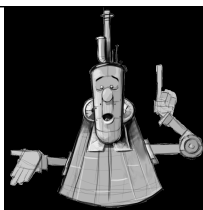


Choirs of the Future?

A look at technology,
voice(s) & “cyber choirs
(of many forms)

Perry R. Cook, Humbug Sonic Arts
Emeritus Professor, Princeton University
Computer Science (also Music)
also Sonic Mule
(and CalArts, ASU, and Stanford CCRMA)



SLEO Workshop
Baton Rouge, LA
April 15, 2012

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1

Choir(s) of the Future?

- Fundamental differences between orchestras and choirs, or, more basically, players vs. singers
- Pose and posture, pedagogy, practice, memorization, unions, attire, ...
- Cantabile, other “singing” score markings
- Opera, Recit/Aria, Lieder, Art Songs
- Storytelling: The “Song”, Oratorio, Theater, Emotion
- Audience/Public Expectations
- Gear: Speakers/mics/monitors/etc.?



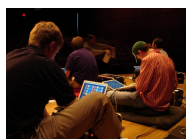
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2

Orchestra(s) of the Future?

PLOrk, SLOrk,
and now many other *Lork(ses)

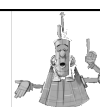
P
S
O
B
Mo
Pho
K
L
V
A
...



3

Major Topics:

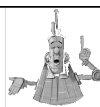
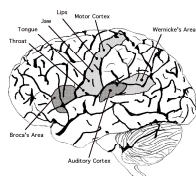
- History of voices/choirs + technology
- Voice processing (DSP, acoustic)
- Computer analysis of vocal signals (DSP)
- Singer “instrumentation” (measurements, sensors, pose, posture, other physics, & bio signals)
- Voice synthesis, many models (DSP, mechanical)
- Instruments (interfaces) for controlling vocal models (singing machines, computers)
- Voice as controller for “instruments” or other
- Amplification (mic/speaker) issues



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4

Pre-History: Vocal Imitation



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5

Voice: Animal Cries, Magic, Expression, Spiritualism, Coercion

- Imitating birds, animal howls, nature
- Language acquisition itself is/was imitative
- Storytelling, song, music (tonal speech)
- Shamanism, healing, magic, control (social)
- Sternomancy, Ventral Fatiloquency, Gastromancy, Voix et l'ombilique, Engastrimythy, Bauchrednung (Ventriloquism)
- Spirits, divination, séances
- “Spirit Trumpets,” “Spirit Telegraphs,” etc.



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6

Architecture (delay)

Naturally interesting: Canyons, caves

Regular structures

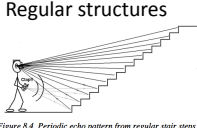


Figure 8.4. Periodic echo pattern from regular stair steps.

Design of space:

- Theaters
- Arenas
- Churches
- Concert Halls

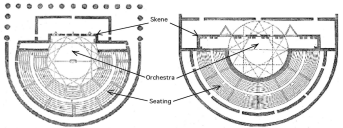


Figure 8.2. Plan of 4th century BCE Greek theater.

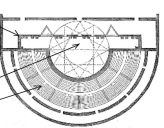


Figure 8.3. Plan of typical Roman theater.

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Primitive Voice TeQ


Cupped Hands



Hollow Logs



Megaphones



Early Voice TeQ



"Medicine?!"

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Voice as Instrument

- Vocalize (songs without words)
- Humming
- Whistling
- Diddling, Nonsense Vocal Rhythms
- "Reso-Head"
- Clucking, Popping, Other Mouth Sounds
- Ancient and Modern Mouth "interfaces" (seashells, digeridoo, jaw harp, etc.)

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Notated (and Instrumental) Voice

Kodaly

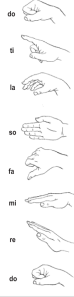



Tabla Bols



Voice-specific Notations

Instrument-linked


Vocal/Visual/Gestural

Hand-based Notations


Conducting

Clix, other sync.

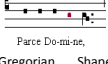
Guido




Earliest Greek




Gregorian



Shape Note



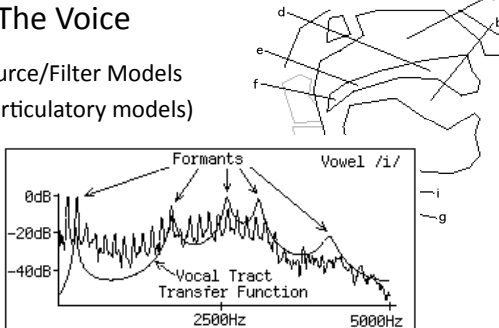
Shamisen



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The Voice

Source/Filter Models (articulatory models)



Spectral Models (perceptual models)

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Early "Synth" History: Speaking Machines

"We represent and imitate all articulate sounds and letters, and the voices and notes of beasts and birds"

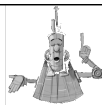
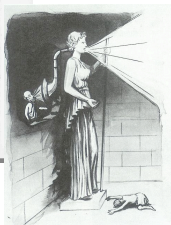
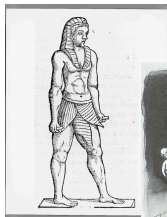
Francis Bacon (1561-1626)

from "The New Atlantis," 1626

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Mechanical Voices

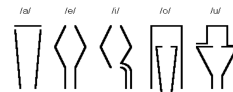
- Ancient Speaking Statues
- Other Voices from (pre-formal) History
- Acoustic Tubes
 - Kratzenstein
 - Paget
 - Marage
 - von Kempelen
 - Faber
 - Reisz
 - Wheatstone
 - the Bell Family
- Spectral Models (Helmholtz, Koenig)
- Waveform Models (Konig, Preece and Stroh (Phonograph tool))



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Early Speaking Machines

- Kratzenstein's (1779)



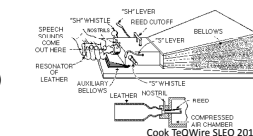
(vox humana)

Speaking Tubes

- Abbot Mical's (1783) Speaking Heads



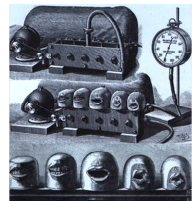
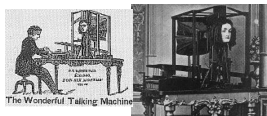
- Von Kempelen's (1791) Speaking Machine



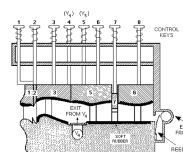
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More Speaking Machines (-1937)

Faber's
Euphonia
(1840)



Marage's
Vocal
Tracts
(1900)



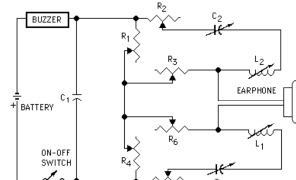
Riesz's Vocal Tract (1937)

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Speaking Machines: Into The Electrical Era

Bell: Helping the deaf communicate,
Dogs, Cadaver heads, the Telephone,
Harp Telephone (Harmonic Telegraph)

Edison
Helmholtz
Konig
Stewart
(1922)



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Dudley's Voder

- 1939 World's Fair
- Operators (female) manipulate console

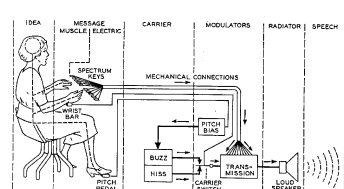


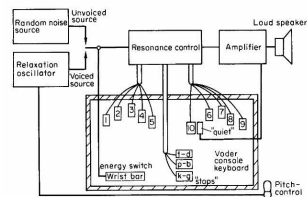
Fig. 8—Schematic circuit of the voder.



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Voder: Source/Filter Model

- Noise/Pulse (wrist bar)
- Pitch control (foot pedal)
- Resonances (10 finger sliders)
- Consonant/Stop Presets (thumb buttons)



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Dudley's Voice Coder (VoCoder)

- Subband decomposition of voice signal
- Voiced/unvoiced source detection/modeling



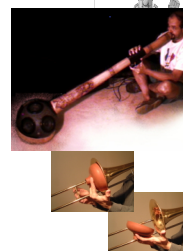
- Immediately CLASSIFIED by US Government

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Making Instruments Talk

A Brief History of /u/a/u/a/ (WahWah)

- Animal Cries => Pre-Lingual Babbling
- Hands at Mouth => Object at Mouth
- Lip instruments (brass, mutes)
- Reeds and Free Reeds: Harmonica, Flute, Sax
- Electrical Era: Working the tone-control knob (1961, Chet Atkins)
- And finally, the electric Wah-Wah pedal. Right?
- Nope (another story)



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Making Instruments Talk

- The "Talk Box"
- Sound source excites vocal tract
- Sound source => Hose => Mouth => Mic
- 1976 Frampton Comes Alive, right? Nope...
- 1940 The SonoVox
- Kay Kaiser, others
- Alvino Rey (1939)
- Pete Drake's "Amazing Steel Guitar" (1964)
- Then Frampton, right? Nope!
- Then, the "VoxWah" pedal (1966, Brad Plunkett, Electronics) demoed by Del Casher



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Making Things Talk, The TalkBox Comes of Age (1969+)

- Finally, the "modern" Talk Box (speaker/hose/mic)
- "Frampton Comes Alive" right? Nope, not yet
- "The Bag", Kustom Electronics (Doug Forbes, 1969)



Mike Pinera, Iron Butterfly



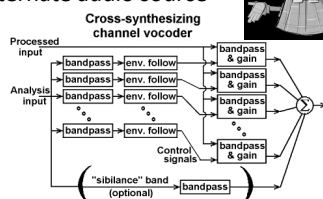
THEN Heil's (1971)
Stevie Wonder (1972)
Jeff Beck (1975)
THEN, Frampton (1976)

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The Cross-Synthesizing Vocoder

- Vocoder, but alternate audio source
- Subbands
- Optional /s/
- Optional fuzz
- Optional

Harald Bode



and Wendy Carlos
"Switched On Bach" (1968)
(Clockwork Orange 1971)

DEMO?

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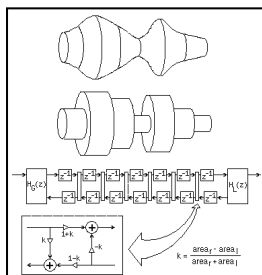
Speaking/Singing Machines and Synthesizers (cont.)

- Acoustic Tubes (von Kempelen, Kelly-Lochbaum)
- Vocoder/Voders (Dudley, Bode/Carlos)
- Variable Filter-based Models (Klatt, Sundberg)
- Linear Prediction (Atal, Dodge, Lansky)
- Formant Wave Functions (FOFs) (Rodet, Jaffe)
- Sinusoidal Models (McAulay/Quatieri Serra/Smith)
- Frequency Modulation (Chowning)
- Acoustic Tubes (Kelly-Lochbaum, Cook, Carre, Liu, Kim)
- Template-based models (Lomax, George, UPF)

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Acoustic Tubes

- Mechanical
- Analog Electronic
- Digital Articulatory Ladder Filter
Bell Labs 1961
(Kelly, Lochbaum & Mathews)

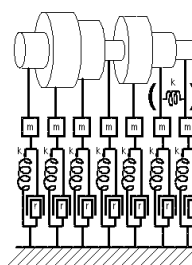


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Acoustic Tubes (improved)

- Acoustic Tubes (Cook, Carre, Liu, Kim)



- Nasal Tract
- Throat Radiation
- Lots of Real-Time Control
- Shape/Spectrum Feedback
- Articulation Tracking
- Inertial Articulation Modeling

Greek Shiela

Daisy Duet

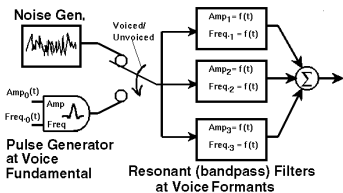
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26

Source/Filter Models

- Linear Prediction (Atal, Dodge, Lansky)
- Formant Filter Models (Fant, Rabiner, Klatt, Sundberg)

Subtractive Voice Synthesis Block Diagram

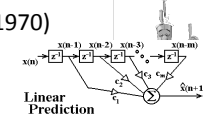
Choir
(Ternstrom 89)

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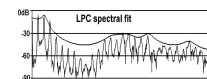
27

Linear Predictive Coding (Atal, 1970)

- Waveform: next sample = linear combination of previous samples
- Spectral: best predictor coefficients are least-squares spectral filter
- Perceptual: formant peaks
- Physical: source + ladder filter
- Cross-synthesis
- Music composition (Lansky, Dodge, Moorer, Peterson, others 1980's)
- Speak&Spell, other TI products
- Coders of all types, LPC10, etc.
- to eventually, VCELP (Cell phones)



Linear Prediction



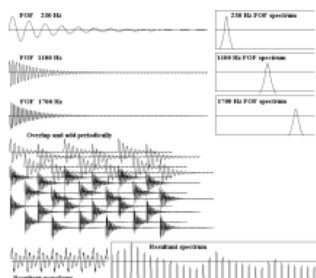
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Formant Wave Functions

- Formant Wave Functions (FOFs) (Rodet)

Formants in the time domain

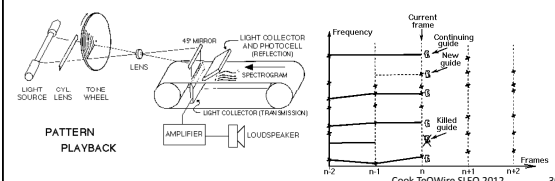
Impossible
Animals
(Jaffe)Gesualdo
(Rodet/
Bennett)

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29

Spectral Models

- Helmholtz, Konig
- Haskens Labs PAT (1949)
- Sinusoidal Models (McAulay/Quatieri 1986)
- Sinusoidal Models + Residual (Serra/Smith 1989)
- Sines, Residual + Transients (Verma/Meng 1998)

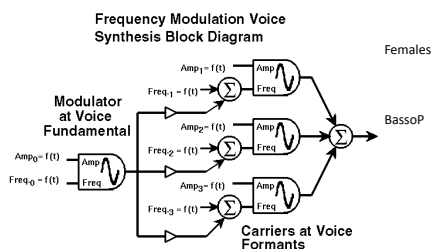


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Frequency Modulation

- Frequency Modulation (Chowning)



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Template-based Models



Lyracos (Lomax, George, UPF)

LomaxElvis

LomaxElla

Vocaloid (UPF, Yamaha)



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And.....

We can't talk about
voice, technology, and
synthesized singing
these days without...

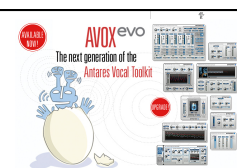
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Autotune™!

- Antares Inc. (1997)

- Detect pitch
- Pitch-shift to steer toward target pitch
- Retune speed [0.0,1.0] sets speed at which correct pitch is approached (0.0 = “Cher”)

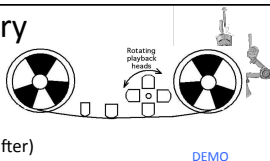
- Best selling plug in for last couple of years
- Dirty secret: everyone uses it (not set to 0.0)
- T-Pain and others proudly set it to 0.0
- Newest dirty secret: increasingly used live



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Autotune Pre-History

- Rotating head pitch/time shifting (1965) (motivates cheap digital pitch shifter)
- Eventide Harmonizer (overlap-add, 1976)
- De-glitched Harmonizer (PSOLA, 1977)
- Smart Harmonizer (real/tonal shift, 1980's)
- AHA! Factor/Agnello et al invented AutoTune?
- Formant correction: Digitech (Studio) Vocalist

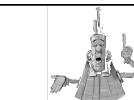


DEMO

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Autotune History

- Cher “Believe” (1998)
- Eiffel 65 “Blue (Da Ba Dee)” (1999)
- Soon, countless others
- Soon, everyone (Chicks, Avril, ...)
- Soon, many using it live (Reba, Garth, ...)
- T-Pain
- then.... the backlash:
Jay Z “DOA (Death of Autotune)”
Grammy Blue Ribbon Campaign



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Social Commentary

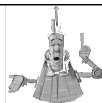
- “Autotune the News”
Michael and Andrew Gregory

Take great (and not so great) speeches, moments in history, stupid news, etc.

Run them through Autotune

Add music, effects, make videos, put on YouTube, go viral, get famous.

Yea!



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AutoTune for the Masses?

T-Pain

+ Sonic Mule (Smule)

+ Antares



= “I Am T-Pain”

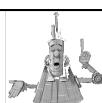
AutoTune™ for the iPhone



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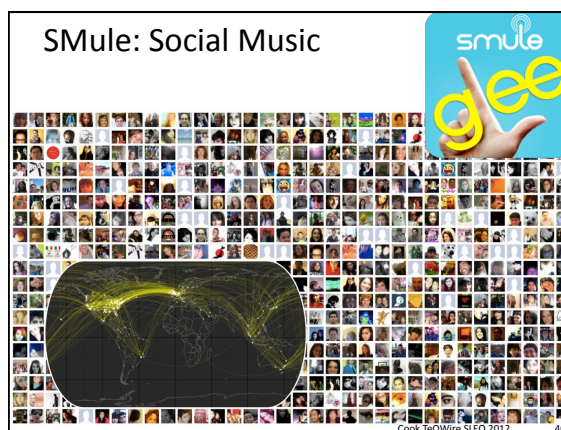
OK, Enough AutoTune

Let's talk about how mobile and ubiquitous technologies have been, and can be used for choral purposes



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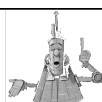
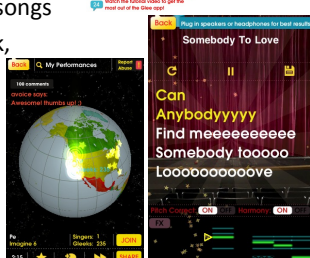
SMule: Social Music



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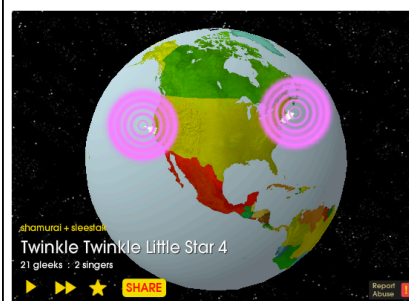
Glee!

- Pitch Correction and Harmonies
- Songs from the Show
- Other (non show) songs
- Share via Facebook, Smule, Email
- Global “Glee Clubs”
- Ad Hoc Groups
- Earn “Glee” Comments



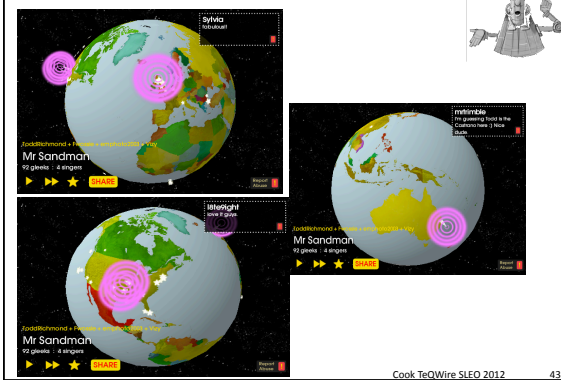
41

People who know each other, but geographically separated, singing together

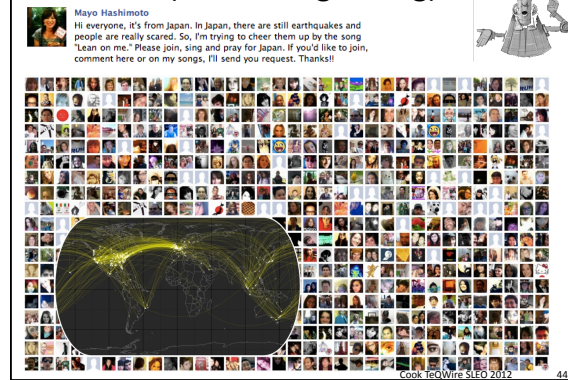


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Strangers making ensembles



Massive (3000 and growing)



- Bicycle Built for Two Thousand (2009) (Aaron Koblin and Daniel Massey) uses Amazon Mechanical Turk

- Present a audio token "snip"
- User records imitation of that
- Do this to cover the whole song multiple times
- Collect and mix all
- Animate with "piano-roll" style display

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- Lux Arumque, Eric Whitacre (2010)

- YouTube call
- YouTube submissions
- Assemble video/audio
- Make cool "world choir" video

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Libertaria, Sabrina Peña Young (2013)

- Virtual Animated Opera
- Casting calls via Facebook, other
- Auditions by submitted recordings
- Click/backing tracks on BandCamp
- Vocal parts submitted by email/upload
- Editing/mixing by distributed team
- Multiple singers per role, for morphing
- Animation by distributed team
- Sound/Score driven facial animation
- Many cast/composer have never met
- Screen in 100+ locations in 2013

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Speaking of Animation, and Video...

- Video unrelated to performers
- Performers controlling video
- Video tracking (faces, bodies)
- Display to performers (scores, other)
- Remote (Telematic) performances

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Messa di Voce (Levin 2003)





- Camera tracking +
- Voice Analysis +
- Real-time Animation

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000000swan

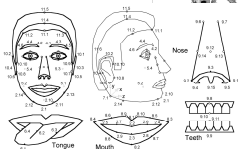

- Kinect tracking
- Sensors, mics, instruments (cello)
- Video display
- Goth/tribal costumes
- Wekinator
- Video(s)



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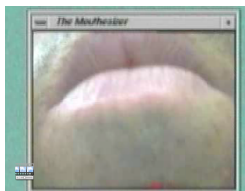
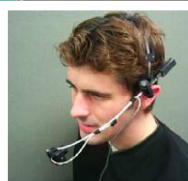

Mouth/Face tracking (body too)

- Very Nervous System
- EyesWeb (vAchorale movie)
- Processing Video Demo
- Jitter
- FaceOSC
- MAGE (vid)
- Mouthesizer

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The Mouthesizer (Lyons, ATR, 2001)

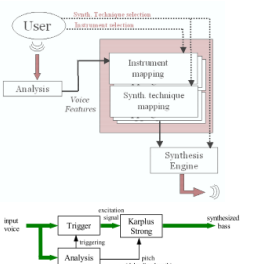




“Boom” Camera + Image Processing

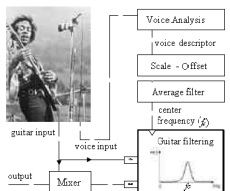
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Voice-Controlled Synthesis and Processing (2005, UPF)

Voice-controlled Bass and Synth

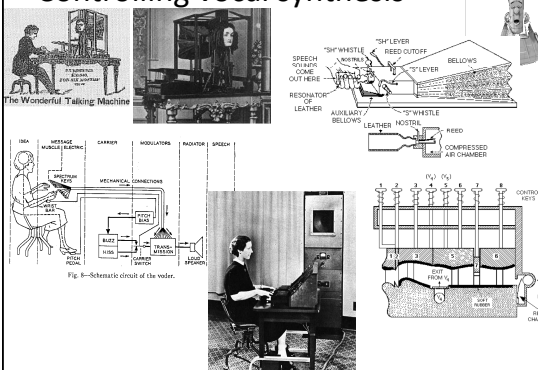


WahWactor: Voice-controlled WahWah



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Controlling vocal synthesis



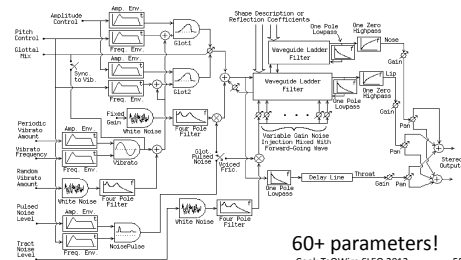
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Controlling Vocal Synthesis

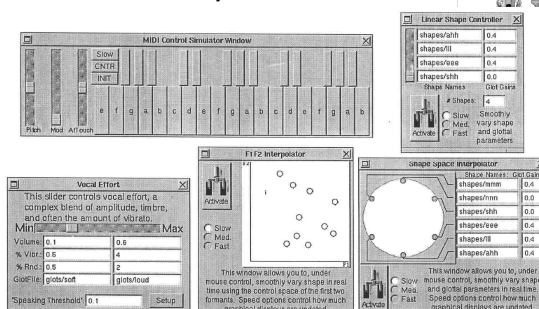
- Real time, so possible
- But many, many parameters
- Not a natural “fit”

Uh....

Huh?



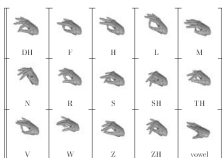
Few-to-Many Controls ('93)



Tract/Glot, Linear, F1F2, Arbitrary 2D
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GloveTalk (Fels and Hinton, 1990+)

- Data gloves and 3D position to control speech synthesizer
- Lef Hand “Macros” for Consonants
- Pitch height
- Vowel Space



SqueezeVox (with Colby Leider 2001)

- **Voice Control Issues:**
- **Pitch**
- **Breathing**
- **Articulation**
- **etc.**
- **Fix: Accordiaae?**



Maggie

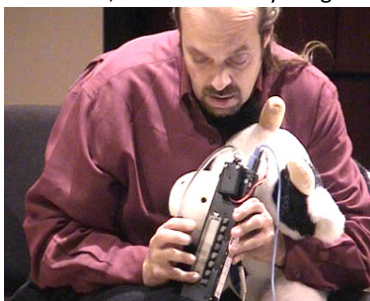


Colby's Bart



The COWE

Controller, One With Everything



“Bagpipe” with
Tilt Sensors,
Linear FSR,
Buttons,
and more

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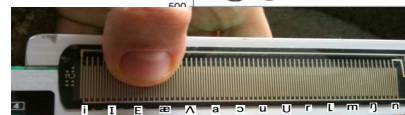
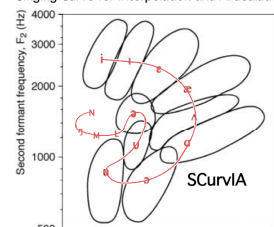
A New One-to-Many Map:

SCurVIA (2011)

Singing(Synthesis)
Curve for
Interpolation
of Articulation

“Rainbow”
vowels and liquid
consonants
arranged
along a
single line

Singing Curve for Interpolation and Articulation



2004: More Voice Control

Voice
Oriented
Melodica
Interface
Device

VOMID

Blowing, Keyboard, Linear FSR, 3xTilt, Joystick, Buttons, Knobs, Sliders, ...



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Re-Design: Maggie 2009

Lots o' buttons, sliders (more buttons)

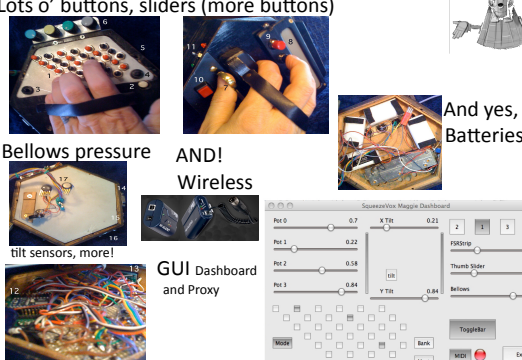
AND! Wireless

GUI Dashboard and Proxy

And yes, Batteries

tilt sensors, more!

Bel lows pressure



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Others

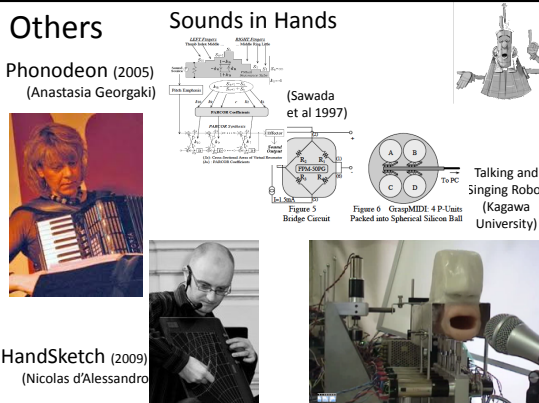
Phonodeon (2005) (Anastasia Georgaki)

HandSketch (2009) (Nicolas d'Allesandro)

Sounds in Hands

(Sawada et al 1997)

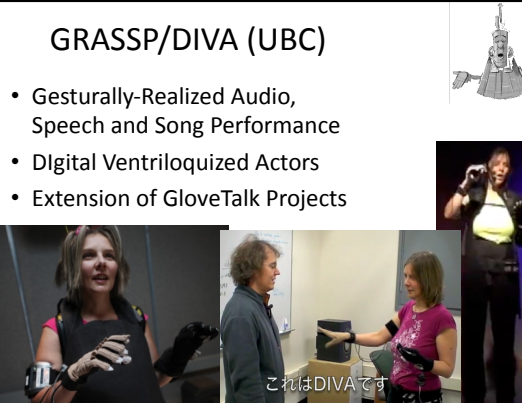
Talking and Singing Robot (Kagawa University)



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GRASSP/DIVA (UBC)

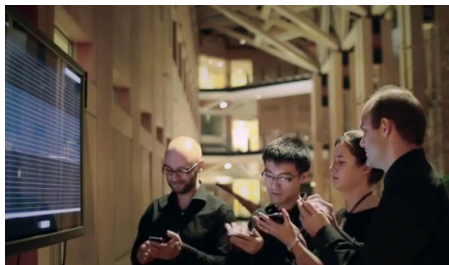
- Gesturally-Realized Audio, Speech and Song Performance
- Digital Ventriloquized Actors
- Extension of GloveTalk Projects



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Choir Mob (Astrinaki and d'Allesandro 2011)


- iPhone Singing Synthesis App
- "Intertwine" by Aura Pon, for Choir Mob and Vuzik



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Choirs of the Future?

- Players/Dancers/Actors Controlling Digital/Mechanical Vocal Models?
- Robots? Androids? Cyborgs? DIVAs? Toys?
- Computers Singing to Other Computers?
- Vocaloids Judging AutoTuned Humans? (Cyberidol™ on FOX!)
- Hey! How About Augmenting Singers?
(perhaps the optimal vocal controller...)
- draw experience from...



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Orchestra(s) of the Future!

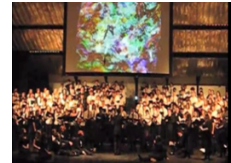


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Future (past, now) "Cyber" Singers



- Ursula Dudziak 1970's+
- Laurie Anderson 1980's+ (+Video)
- Pamela Z. 1990's+
- Amy X. Neuburg 1990's+
- Bjork! (rhymes with PLOrk)
- Many others
what about choirs??)
- Many works for "choir and tape" (70's)
Stockhausen, Tavener, Pinkham, Schafer,
Kemner, Winsor, Adams,



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Choirs of the Future

- Effects added to singer voices
(controlled by singers)
- Synthesis via controllers
(controlled by singers
dancers, audience?)
- Integrating this + more



Courses: TeQWire: Voice Technology Seminars
Two-Sided Plays (with Laurie Anderson)

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Choirs of the Future: TeQ

Singer signals, and sensors to measure:

- Pose, Posture, Joint Angles
- Head, Face, Mouth
- Bio Signals
- Pitch, Loudness, Timbre, other acoustic

DSP to do:

- Processing of live singing, canned singing,
pre-recorded sounds
- Feature Extraction and Machine Learning

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Bio Signals and Sensors

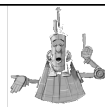
- Breathing (events, depth, rate)
(mask, hot-wire, fan, diaphragm, bernoulli,
chest band, cond/resistive fabric)
- EGG (Ω between vocal folds, neck band electrodes)
- EMG (electrical muscle signals, skin electrodes)
- EKG (heart EMG, electrodes !!CAUTION!! pulse, audio)
- EOG (electrical/magnetic eye direction, coils)
- EEG (brain: α , β , ..., electrodes, coils, squid, IR)
- GSR (skin resistance, electrodes, pennies ☺)
- Pulse (heartrate, EKG, electrodes, pulse oximeter)
- Blood gasses (O_2 , N_2 , CO_N , ... IR, other)

(VAC
vid)

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Physical (Pose) Sensors

- Tilt (head, hands, torso, foot/feet, ...,
accelerometers, video)
- Absolute spatial positions/orientations (6DOF)
(body in room, head, hands, feet, etc.,
RF, polhemus, video, IR, tethers!) (DEMO)
- Joint angles (arms, wrists, neck, fingers, hands
knees, ankles, torso, cuffs, bendies, gloves, video)
- Facial: orientation(s), mouth/lips, eyebrows, eyes,
gaze/focus, video, IR with markers)

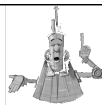
(VAC
vids)

Recent solutions for some of these: Kinect!, iPhone! (DEMO)

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DSP Things To Do

- Delay, loops, chorus, flanging, ...
- Pitch shift (correct), harmony
- Spatial processing
- Gender/character (accent?) modification
- Sinusoidal resynthesis (with modification)
- LPC/Vocoder modification/cross-synthesis
- Playback of pre-recorded (contributed) audio
- Gating of audio (captured or pre-recorded)
- Scrubbing of audio (captured or pre-recorded)



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Audio Features to Extract (and things to do with them)

- Time Domain:
 - Loudness (peaks, power)
 - Zero Crossings (Noisiness)
 - LPC coefficients (cepstrum)
- Frequency Domain:
 - Spectral Flux, Centroid, Tilt, Rolloff(s), Sub-band energies, Formants, Harmonicity, Harmonics to Noise Ratio (HNR), Pitch, Multi-pitch
- Classification/MIR/Machine Learning:
 - Vowel/Consonant, Phoneme, Gender, Singer ID, ...
- SMIRK, CLAM, Weka, Wekinator

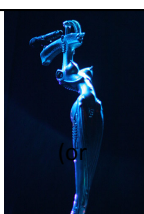


DEMOs

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Microphones/Amplification

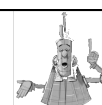
- Mic Stand(s)
(Freddie, Korn, Emic (NIME03), grunge (2mics))
How about sensors on/in mic stand?
- Microphone in/on music stand concealed in folder, **or in the laptop?**
- Sensors in/on music stand, or in folder
- Head(set) microphones
(Countryman, Shure, Sennheiser, Audio Technica)
- Wireless mics, mic/instr. packs, in-ear monitors
- Wireless sensor systems (MIDI(Tron), Spark, Arduino)
- Speakers: House sound? Monitors? Local? Wearable? (remember precedence)



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Haptics, Robots, ???

Haptics (display to singers, audience?)
Robots (with singers, as singers)
Exoskeletons, prostheses, ...
Waisvisz (the Hands), BugMudra, Stellarc
Karmetik Machine Orchestra

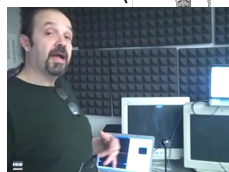


The Virtual Augmented Choral (with Ben Knapp, 2005-2009)

Part of the
"Integral Music Controller"

Signals/Inputs:

- Physical/Gestural (pressure, tilt, etc.)
- Bio (EMG, EKG, EOG, O₂) (VACHorale music stand)
- Video: Face, Body
- Emotion (inferred from bio signals listed above)
- Other



Breathing =>
Launch phrases

Arm up/down
=> #singers

Left grip =>
scrub mode

Right tilt => rate

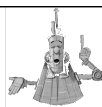
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SSSS: Singer's Sensor Speaker Stand



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Some Recent CyberVoice Pieces I've Done



- Credol (solo – trio) (2010)
- I Want (solo) (2012)
- LOrX Aeterna (PLOrk, April 7, 2012)

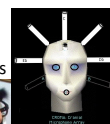
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NogginSonics ("head art") Head-Shaped Speakers/other



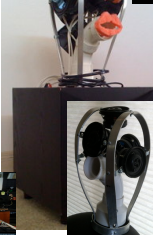
Spelmet

Head/speaker Arrays



PhoNoggin (ipa)

SolFoggins (pitch)



CraniOrgan

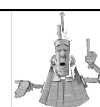
Conclusions



- Our voices are primal
- Humans perceive the world through (nearly) hard-wired linguistic "lenses"
- Singing is synonymous with "beauty"
- Synthesis methods abound
- Sensors for new controllers abound
- DSP and machine algorithms abound
- Much research remains to put them together
- Figuring out what to do is the hard part
- Magic (aesthetic transcendence?) is possible
- Goal: Make Art!!
- Cantabile (perform in a singing-like manner)

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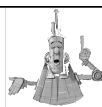
Open Questions, Vexing Problems



- The Curse of Causality
- "Grey Paint"
- "What the hell are they doing?" (a common issue)
- Robustness (or at least less fragility)
- Repeatability, reliability, flexibility
- Persistence (of "instruments", pieces)
- Feedback!!!

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Things I Ain't Seen (much of) Yet



- Audience involvement
- Masks (Greek, dance/theater, puppets, but little in the way of cool EFX in masks)
- Features and Machine Learning on whole choirs (bio signals, acoustic signals)
- Singer/Choir-specific speakers
- Integrated wireless systems (mic, and sensors, and in-ear monitors)
- Actual dedicated cyber-choral ensembles
- Vocoder choir, sonovox choir, speaking machine choir...
- Theremin-like instruments, ensembles, audience theremin
- Tradition: pedagogy, practice, repertoire, (yea, sure)

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Resources



- Gear (sensors, electronics):
 - ElectroTap
 - Infusion Systems
 - Sparkfun, AdaFruit, Parallax, Arduino.cc, AllCorp, Jameco, DigiKey, others.
- Speakers: ElectroTap, Isobel, Bluetooth, ???
- Software:
 - Max/MSP, PD, Processing, SuperCollider, Aura/Nyquist, C*(monkeys), STK, Chuck, Java
- This talk: vocebella.org

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ACKs

National Science Foundation

Guggenheim Foundation

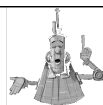
MacArthur Foundation

Ariel Foundation

David A. Gardner '69 Magic Fund
(Princeton Humanities Council)

Kimberly and Frank H. Moss '71
Research Innovation Fund
(Princeton SEAS).

NIME, PLOrk, TeQWire, LAP,
Colby Leider, Dan Trueman,
Ajay Kapur, Ben Knapp, Curtis
Bahn, Ge Wang, Rebecca
Fiebrink, and the Princeton CS
and Music Graduate Students.



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Thank You!



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Drawn from Upcoming Book:

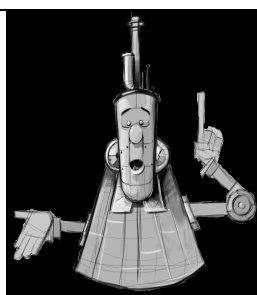
La Bella Voce e la Macchina

(the beautiful voice and the machine)

A History of Technology
and the Expressive Voice

Technology: Any human-fashioned tool,
technique, method, law, notation,
enhancement, etc.

Expressive Voice: Singing, acting,
preaching, rapping, praying, etc.



"Steamo"

(fictional turn of century steam-
powered opera singer)

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Table of Contents (Section 1)

1 The Voice Basic human voice physiology, neurology, and acoustics.

2 The Articulated Voice Motions of our tongue, jaw, etc. for
linguistic communication. Gesture in production and perception.

3 The Pitched Voice Aspects of vocal pitch control and perception,
specifically as related to emotion and singing. Loudness too.

4 The Visual Voice Emotion in facial expression, lip reading, visualizations
of the vocal organ, and of vocal sound. Spectrograms, hand signs, other
visual speech tools.

5 The Singing Voice Singing vs. speech. The basic voice parts. Research
and lore about singing. Vibrato, Singers Formant, etc.

6 The Bio-Medical Voice Castrati singers (surgery to enhance singing).
The aging voice, voice damage, Stuttering and other disphonias.
Artificial larynx's, other therapies and devices to aid the voice.

7 The Noisy Voice Normal and abnormal noise, deviations, expression.

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Contents (Section 2, Technology)

8 The Delayed, Delayed Voice Acoustic echo and delay, from caves to
concert halls. Space and echo in composition. Electronic delay,
reverb, reverse echoes, chorus, flanging, pitch shifting, etc.

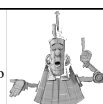
9 The Notated Voice Speech vs. written language, Musical notation
systems, Guidonian hand notation/conducting, Kodaly hand signs.

10 The Broadcast Voice From smoke signals to drums to wireless
telegraph to telephone to radio to television to the interwebs.

11 The Microphonic Voice Microphone types, technologies, and
pickup patterns. The "Perfect Mic?" Microphones for effect. Mic,
stand, and cable as instrument and fetish.

12 The Recorded Voice Sound recording in myth, lore, and pre-
history. Music boxes, player pianos, mechanical, electrical, digital
recording. The "Record Biz." Studio is musical instrument.

13 The Amplified Voice Megaphones and Ear Horns to Microphones:
Caruso vs. Bing Crosby. Home, theater, and studio speakers.



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Contents (Section 3, Culture)

14 The Holy Voice Rosary beads, prayer wheels, prayer bowls,
religious chant, notation, religious pop and metal bands, etc.

15 The Silent Voice The most powerful "speech." Vows of silence, spaces
and pauses in poetry and music.

16 The Anonymous Voice Paging (air, bus, pilot), Authority, Anonymity,
Radio DJs, Commercial announcing, other voices without faces.

17 The Instrumental Voice Vocalise (songs without words). Voice as
percussion instrument, Vocal tablature (notation) for Indian, African
drumming. Voice interaction with other instruments (brass, other winds).
Controlling vocal models in real time, controllers for doing that.

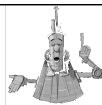
18 The Legal Voice Intellectual property (primarily copyright) related to the
voice. Famous historical lawsuits related to the voice. Music downloading.
Stealth recording, independent bands and labels.



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Contents (Section 4, Machines)

- 19 The Mechanical Voice** Historical speaking machines, from pre-history to mechanical age, up to electricity
- 20 The Synthesized Voice** Overview of voice synthesis, especially singing synthesis, from electronics through digital.
- 21 The Fictional Robotic Voice** Voices of machines, robots, and computers in movies, television, etc.
- 22 The Contemporary Electro-Acoustic Music Voice** Contemporary art-music technology and voice composition.
- 23 The Popular Electronic Musical Voice** Popular music/art technology and the voice.

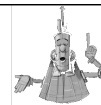


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Contents (Appendices)

Interviews and Supporting Materials:

- Appendix A Researching the Voice** Interviews with researchers from Bell Labs, MIT/Lincoln Labs, Haskins Labs, Stockholm KTH, etc., such as Max Mathews, Jont Allen, Ben Gold, Johann Sundberg, Students of Dennis Klatt, Gunnar Fant, etc.
- Appendix B Composing the Voice** Interviews with John Chowning, Charles Dodge, Paul Lansky, others.
- Appendix C Performing the Voice** Interviews with Laurie Anderson, Meredith Monk, Bobby McFerrin, Pamela Z, Amy X, others.
- Appendix D Switching On the Voice** Interviews with many voice hackers, from Wendy Carlos to Kraftwerk to RadioHead
- Appendix E Description of materials at VoceBella.org**



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