medialab, 1999)



Tactical Sound Garden

(Mark Shepard, 2004)



Tejp / Audio tags

(PLAY & FAL, 2003-04)





## Mobile music and locative audio

### Locative audio in public space



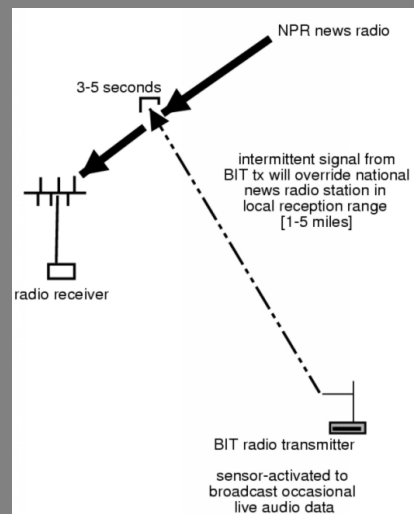
Key Chain Radio Station  
(Rikako Sakai, Ivrea, 2004)

## Mobile music and locative audio

### Locative audio in public space

\* **Radio pirates:**  
sensing environmental factors

**Bit Radio**  
(Bureau of Inverse Technology)



## **Mobile music and locative audio**

### Mobile Music Technology

Music technology meets mobile computing. Devices used anywhere, with awareness of place, in distributed / ad hoc networks...

Device follows user's displacement and connects to the world (physical, social, located virtual)

- Mobile music making, listening, sharing
- Wearable audio
- Sound walks, etc

## **Mobile music and locative audio**

### Mobile music

#### \* Mobile music sharing

Social aspect of mobile computing: ad hoc networks, distributed social networks, etc

-> spontaneous and situated music sharing with people in public space

## Mobile music and locative audio

### Mobile music

#### \* Mobile music sharing

SoundPryer (Mattias Östergren, Interactive Institute, 2001)



#### TunA

(Arianna Bassoli et al.,  
Medialab Europe, 2002)



Push!Music (Håkansson et al., Viktoria Institute, 2005)

## Mobile music and locative audio

### Mobile music

#### \* Mobile music sharing

#### Bass Station

(Mark Argo & Ahmi Wolf,  
ITP/NYU, 2003)



## Mobile music and locative audio

### Mobile music

#### \* Mobile music making

Music making away from computer screen or performance setting: in the everyday

Sensor technology + GPS -> situated music making

Ad hoc & distributed networks throughout the city -> collaborative music making

etc

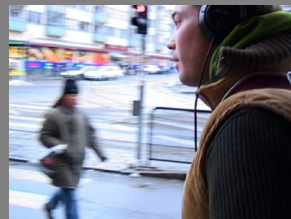
## Mobile music and locative audio

### Mobile music

#### \* Mobile music making

Sonic City

(Gaye et al., FAL & PLAY, 2002-04)



Malleable Mobile Music

(Atau Tanaka, Sony CSL, 2004)



## Mobile music and locative audio

### Mobile music

\* Mobile music making

Sound Mapping

(Mott et al., Reverberant, 1998)



Sonic Interface

(Akitsugu Maebayashi, 1999)



## Mobile music and locative audio

### Mobile music

\* Mobile music making

CosTune

(Nishimoto, ATR, 2001)



Sound Lens

(Toshio Iwai, 200?)



## Mobile and locative sound

### "Walking through sound" (D. Toop)

#### \* Sound-art installations

Electric walks

(Christina Kubisch)

Drift

(Rueb)

#### \* Walking through digital space

Seven Mile Boots

(Beloff et al., 2003-04)

#### \* Non-linear audio narratives

The Case at Kulturhuset (Knifeandfork, 2004)

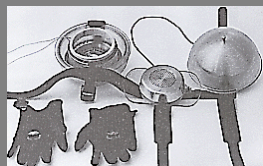


## Mobile and locative sound

### Wearable audio

"Personal instruments"

(Krzysztof Wodiczko, 1969)



(Chelle Hugues, RCA/CRD, 2000)



## Mobile and locative sound

### Wearable audio

#### Nomadic Radio

(Nitin Shawney, MIT Medialab, 1998)



#### Sonic Fabric

(Alice Santaro, 2002)



## Design: music controllers

### Issues

#### \* Criterias

- Relationship between performer and audience
- Physical effort
- Complexity / transparency
- Ergonomics
- Cultural context

It is not just about producing sound, it is about the whole **experience** of producing sound