

Extended playing techniques: The next milestone in musical instrument recognition

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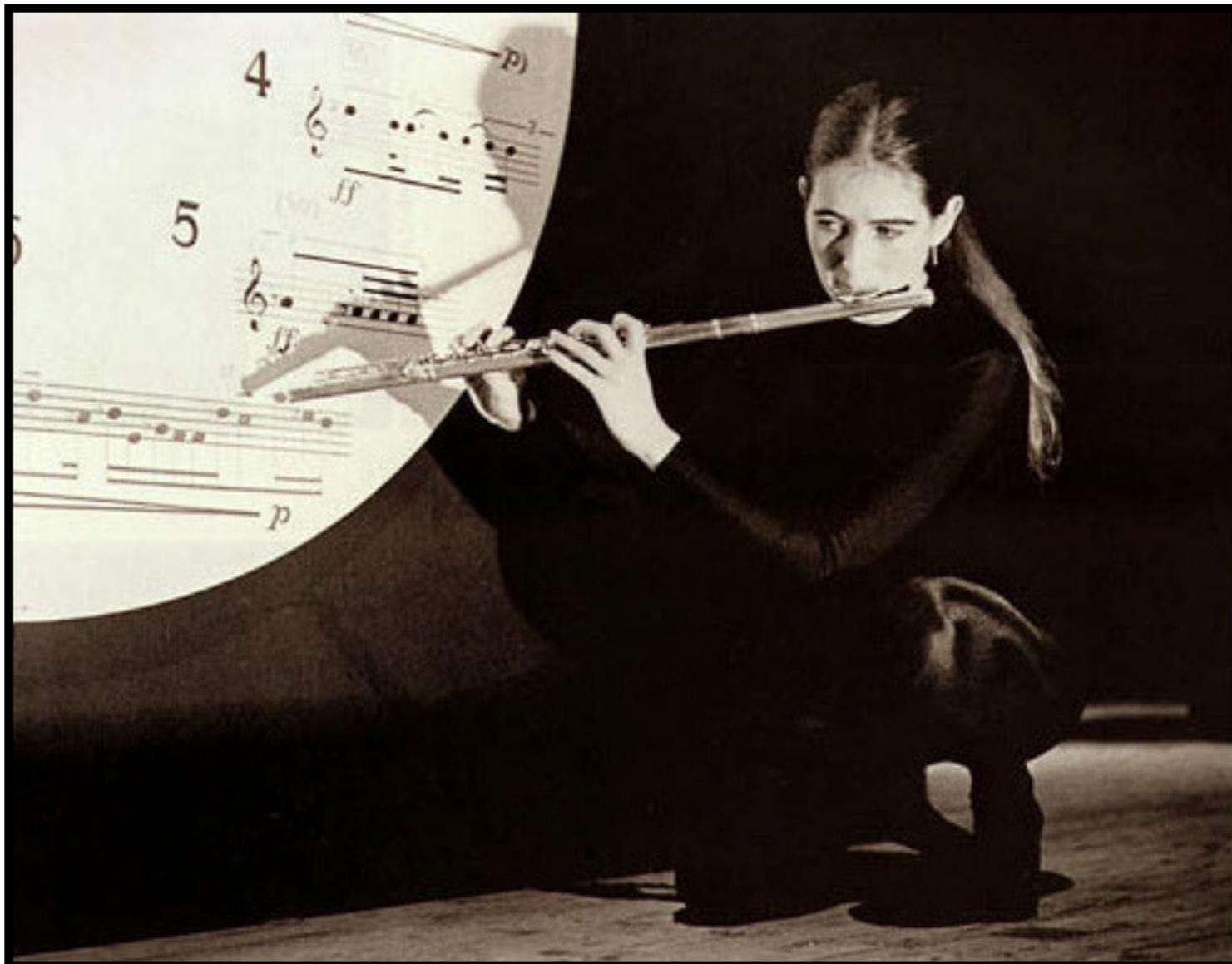
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In a nutshell

Our definition of **timbre** requires a more systematic inclusion of **performance effects**.



*Kathinka
Pasveer*

Context: spectralist music creation

Analysis Explorer Filters Orchestra Solutions Maquette Quit

Orchestra

Preset: Modern a 4

- 2 Fl+Picc
- 2 Fl
- 3 Ob
- 1 Ob+EH
- 1 CIBb+CIEb+CIA
- 2 CIBb+CIA
- 1 CIBb+BCIBb
- 3 Bn
- 1 Bn+Cbn
- 4 Hn
- 3 TpC
- 3 TTbn
- 1 BTb
- 1 Hp
- 2 Vns
- 1 Vas
- 1 Vcs
-

Stage mixer:

Reset Positioning and Gains Reset Gains

Apply Orchestra

[Eslin 2014]

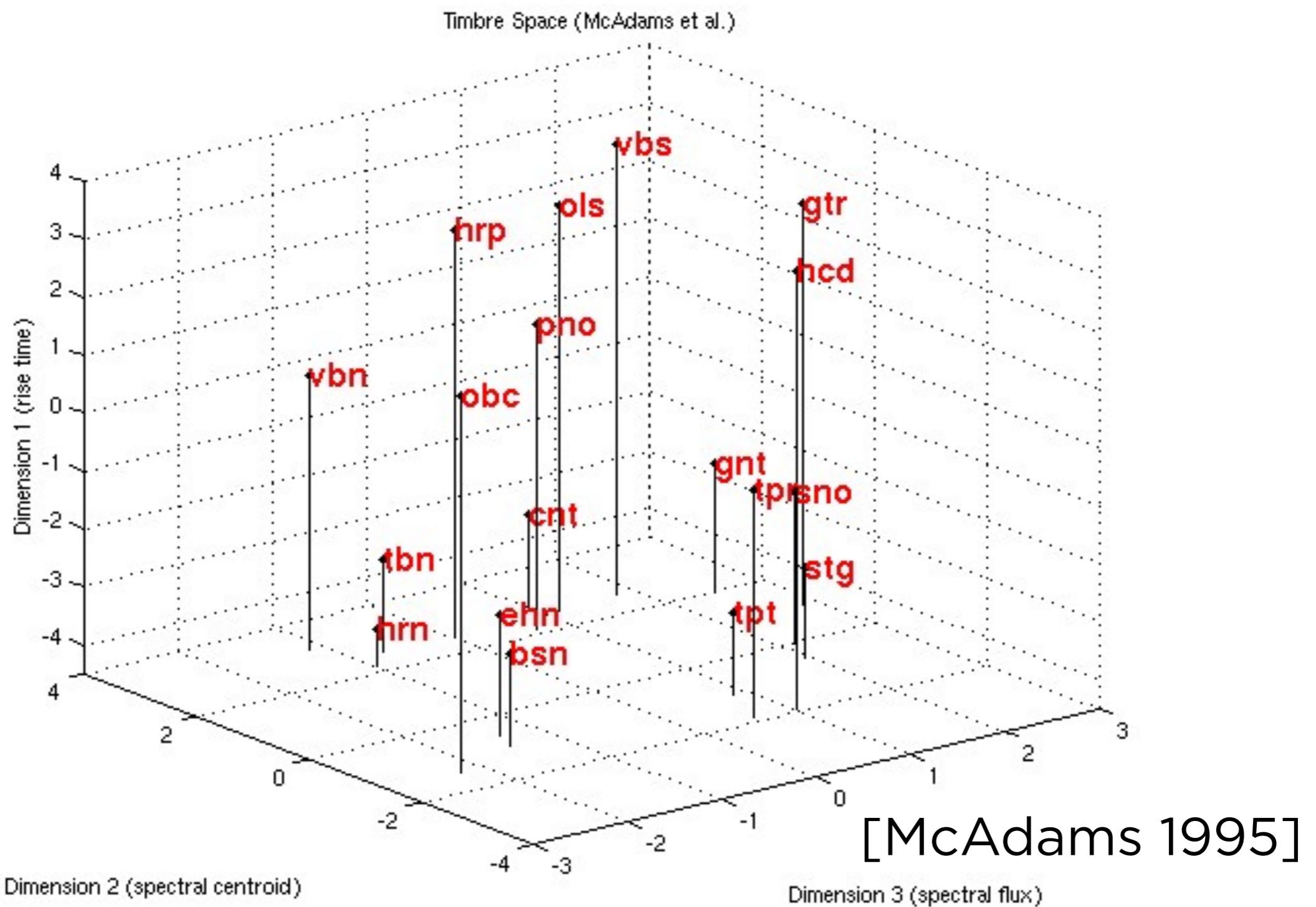
What are musical instruments?

the organology definition:

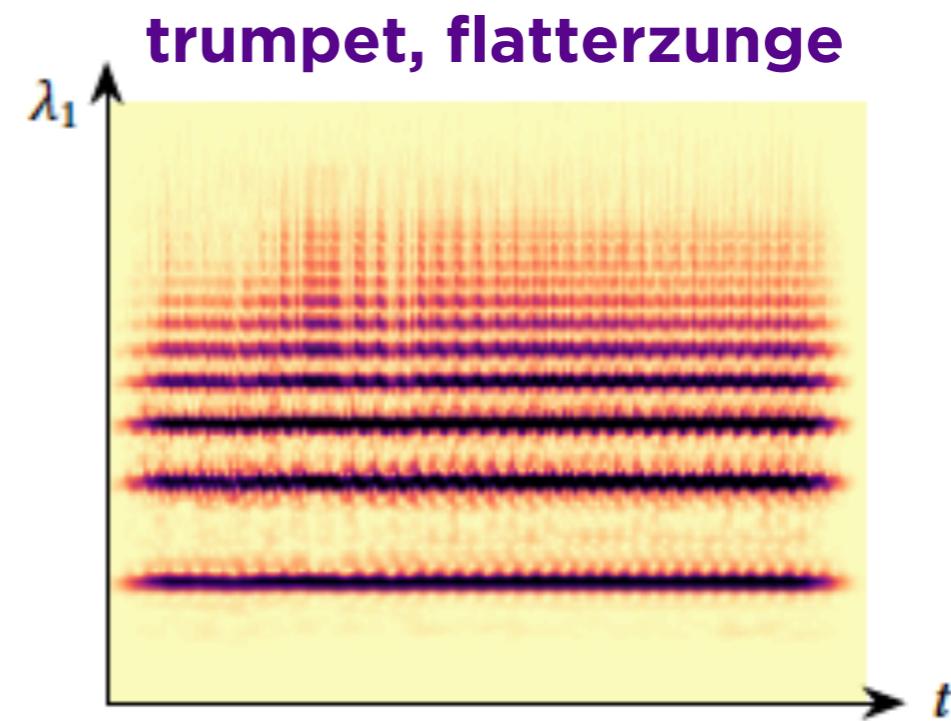
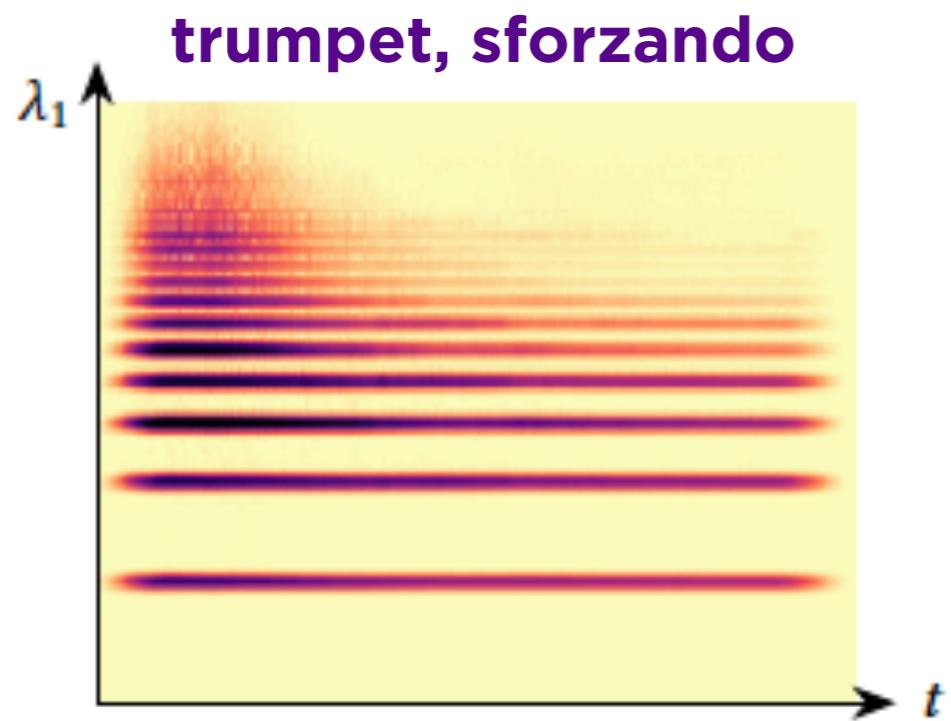
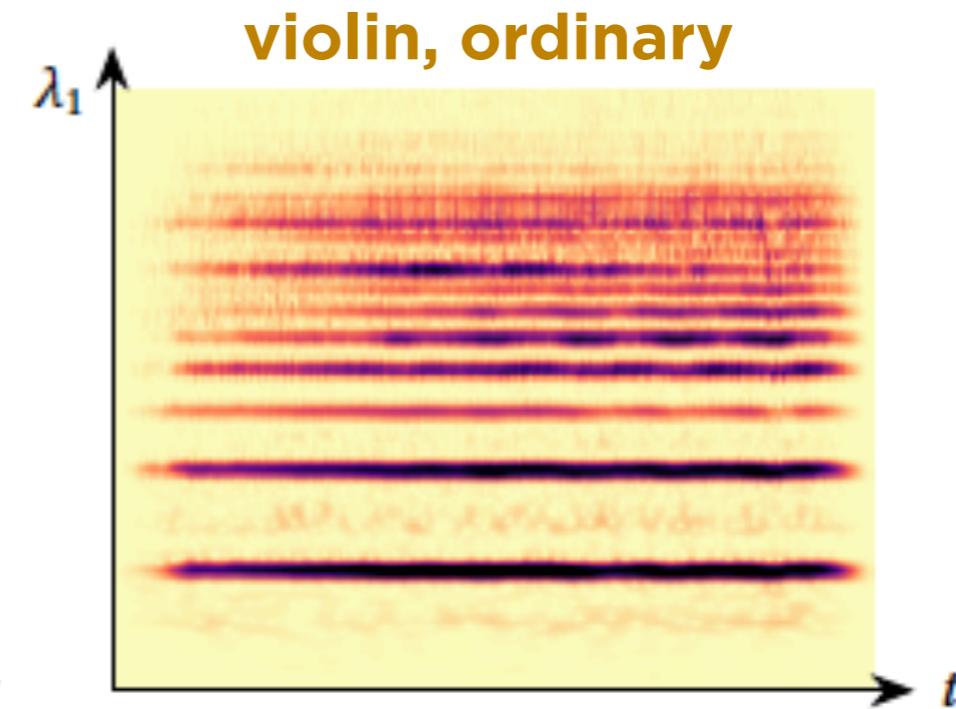
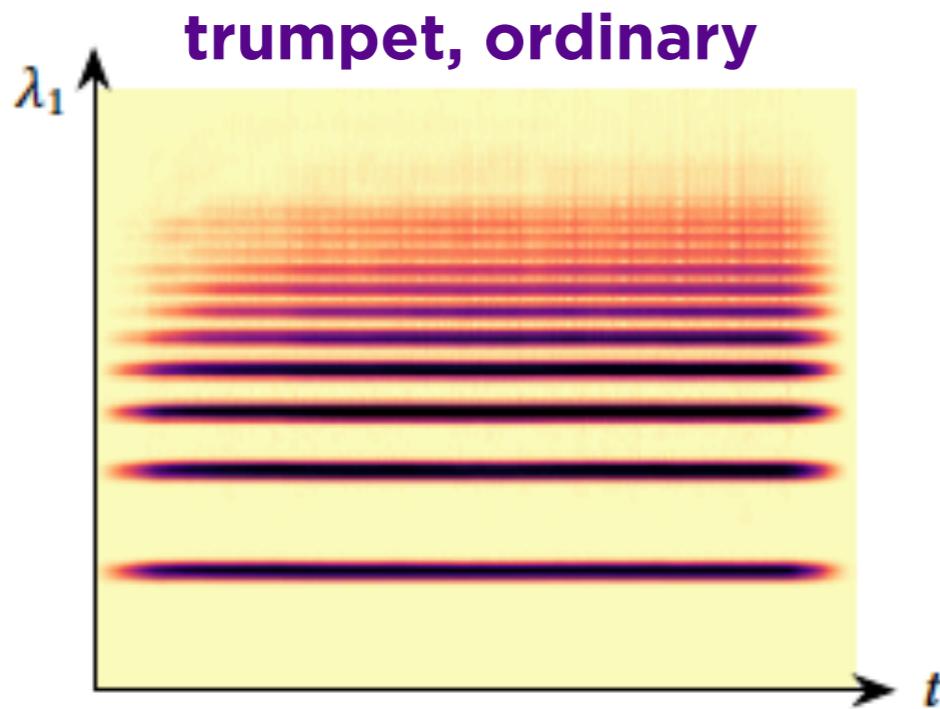


What are musical instruments?

the music psychology definition:



Problem: none of the two definitions account for variability in instrumental playing techniques (IPT).



Yet, non-ordinary playing techniques are frequent

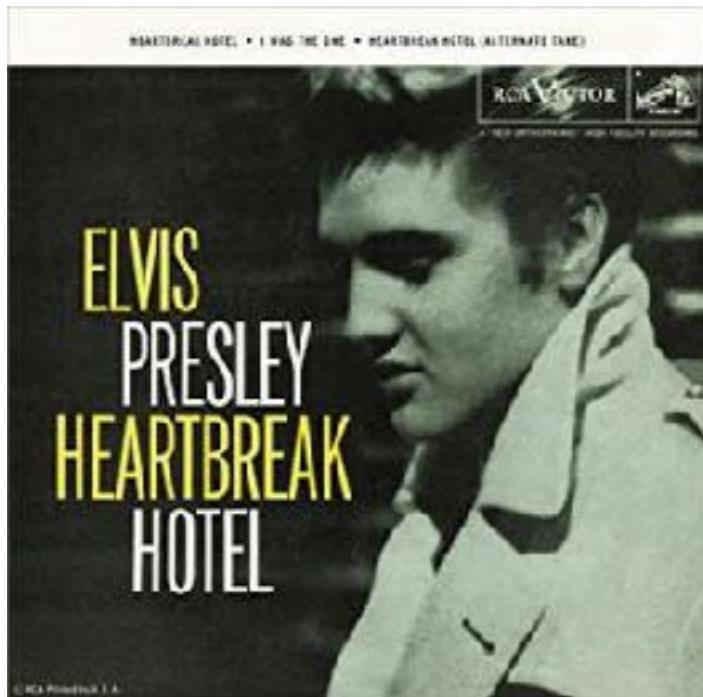
clarinet slide



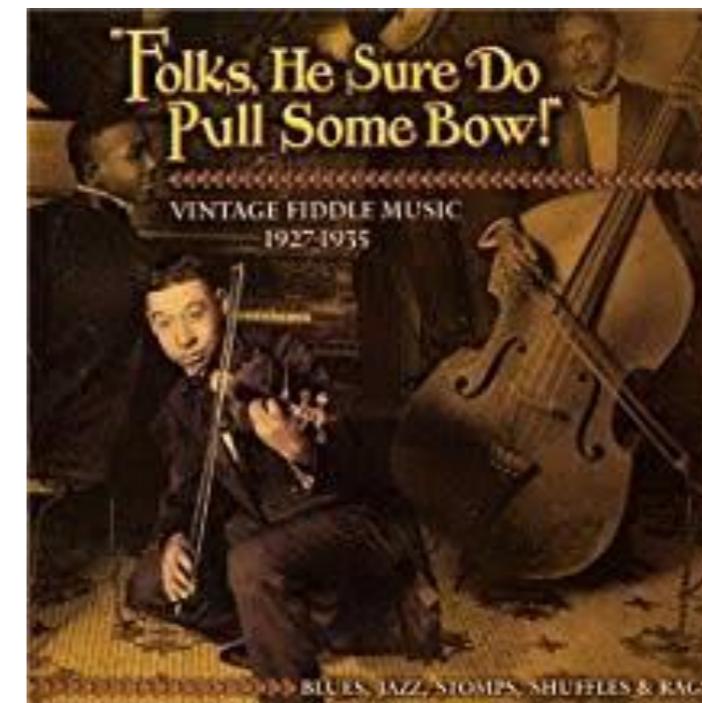
saxophone growl

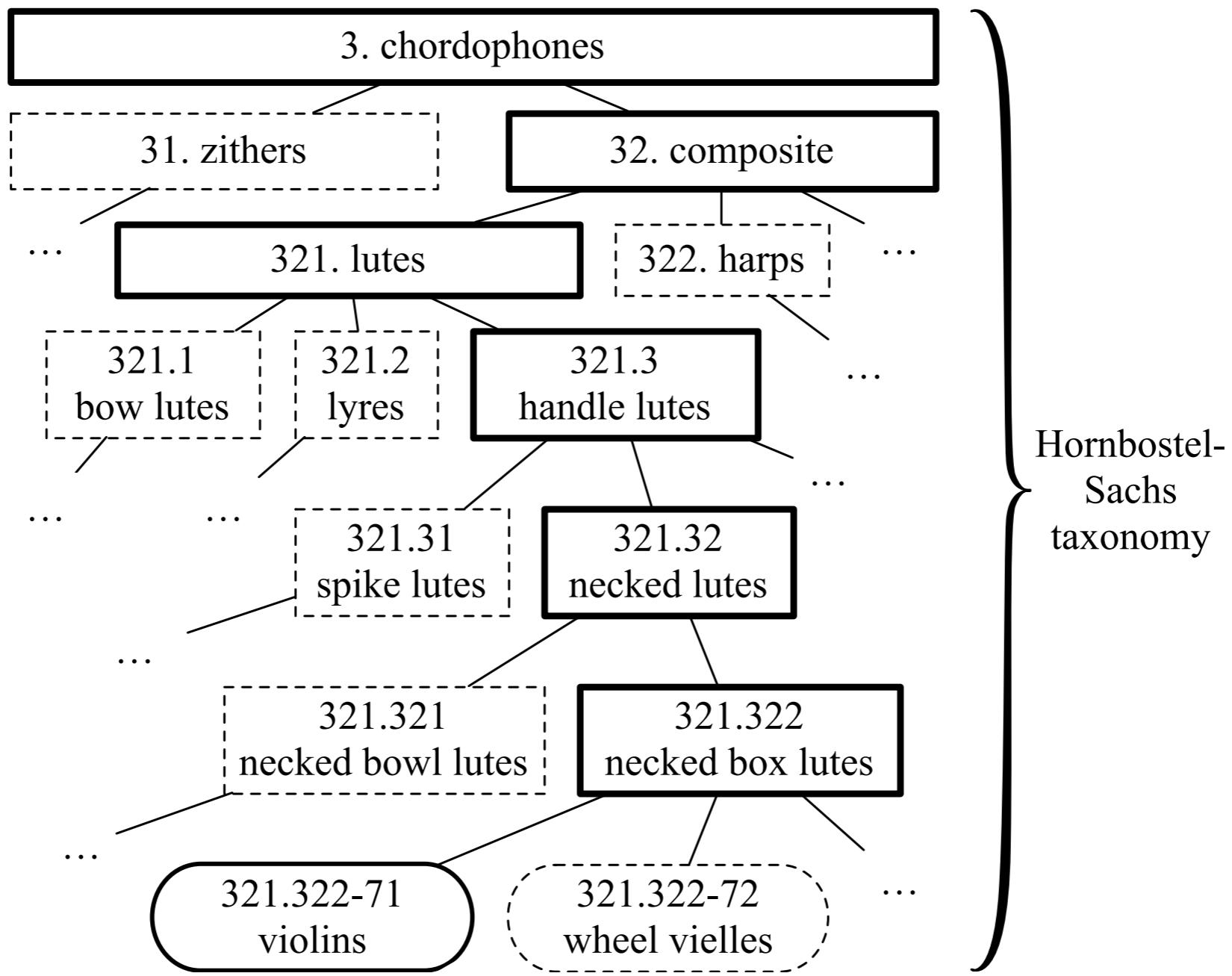


bass slap

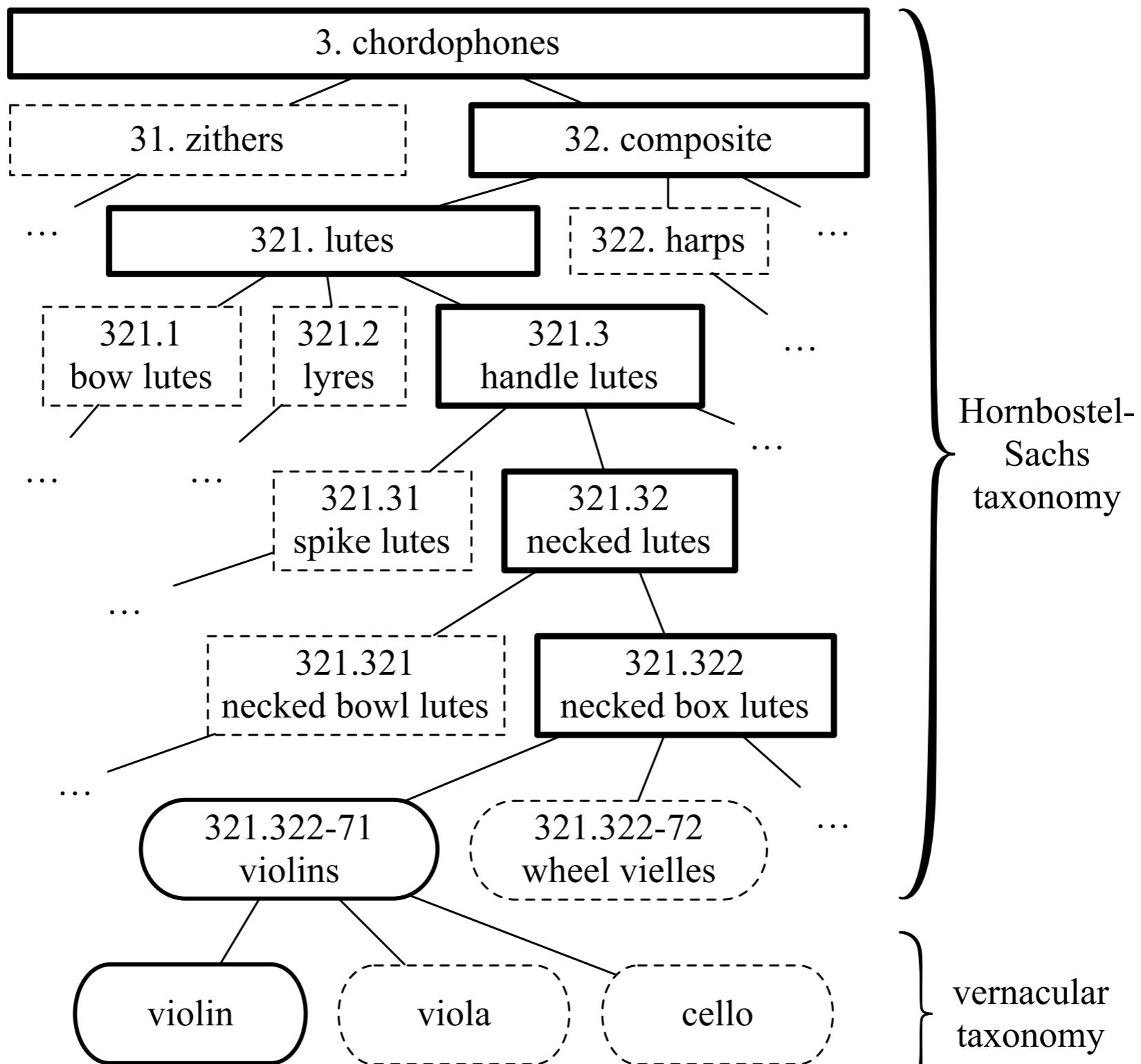


violin shuffle stroke



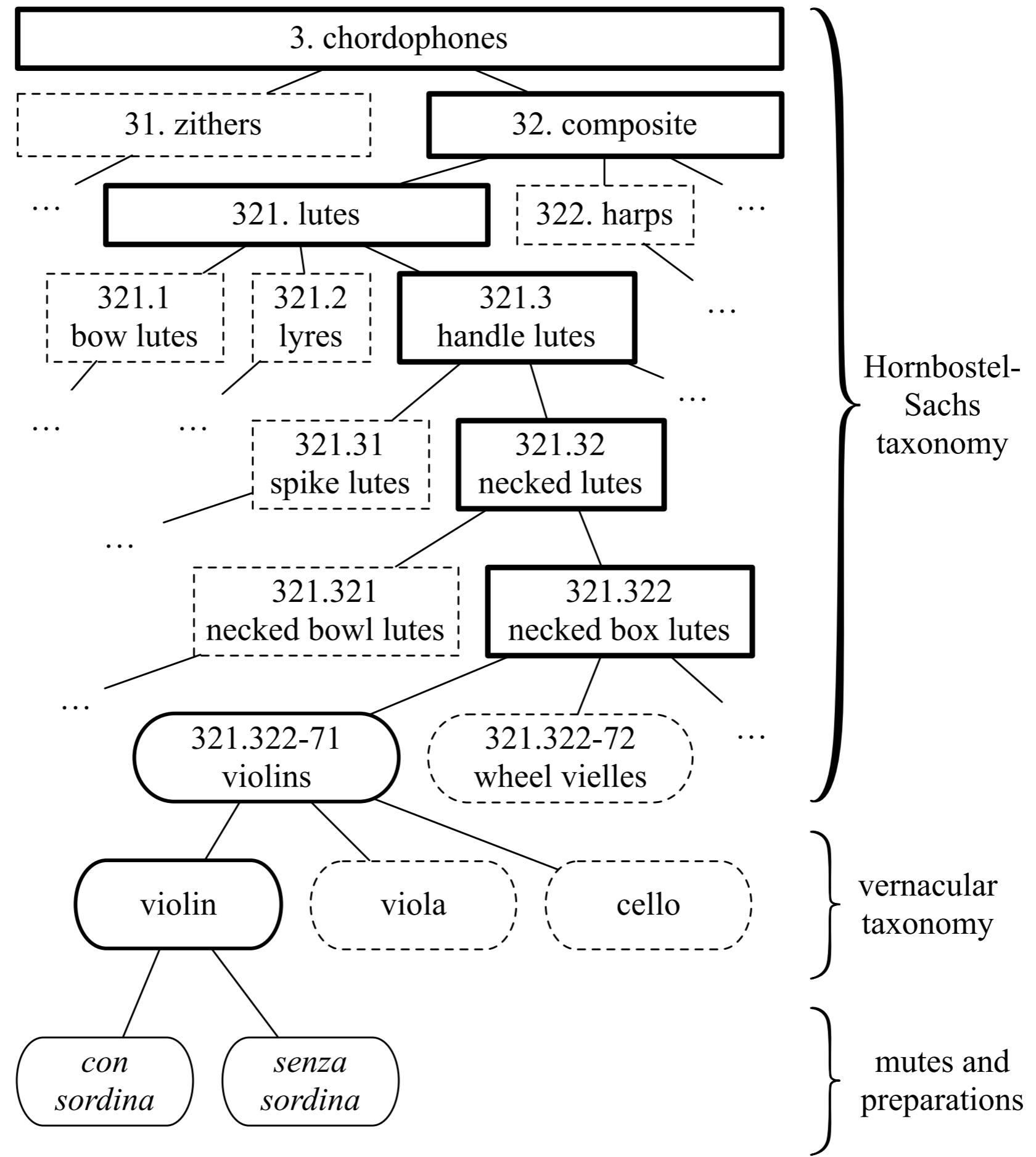


Hornbostel-
Sachs
taxonomy



Hornbostel-Sachs taxonomy

vernacular taxonomy



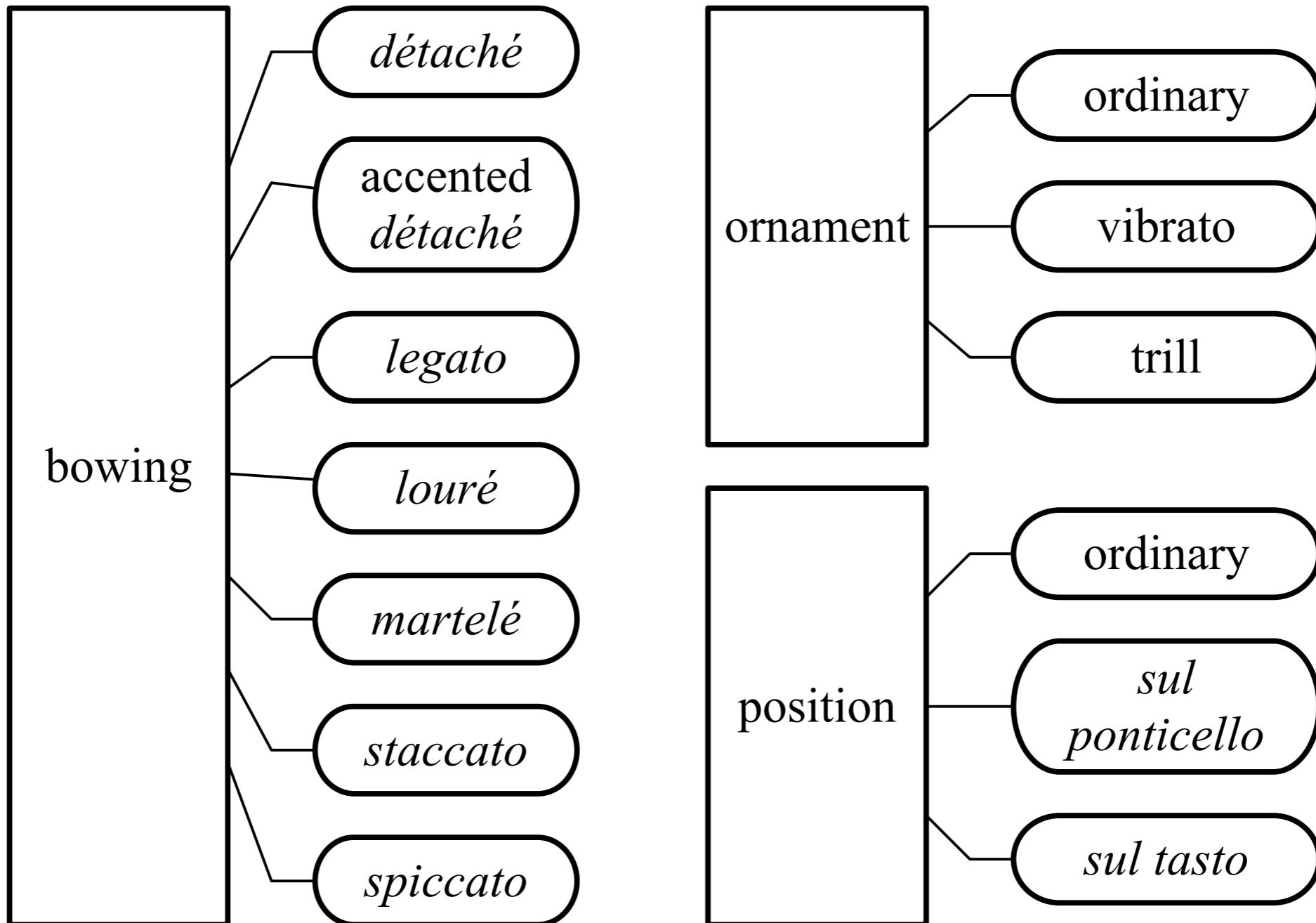
- Musical instruments, as inert objects, may abide to a **hierarchical taxonomy**.
- Yet, instrumental playing techniques form a loose **folksonomy of namespaces**.

An MIR appeal to musicological expertise:
How to reconcile organology and “chironomics”?

We (tentatively) formulate the problem as **query-by-example** similarity retrieval, with a precision@5 evaluation metric.

Example: namespaces of the violin

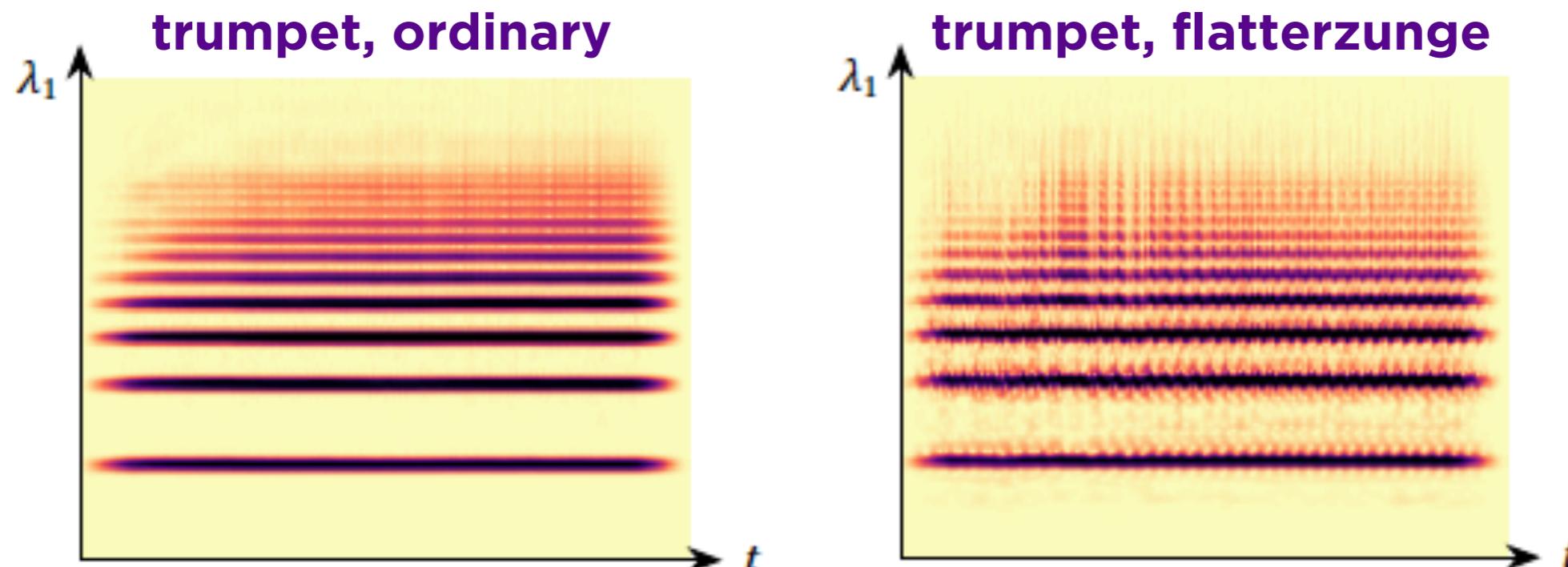
Some, but not all, of these labels are shared with other instruments.



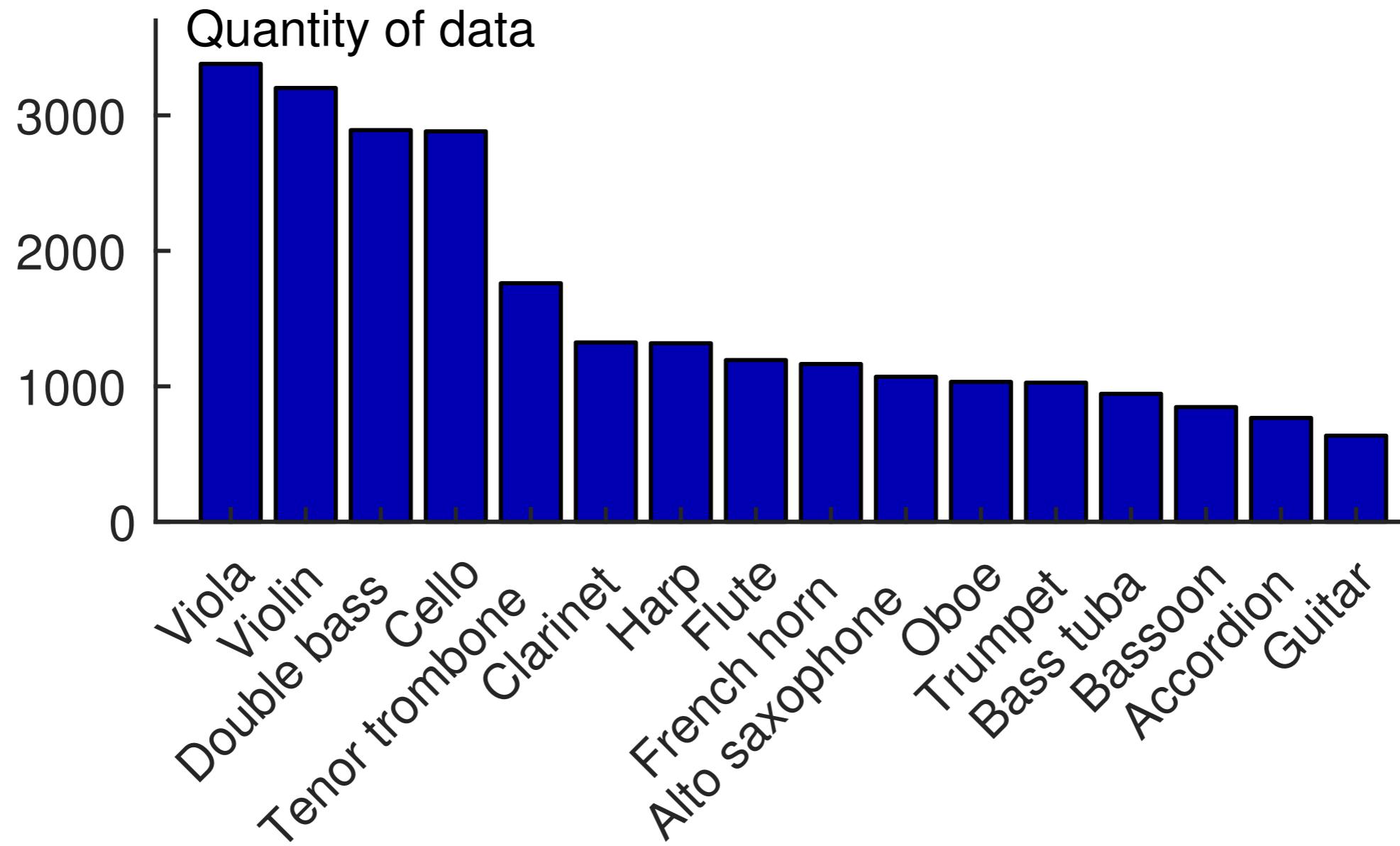
Why techniques are interesting

1. **Nonstationarity** (transientness):
spectral envelope changes through time,
hence a shortcoming of MFCC features.

2. **Long-range interactions** (*Gestalt*):
variability is not elastic in spectrogram domain,
hence a shortcoming of Euclidean distances.



Studio On Line dataset (SOL)



[Ircam 2000]

ordinario
non-vibrato
tremolo
flatterzunge
sforzando
crescendo
note-lasting
pizzicato-l-vib
glissando
decrescendo
pizzicato-secco
staccato
crescendo-to-decrescendo
ordinario-1q
trill-minor-second-up
trill-major-second-up
sul-ponticello
pizzicato-bartok
sul-tasto
sul-ponticello-tremolo
multiphonics
sul-tasto-tremolo
col-legno-battuto
col-legno-tratto
harmonic-fingering
bisbigliando
lip-glissando
artificial-harmonic
ordinario-to-flatterzunge
artificial-harmonic-tremolo
flatterzunge-to-ordinario
vibrato
crushed-to-ordinario
ordinario-to-sul-tasto
ordinario-to-crushed
slap-pitched
sul-ponticello-to-ordinario
sul-ponticello-to-sul-tasto
ordinario-to-tremolo
sul-tasto-to-ordinario
tremolo-to-ordinario
near-the-board
sul-tasto-to-sul-ponticello
ordinario-to-sul-ponticello
aeolian-and-ordinario
brassy
backwards
ordinario-high-register
brassy-to-ordinario
natural-harmonics-glissandi

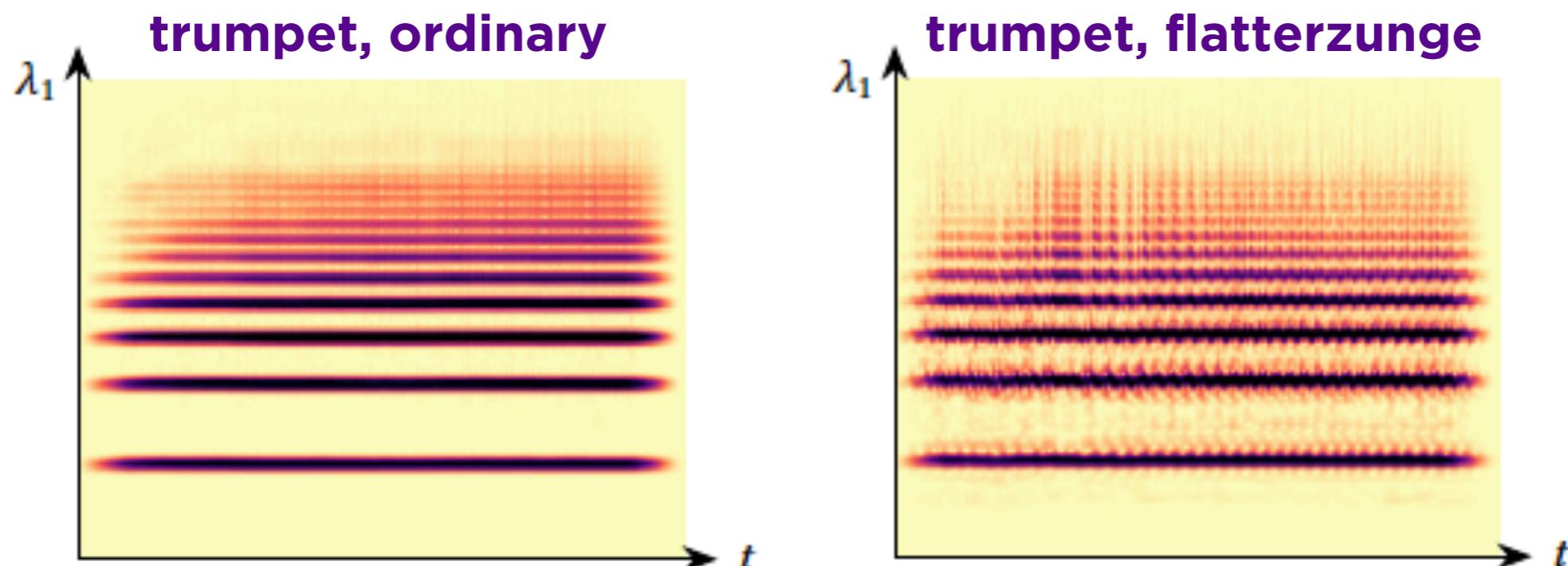
ordinario-to-brassy
discolored-fingering
near-the-pegs
pizzicato
damped
near-the-board-with-nail
key-click
move-bell-from-down-to-up
move-bell-from-left-to-right
glissando-with-stick
bisbigliando-with-stick
xylophonic
open-to-closed
ordinario-closed
ordinario-open
closed-to-open
combination-of-registers
dedillo
flatterzunge-open
pedal-tone
combination-of-registers-dbl
play-and-sing-unison
slide
open-to-stopped
aeolian
stopped-to-open
flatterzunge-stopped
glissando-with-throat
stopped
harmonic-in-wood
aeolian-to-ordinario
ordinario-to-aeolian
single-tonguing
flatterzunge-and-voice-unison
double-tonguing
flatterzunge-closed
play-and-sing-m2-up
half-valve-glissando
blow-without-reed
whistle-tones-sweeping
double-trill-minor-second-up
glissando-with-pedal
slap-unpitched
play-and-sing
play-and-sing-M7-up
play-and-sing-P5-up
play-and-sing-aug4-up
behind-the-bridge
hit-on-body
buzz

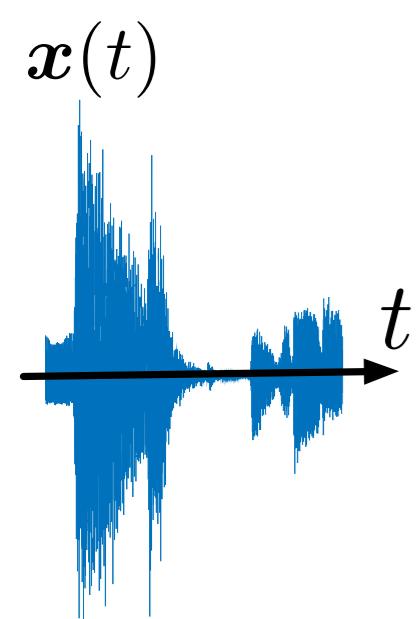
scratch-with-nail
tap-with-stick
on-the-tuning-pegs
tongue-ram
buzzing-pedal
exploding-slap-pitched
double-trill-major-second-up
flatterzunge-high-register
harmonics-glissando
kiss
ordinario-no-mouthpiece
whistle-tones
cluster
discolored-fingering-1q
tap-on-body
speak-into-instrument
bottleneck
cluster-with-nail
glissando-near-the-board
glissando-with-nail
behind-the-fingerboard
double-glissando
chromatic-scale
flatterzunge-no-mouthpiece
glissando-fluido-with-stick
on-the-bridge
on-the-tailpiece
play-and-sing-glissando
growl
on-the-frog
vocalize-on-harmonics
behind-the-frog
bellowshake
blow
breath
drum-effect
exploding-slap-unpitched
filtered-by-voice
glissando-embouchure
inhaled
jet-whistle
percussion-embouchure
tremolo-with-fingertips

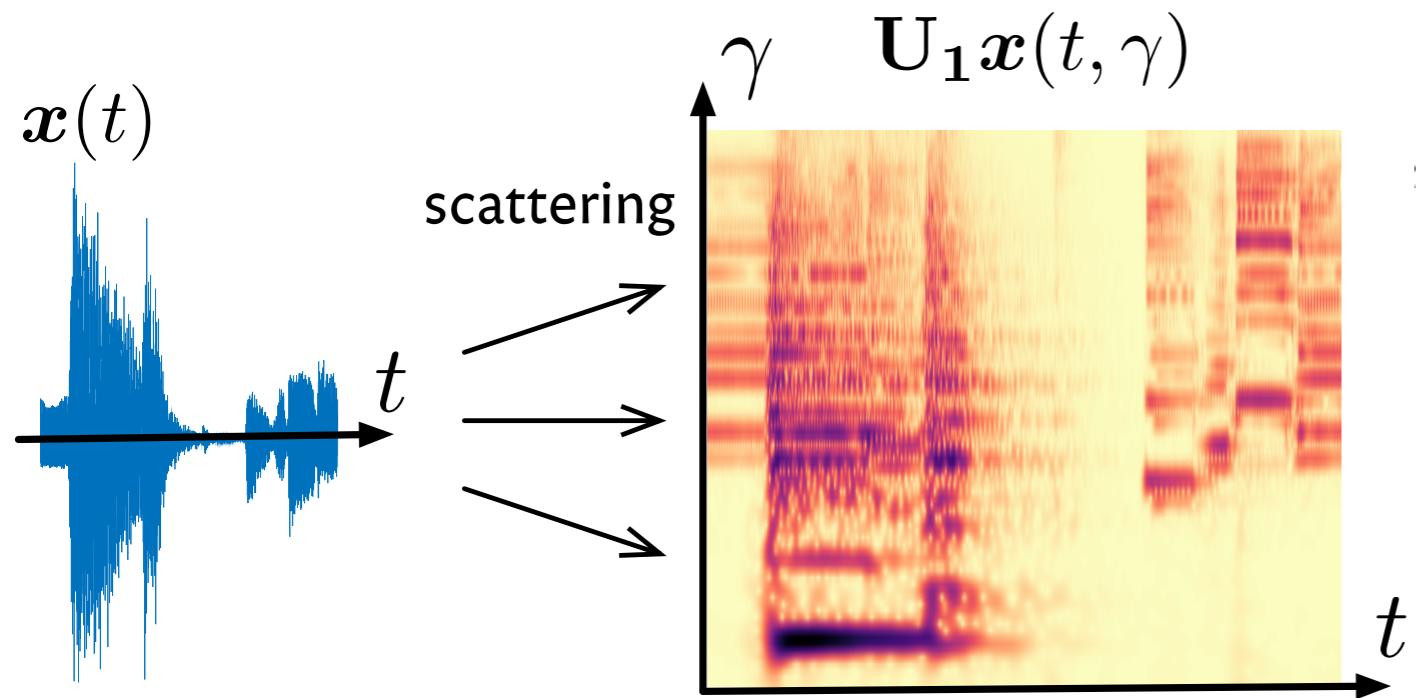
Contributions

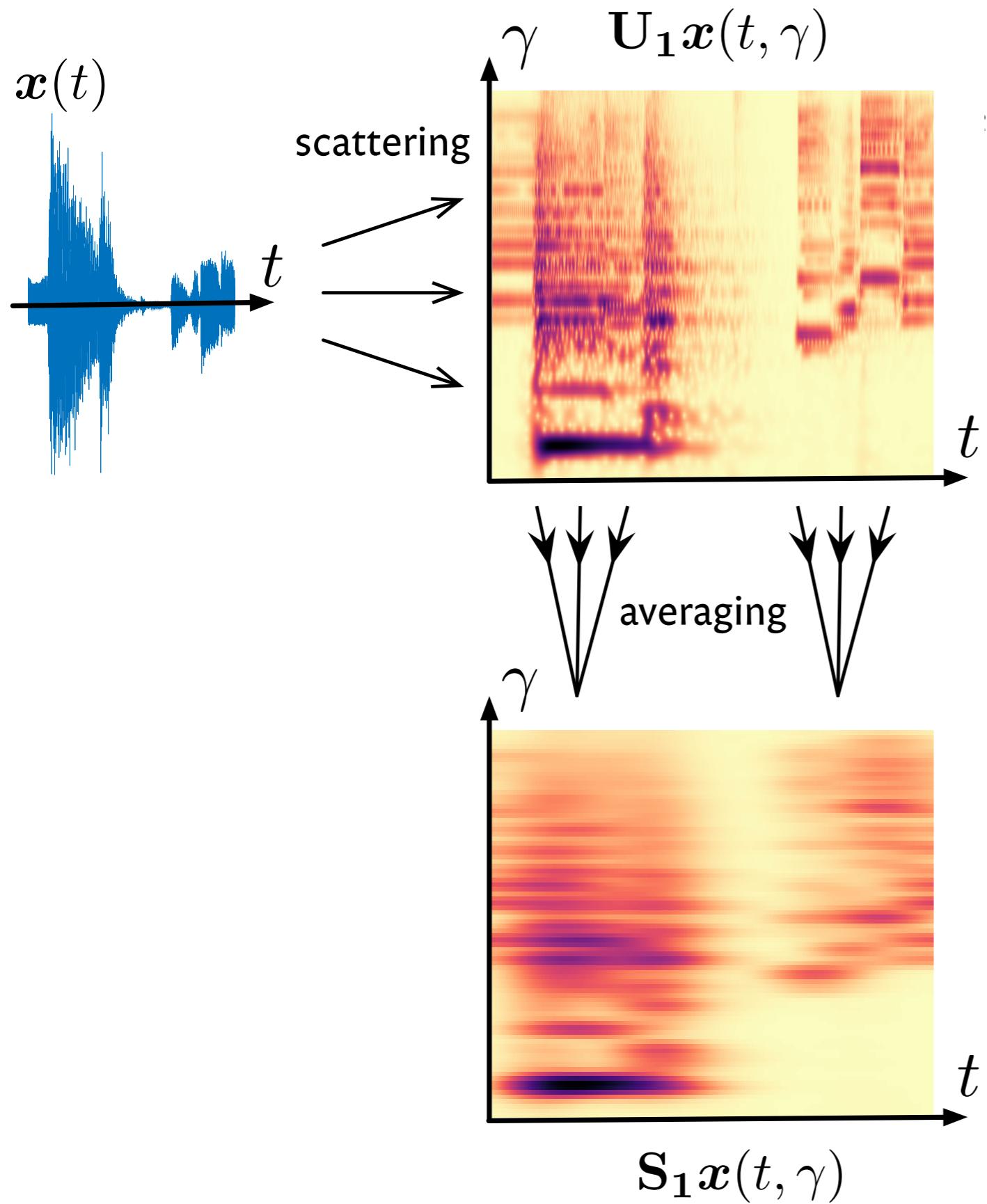
1. **Nonstationarity** (transientness):
replace MFCC by scattering transform.

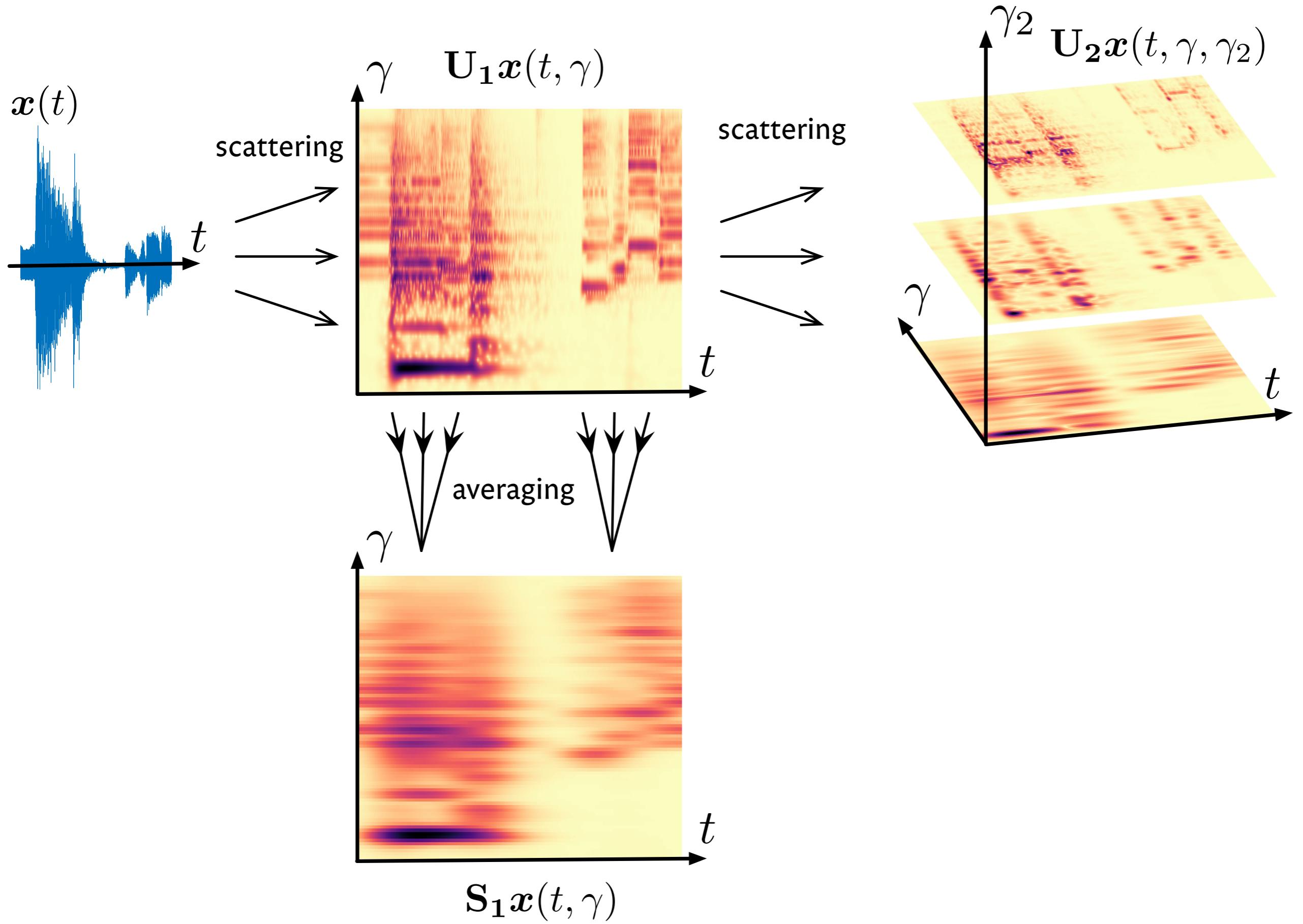
2. **Long-range interactions** (*Gestalt*):
replace Euclidean neighbors by metric learning.

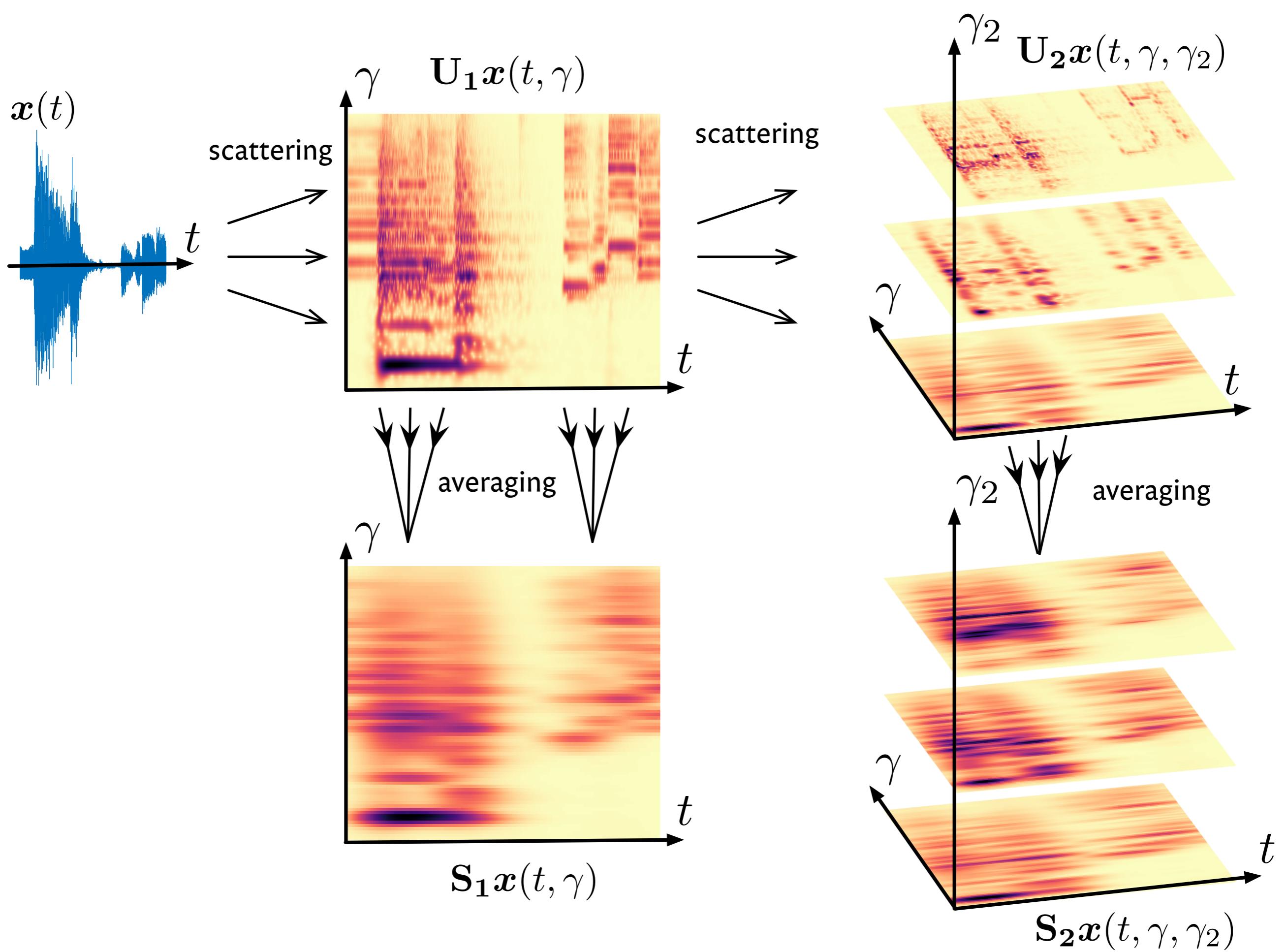










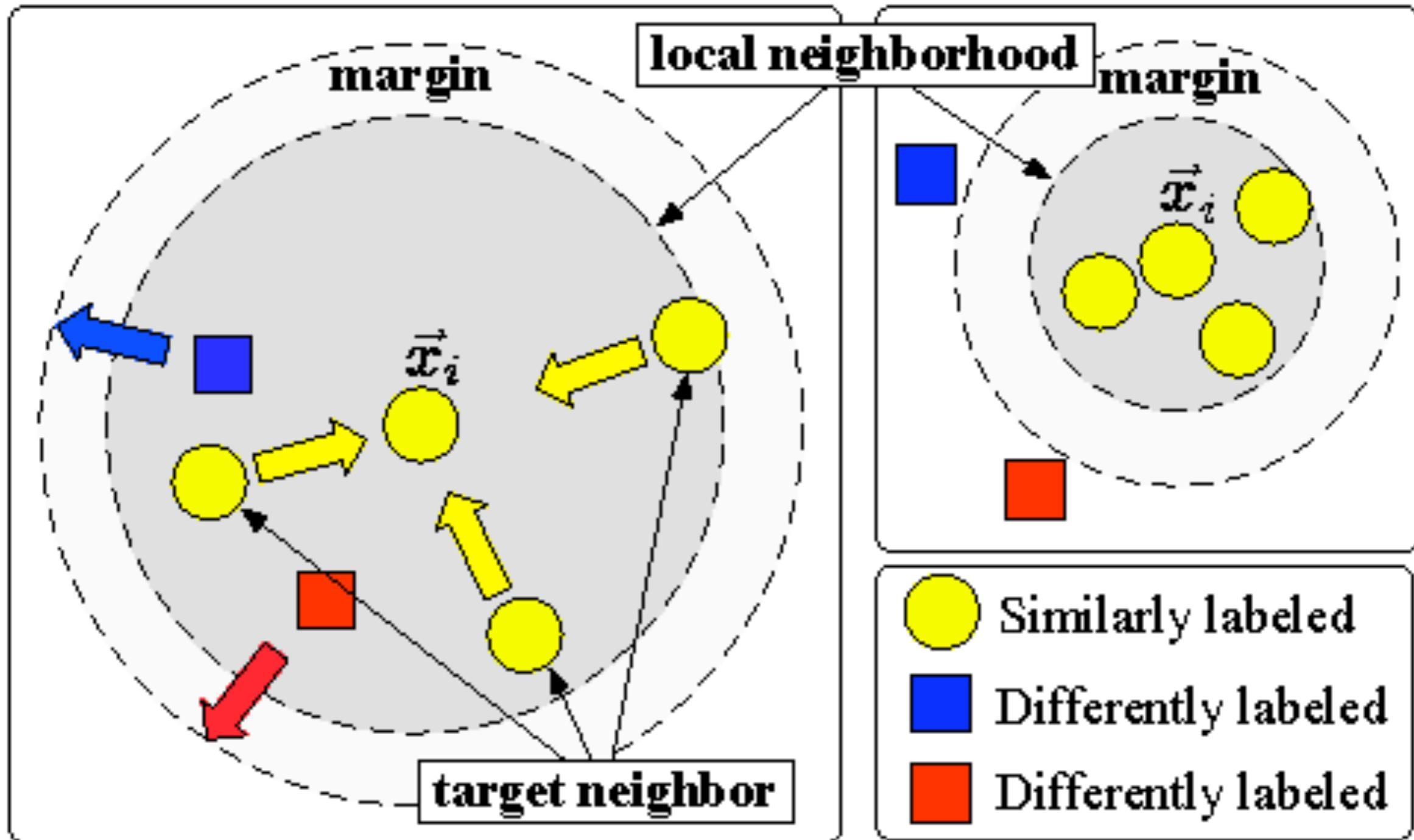


Large-margin nearest neighbors

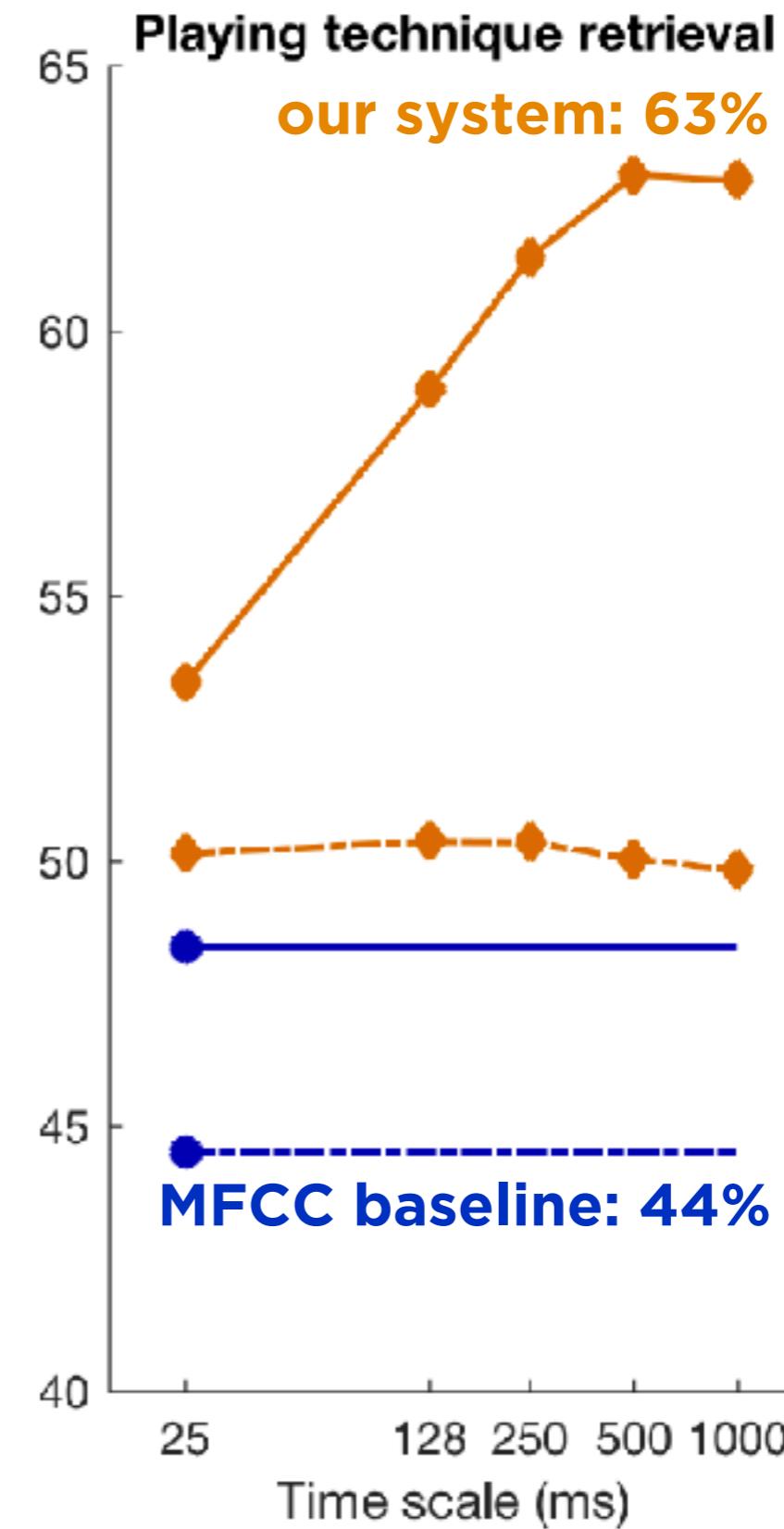
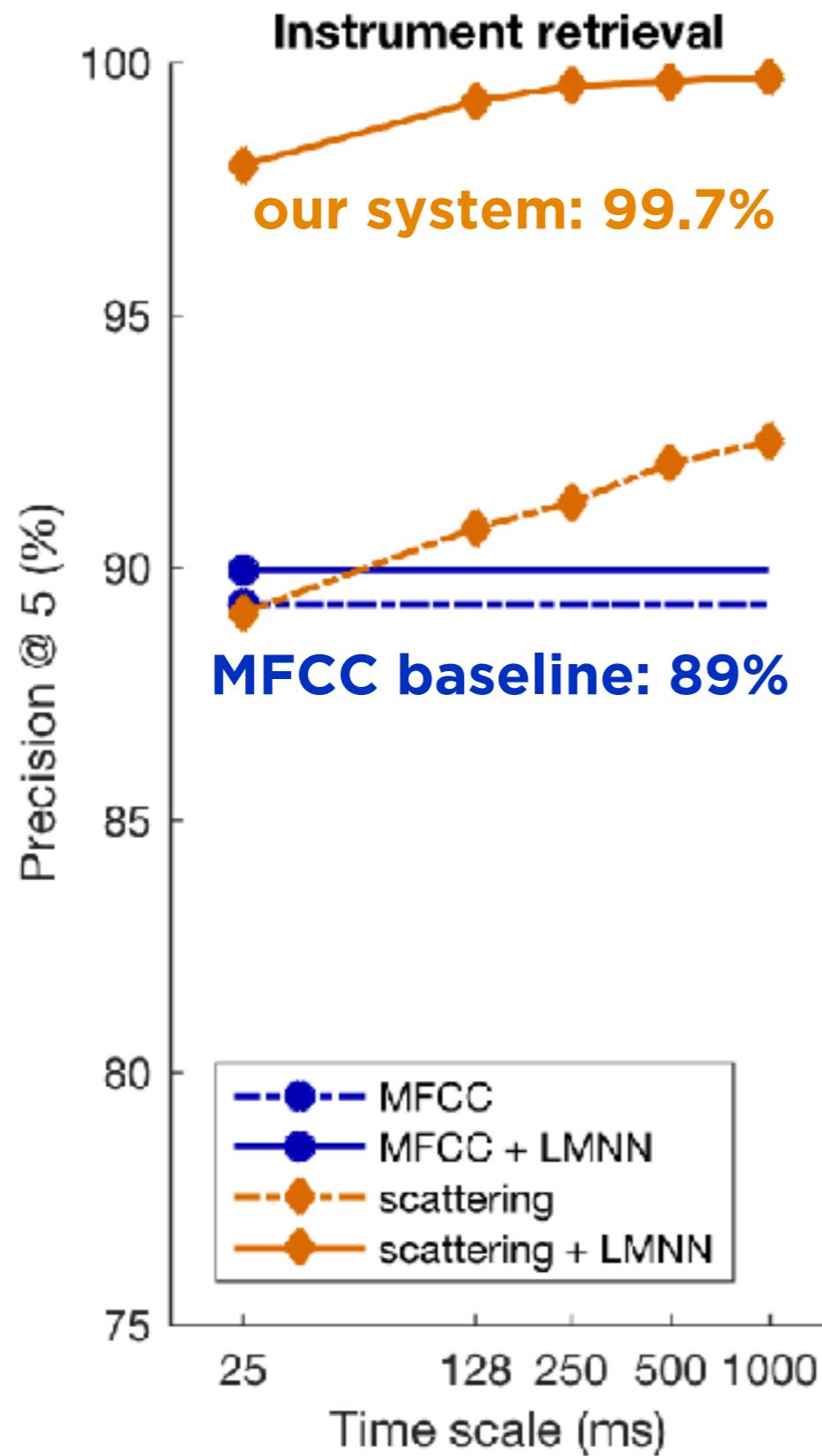
[Weinberger]

BEFORE

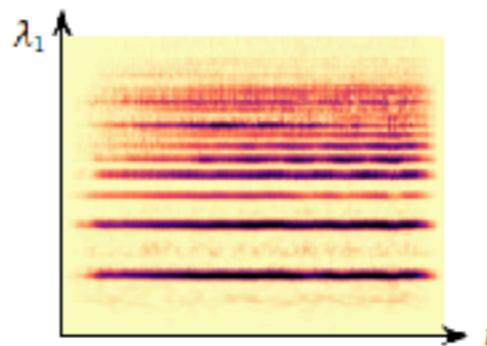
AFTER



Query-by-example results

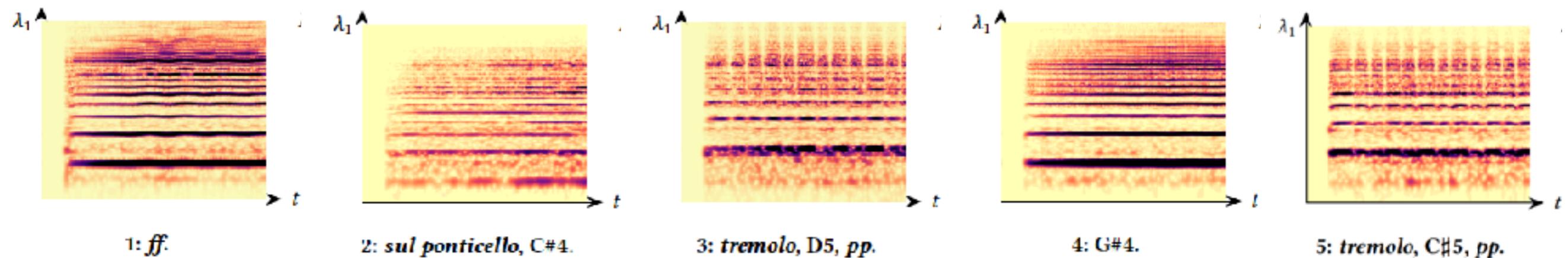


Demo: case of an ordinary query

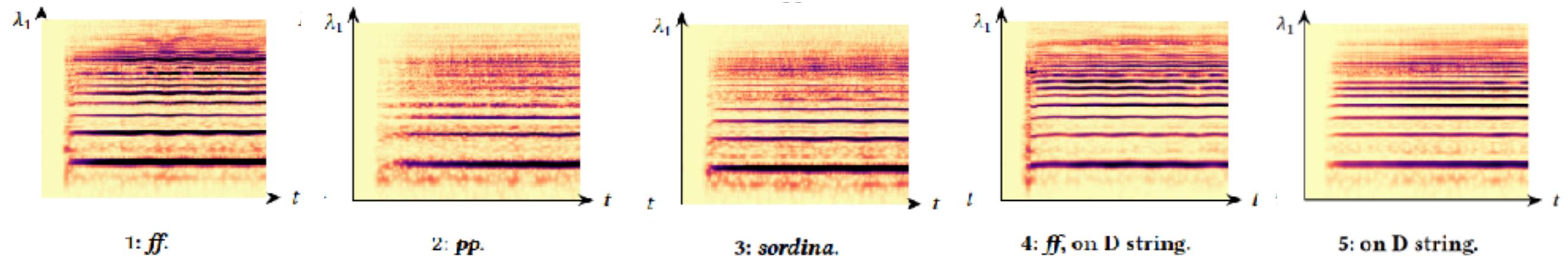


Query: Violin, *ordinario*, G4, *mf*, on G string.

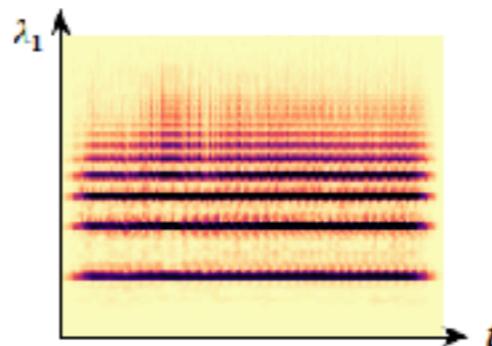
MFCC neighbors



scattering transform neighbors

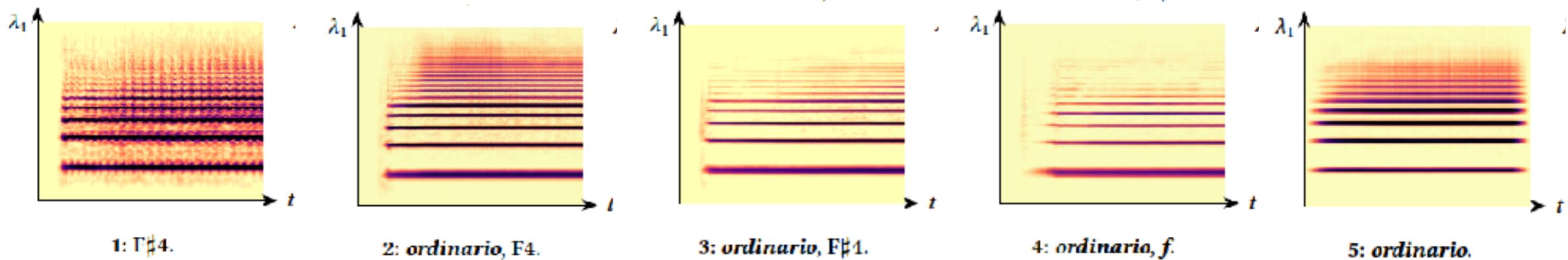


Demo: case of a flatterzunge query

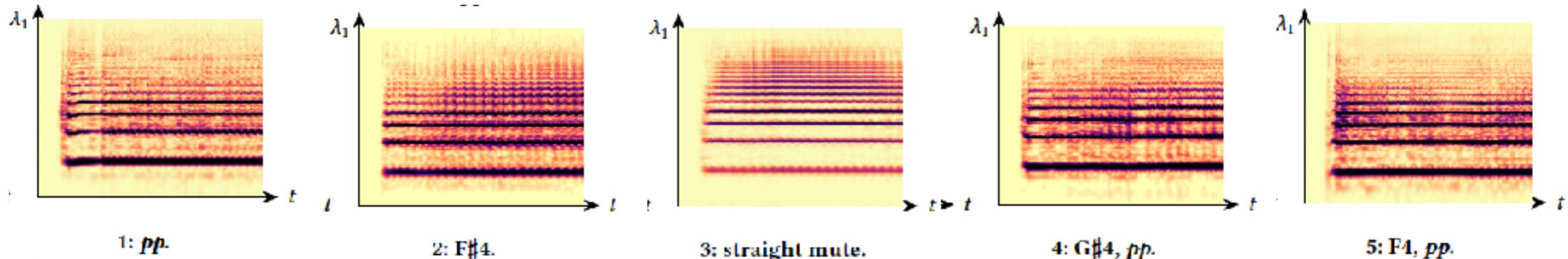


Query: Trumpet in C, *flatterzunge*, G4, *mf*.

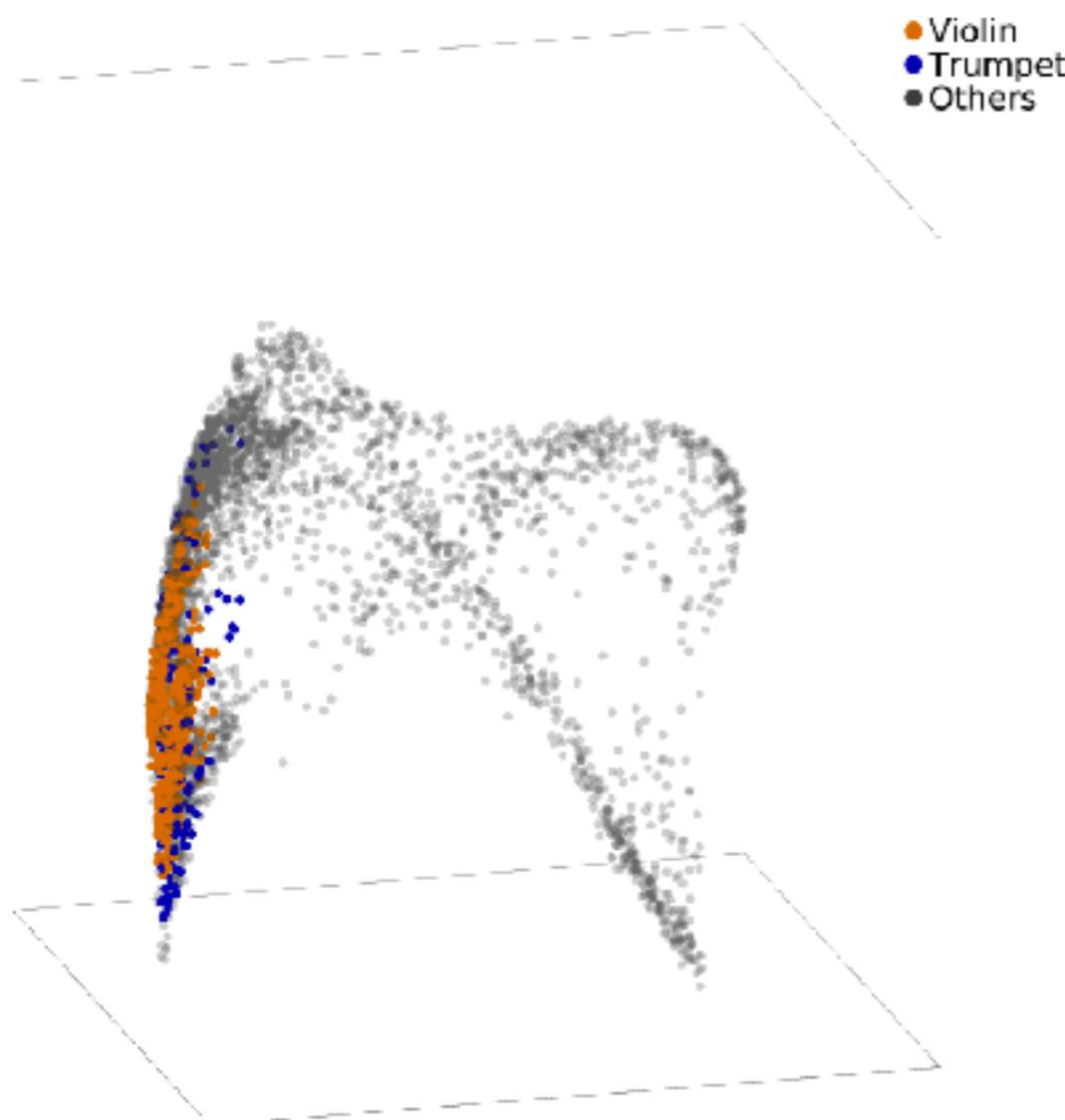
MFCC neighbors



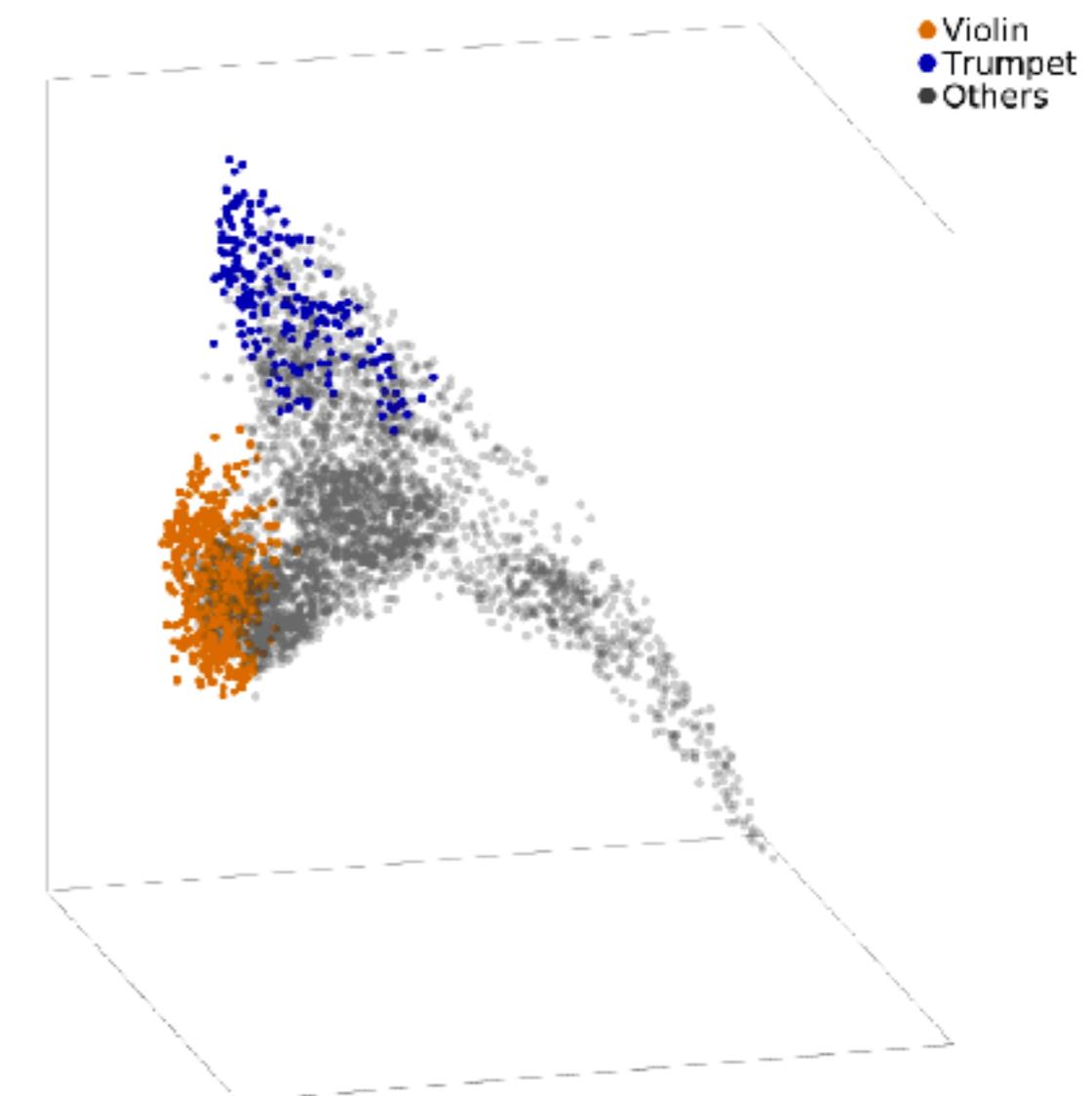
scattering transform neighbors



Isomap embedding

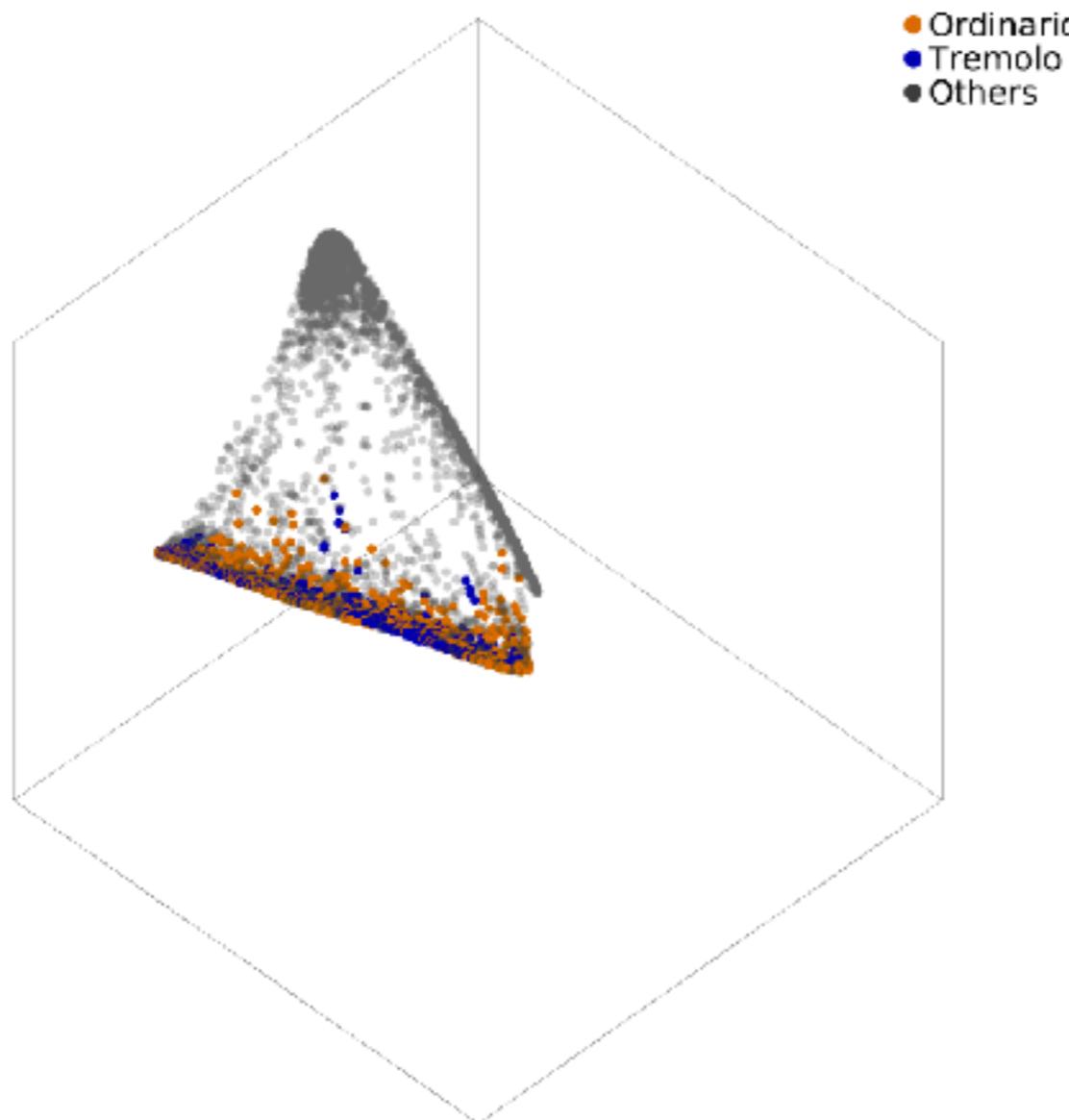


(a) Instrument embedding with MFCC.

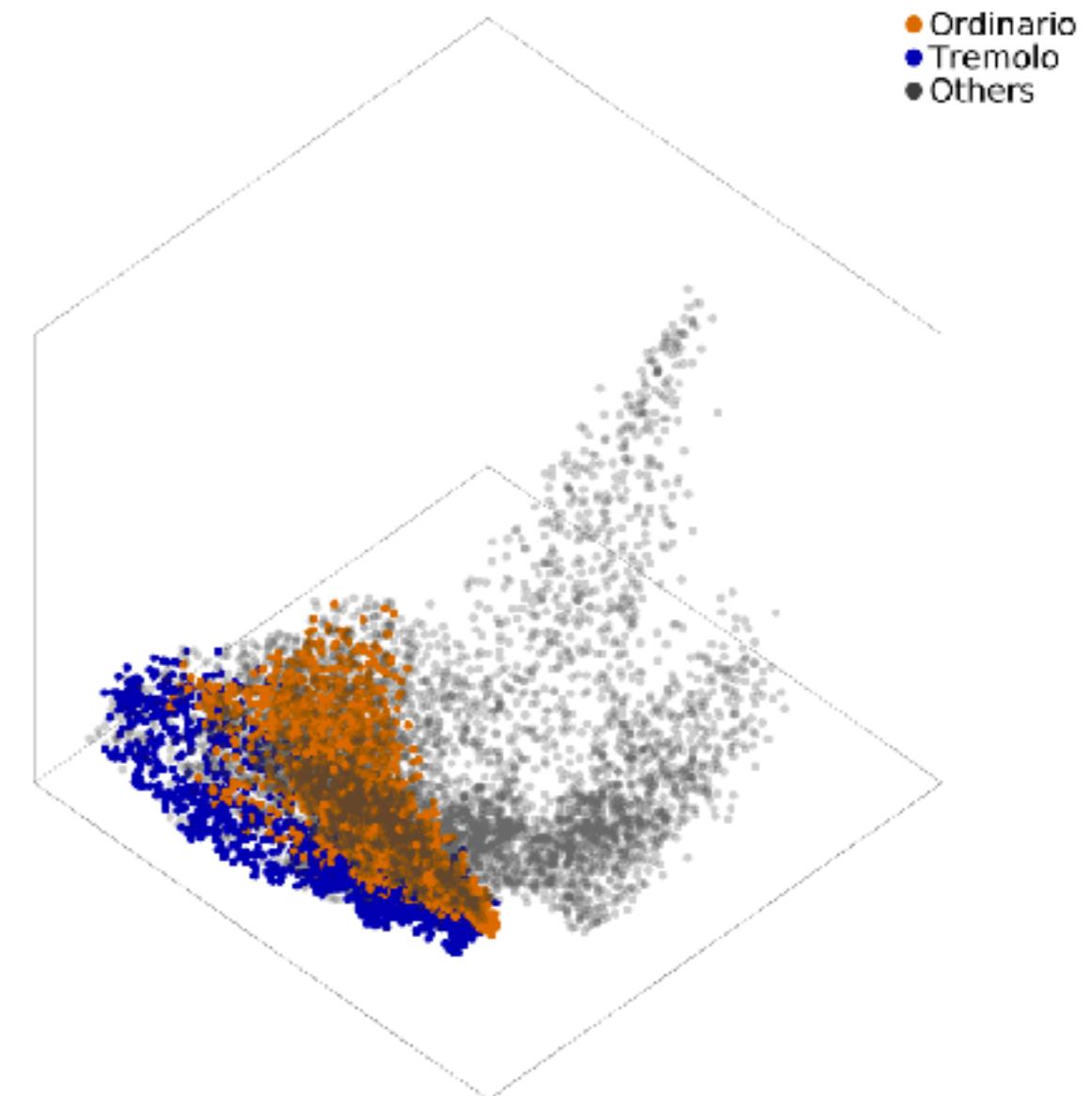


(b) Instrument embedding with scattering transform.

Isomap embedding



(c) Playing technique embedding with MFCC.



(d) Playing technique embedding with scattering transform.

Take-home message:
the timbral modeling of musical events
is **only “solved” for ordinary techniques**,
but is still challenging
for extended techniques

L'effet est plus important que les notes – Levinas

