Segmentation, Transcription, Analysis & Visualisation of the Norwegian Folk Music Archive

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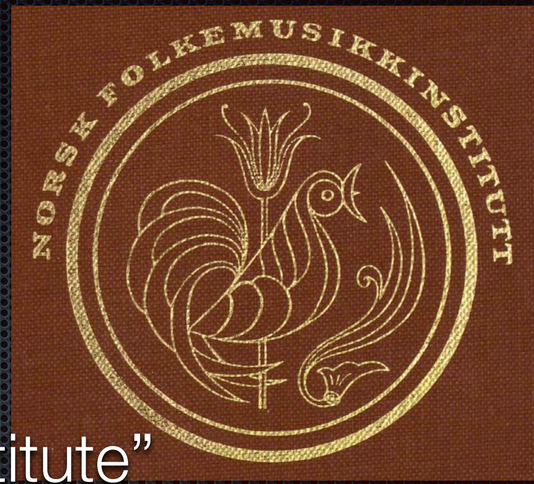
University of South-Eastern Norway
National Library of Norway

MIRAGE project

Overview

- Norwegian Collection of Folk Music
- Segmentation of tapes into tunes
- Automated transcription (in particular of Hardanger fiddle music)
- Music analysis and visualisation
- Dataset and software release

Norwegian Collection of Folk Music



- Founded in 1951 by Olav Gurvin as “Norwegian Folk Music Institute”
- Audio recordings. For sound analysis initially
- Solo performances: singing, fiddle, Hardanger fiddle, langeleik, etc.
- By 1970, 1327 reel-to-reel tapes, ca. 750 hours of music
- Now at the National Library of Music, accessible online via FIOL interface
- Metadata indicates tunes titles, performers’ names, instruments, style, …
  As well as imprecise temporal localisation within tapes.

Fiol & Webbfiol
Hämta programvaran
Beställ FIOL AV 5
Systemkrav FIOL AV 5.2.2
Priser
Support

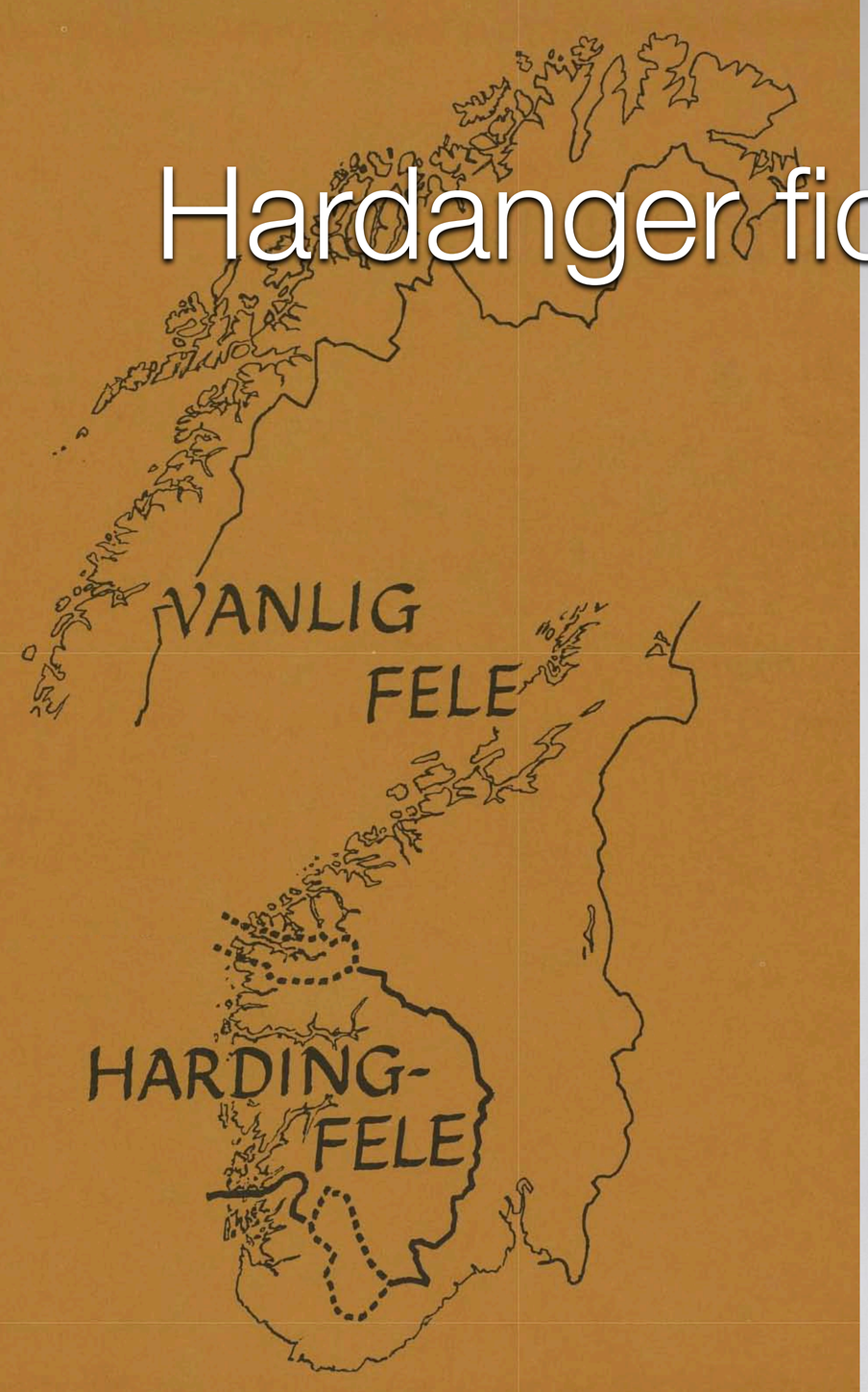
FIOL – ETT AUDIOVISUELLT ARKIVSYSTEM FÖR MUSIK OCH DANS

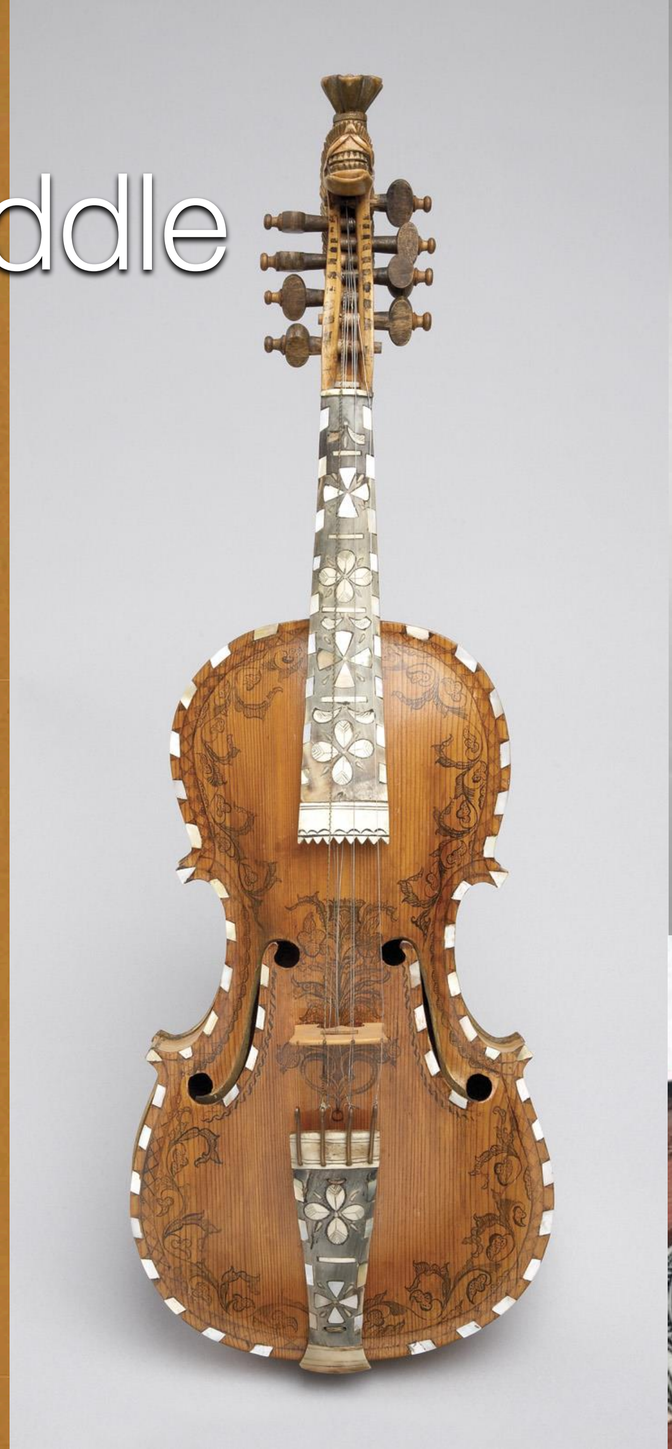
Folkmusikens hus utvecklar sedan 2003 applikationer för folkmusik- och dansarkiv. FIOL AV 5 med den integrerade webbdatabasen WebbFIOL är idag det mest brukade arkivsystemet bland folkmusik- och dansarkiv i Norden.

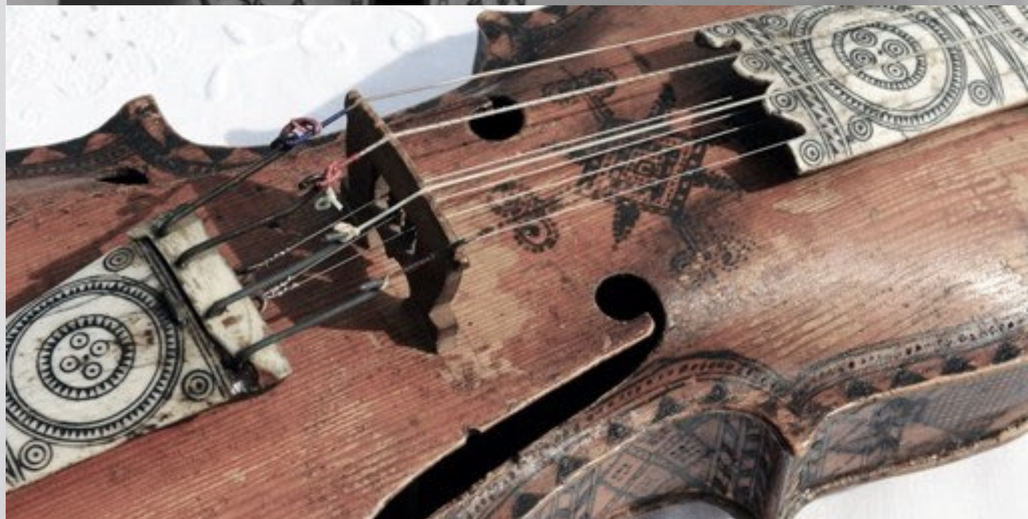
FIOL AV 5

FIOL AV 5 är ett audiovisuellt arkivsystem, speciellt utvecklat för folkmusik- och dansarkiv. Systemet möjliggör presentation av ljudinspelningar, video och arkivhandlingar direkt i datorn genom en koppling mellan en textdatabas och lagringsenheter för digitalt ljud, bild och video. Systemet har sitt ursprung i norsk folkmusik- och dansarkivmiljö. 2003 övertogs utvecklingsarbetet av Folkmusikens hus från Norsk Folkemusikksamling, Oslo universitet. Idag används systemet av ett tjugotal användare, de flesta i Norge men även i Sverige, och Finland.

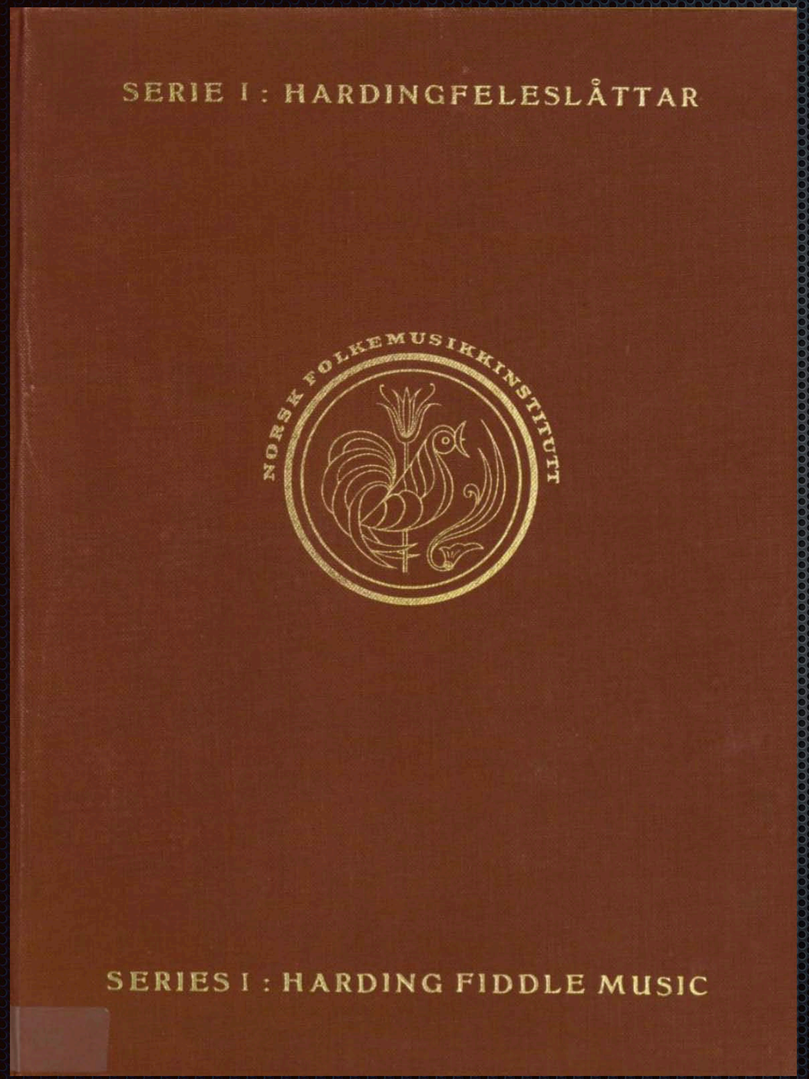
Hardanger fiddle







Norwegian Folk Music Volumes

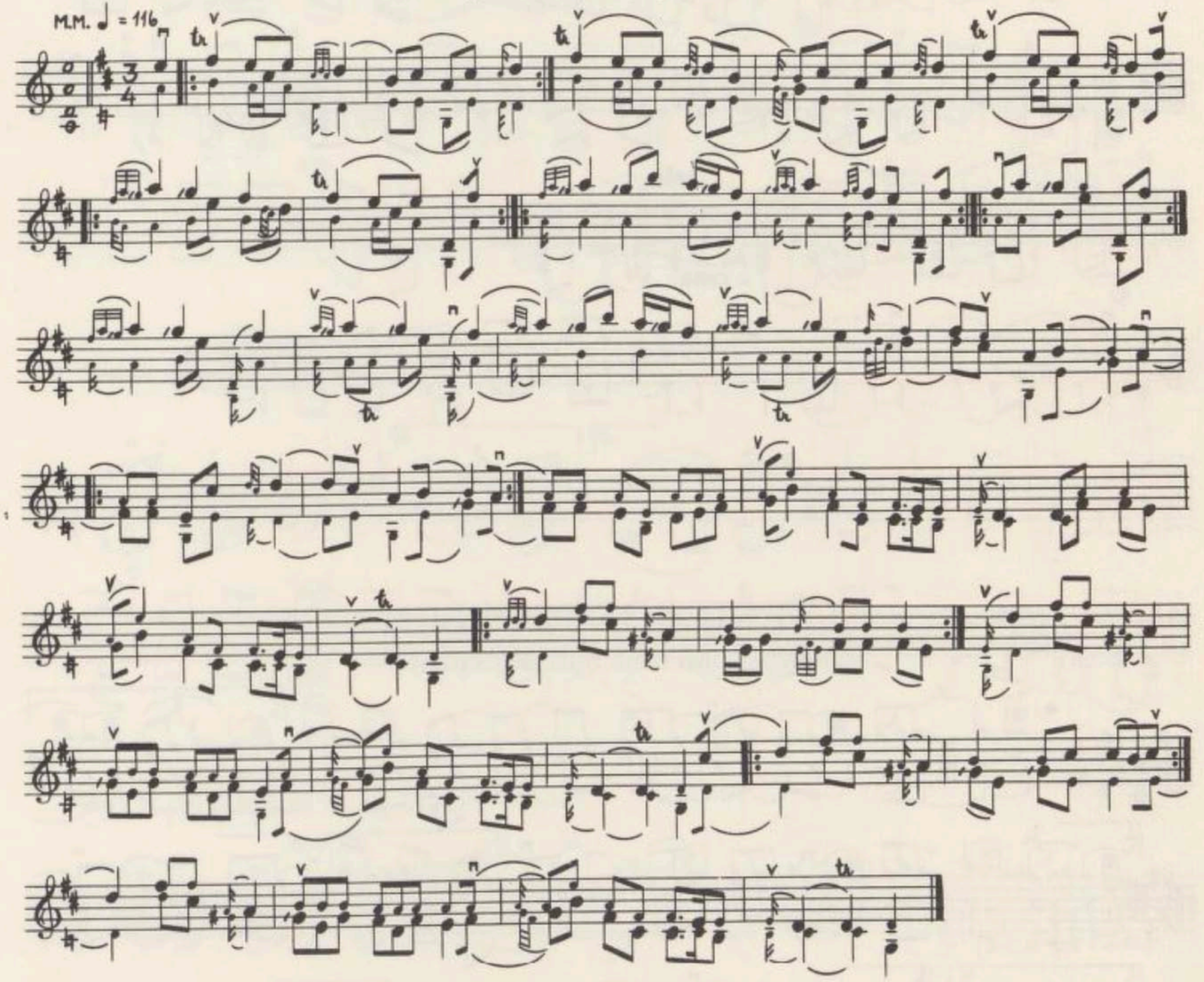


- Olav Gurvin, Serie 1, Hardanger fiddle, Vol. I–V, 1958–67
- Blom, Nyhus and Sevåg, Serie 1, Vol. VI-VII, 1977–81
- Sevåg, Sæta et al., Serie 2, Normal fiddle, Vol. I–V, 1992–2012

457b

FOSSEKALLEN

Etter Steingrim Haukjem, Veggli, Numedal. (N)



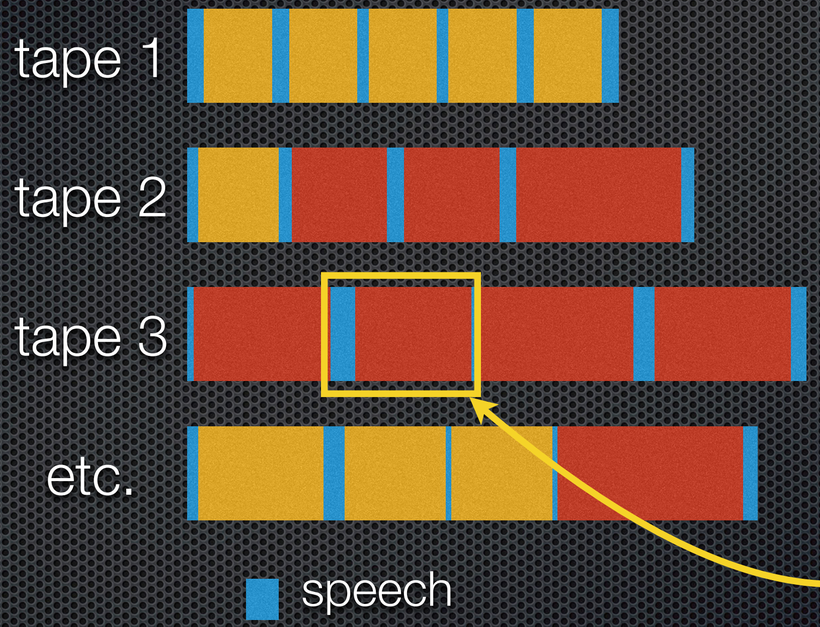
Serie 1,
Vol. VI,
1979

Norwegian Folk Music Browser

- Online music catalogue, easily accessible
- Public domain: recordings from years 1953–1968: 600 tapes, 750 hours
- Automated music transcription → score, aligned to audio
- Augmented music playback through visualisation and sonification
- Music analysis: structure, mode, motifs, form, etc. Intertextual analysis.
- Browsing within catalogue guided by analytical visualisations

Segmenting tapes into tunes

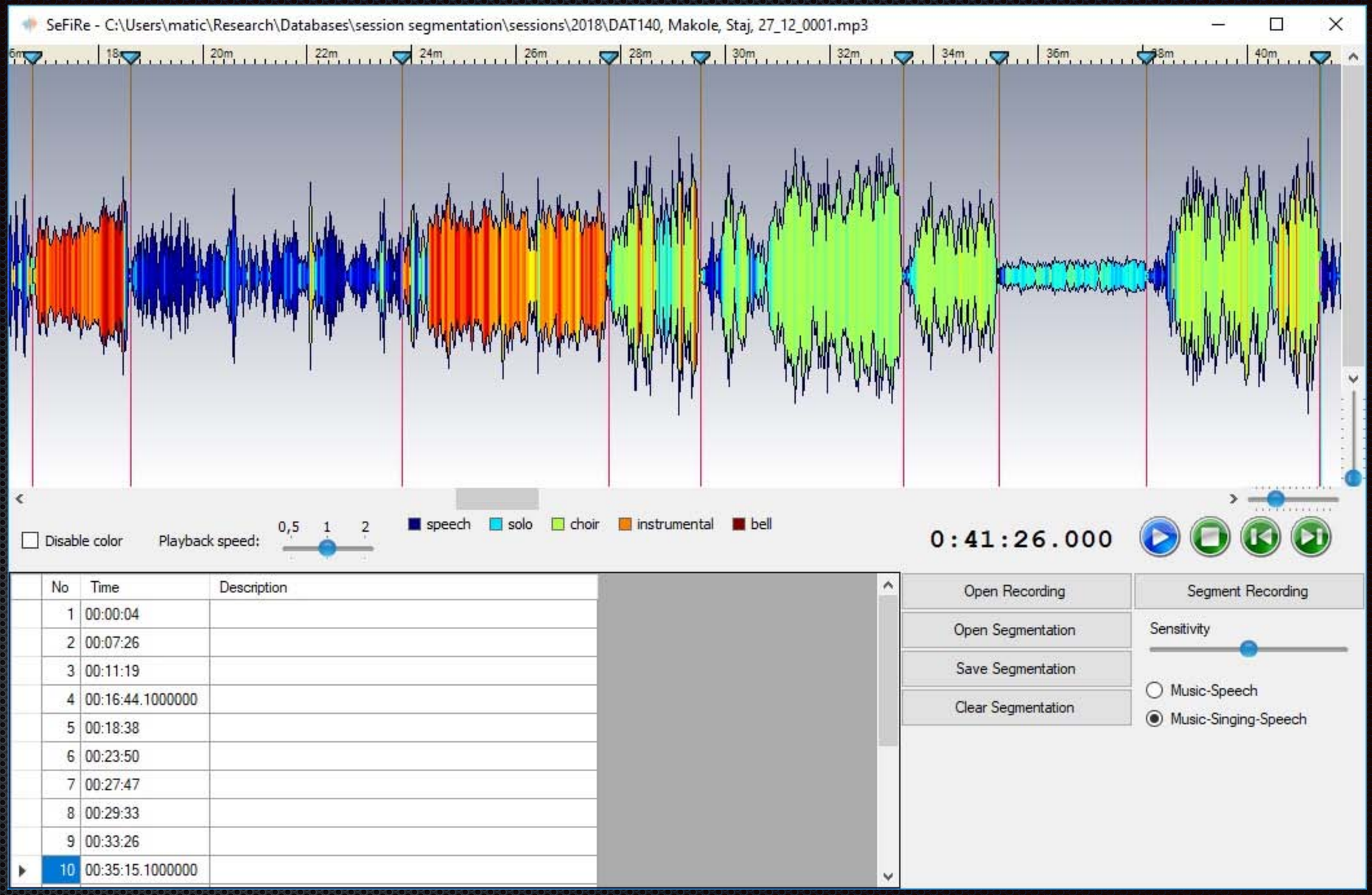
- 343 recordings (1 to 2 hours each)
- Each recording a concatenation of tunes



Metadata: for each tune:

- title, genre, region
- instrument, performer, date
- approx. location in recordings
- etc.

SeFiRe



Marolt et al., “Automatic Segmentation of Ethnomusicological Field Recordings”, *Applied Sciences* 2019, 9, 439

Apple Sound Classification

300 sound classes

dog
music
wind
wind rustling leaves
plucked string instrument
wind noise microphone
guitar
thunderstorm
whistling
electric guitar
dog bark
thunder
bass guitar
water
rain
acoustic guitar
finger snapping
raindrop
steel guitar slide guitar
dog howl
stream burbling
guitar tapping
waterfall
clapping
guitar strum
ocean
sea waves
banjo
dog bow wow
gurgling
sitar
cheering
fire
mandolin
fire crackle

zither
bell
dog growl
church bell
applause
[illegible]
bicycle bell
keyboard musical
cowbell
piano
tuning fork
booing
[illegible]
electric piano
chime
wind chime
organ
boat water vehicle
electronic organ
chatter
car horn
hammond organ
cat
power windows
synthesizer
vehicle skidding
crowd
car passing by
harpsichord
race car
percussion
cat purr
truck
drum kit
air horn
babble
drum
reverse beeps
bus

snare drum
cat meow
emergency vehicle
speech
bass drum
police siren
[illegible]
timpani
ambulance siren
tabla
fire engine siren
child speech
horse clip clop
motorcycle
cymbal
traffic noise
hi hat
rail transport
tambourine
shout
train
horse neigh
rattle instrument
train whistle
train horn
gong
railroad car
yell
mallet percussion
train wheels squealing
marimba
xylophone
cow moo
subway metro
glockenspiel
aircraft
battle cry
helicopter
vibraphone

airplane
steelpan
pig oink
bicycle
children shouting
brass instrument
[illegible]
[illegible]
french horn
engine
lawn mower
trumpet
sheep bleat
screaming
chainsaw
trombone
engine knocking
bowed string instrument
engine starting
violin fiddle
engine idling
whispering
fowl
engine accelerating revving
cello
telephone
double bass
telephone bell ringing
laughter
wind instrument
ringtone
chicken
flute
alarm clock
siren
saxophone
baby laughter

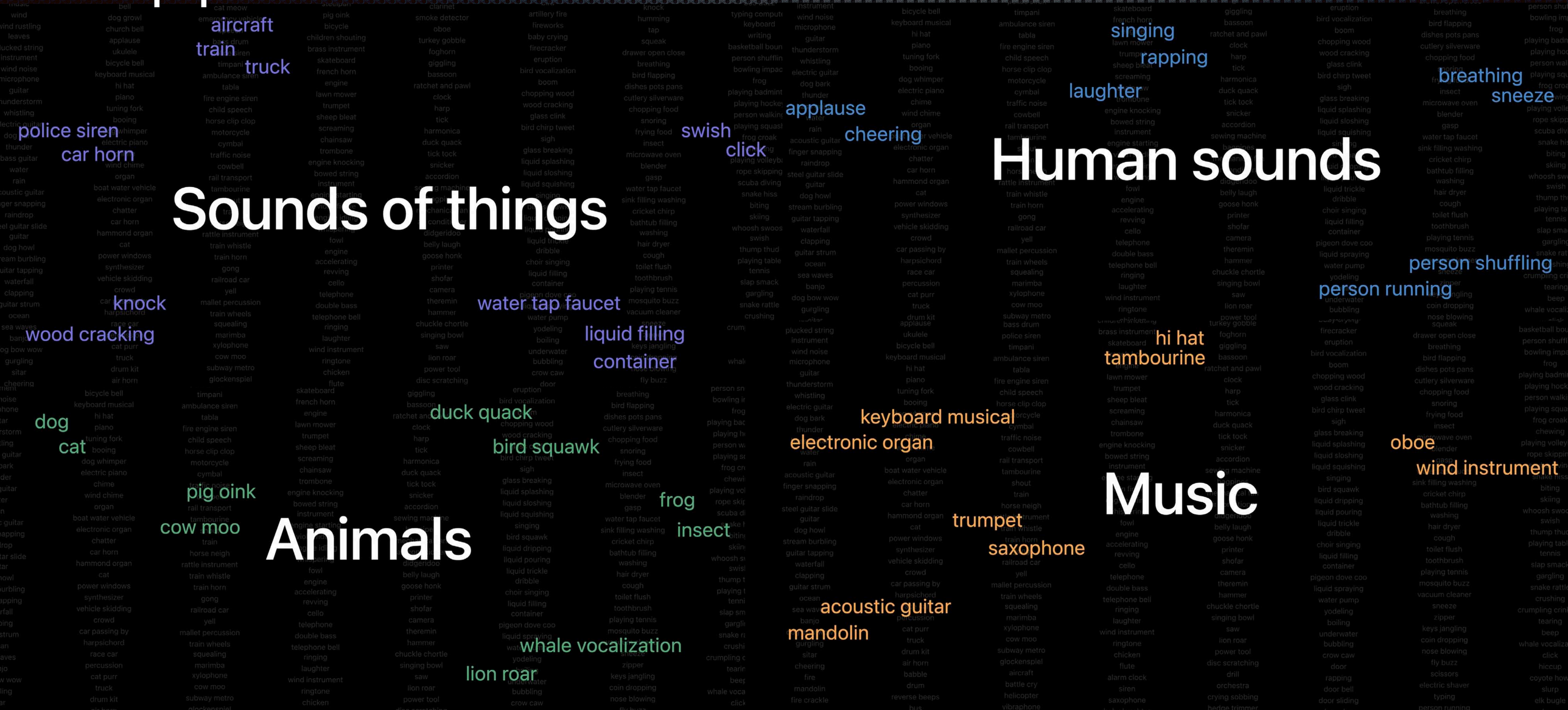
civil defense siren
clarinet
smoke detector
oboe
turkey gobble
foghorn
[illegible]
bassoon
ratchet and pawl
clock
harp
tick
harmonica
duck quack
tick tock
snicker
accordion
sewing machine
bagpipes
mechanical fan
air conditioner
didgeridoo
belly laugh
goose honk
printer
shofar
camera
theremin
hammer
chuckle chortle
singing bowl
saw
lion roar
power tool
disc scratching
drill
orchestra
crying sobbing
hedge trimmer

gunshot gunfire
bird
artillery fire
fireworks
baby crying
firecracker
eruption
bird vocalization
boom
chopping wood
wood cracking
glass clink
bird chirp tweet
sigh
glass breaking
liquid splashing
liquid sloshing
liquid squishing
singing
bird squawk
liquid dripping
liquid pouring
liquid trickle dribble
choir singing
liquid filling container
pigeon dove coo
liquid spraying
water pump
yodeling
boiling
underwater bubbling
crow caw
door
rapping
door bell
door sliding
door slam

owl hoot
knock
humming
tap
squeak
drawer open close
breathing
bird flapping
dishes pots pans
cutlery silverware
chopping food
snoring
frying food
insect
microwave oven
blender
gasp
water tap faucet
sink filling washing
cricket chirp
bathtub filling washing
hair dryer
cough
toilet flush
toothbrush
playing tennis
mosquito buzz
vacuum cleaner
sneeze
zipper
keys jangling
coin dropping
nose blowing
fly buzz
scissors
electric shaver
typing
person running

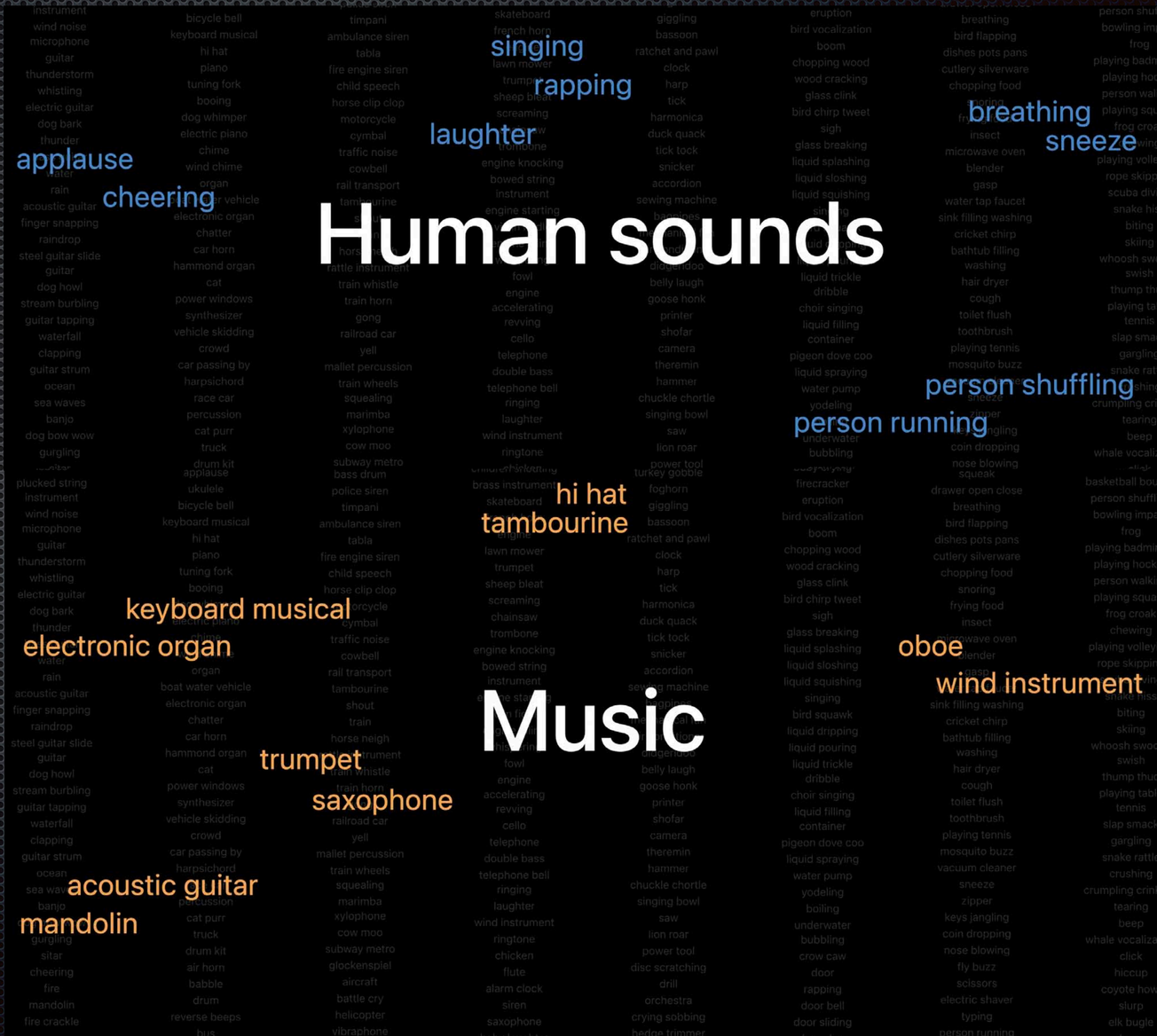
typewriter
bee buzz
typing computer keyboard
writing
basketball bounce
person shuffling
bowling impact
frog
playing badminton
playing hockey
person walking
playing squash
frog croak
chewing
playing volleyball
rope skipping
scuba diving
snake hiss
biting
skiing
whoosh swoosh swish
thump thud
playing table tennis
slap smack
gargling
snake rattle
crushing
crumpling crinkling
tearing
beep
whale vocalization
click
hiccup
coyote howl
slurp
elk bugle
burp

Apple Sound Classification



Apple Sound Classification

- Classes: speech, music, singing, bowing instrument, violin/fiddle
- on a moving window of duration 1.5 seconds
- with a step of 0.75 seconds



AudioSegmentor

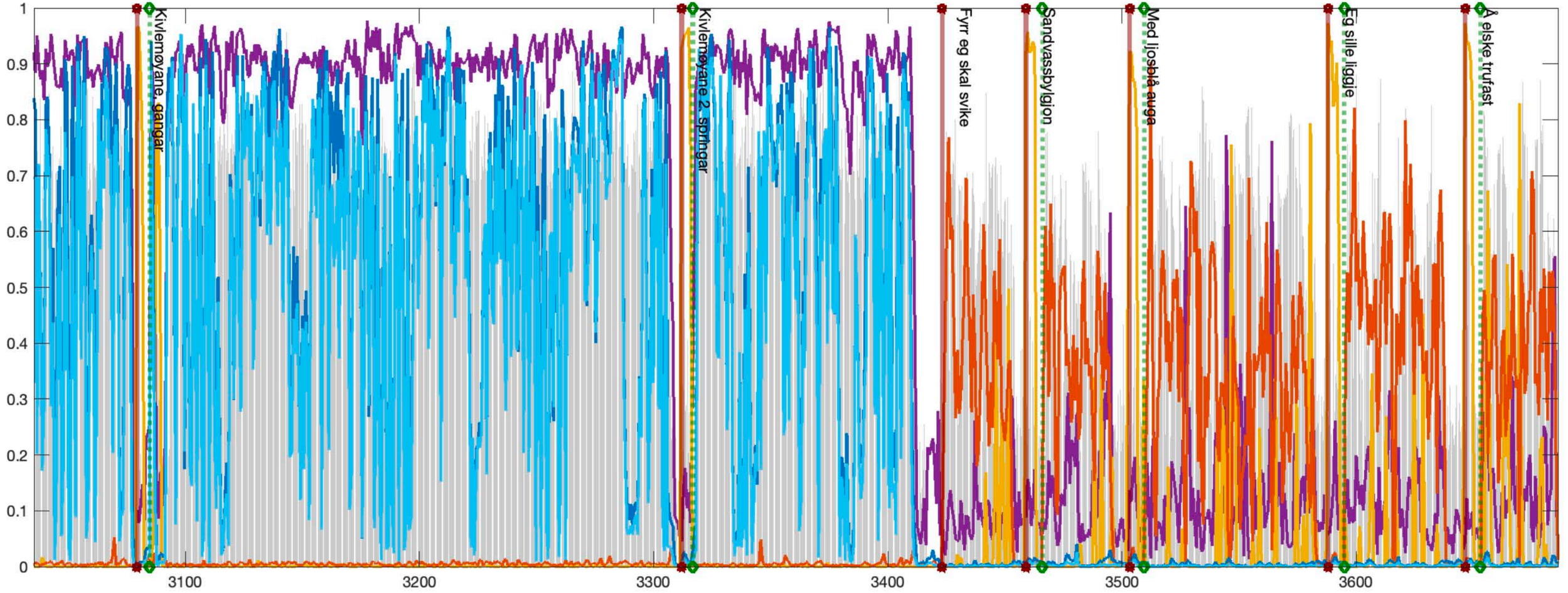


Figure 2: Screenshot of the AudioSegmentor GUI. Coloured curves correspond to the scores, for each successive temporal frame from left to right, related to the classifiers Speech (yellow), Singing (red), Music (purple), Bowing (dark blue) and Violin/fiddle (light blue) of an excerpt of a tape recording. Audio dynamics is represented in grey. Red vertical lines indicate the beginning of tunes, as detected by the automated segmentation system, generally starting with a little speech, and then followed by the actual music, starting at the green vertical line. The title of each tune is shown on the right of each read line.

AudioSegmentor

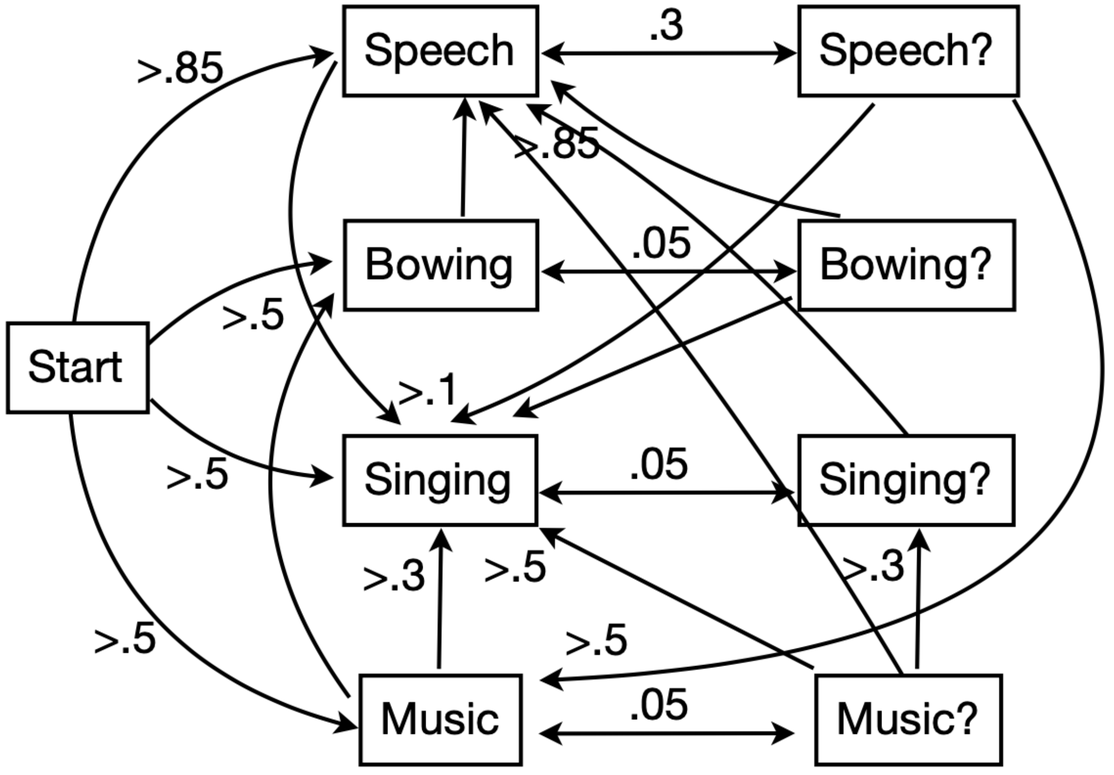
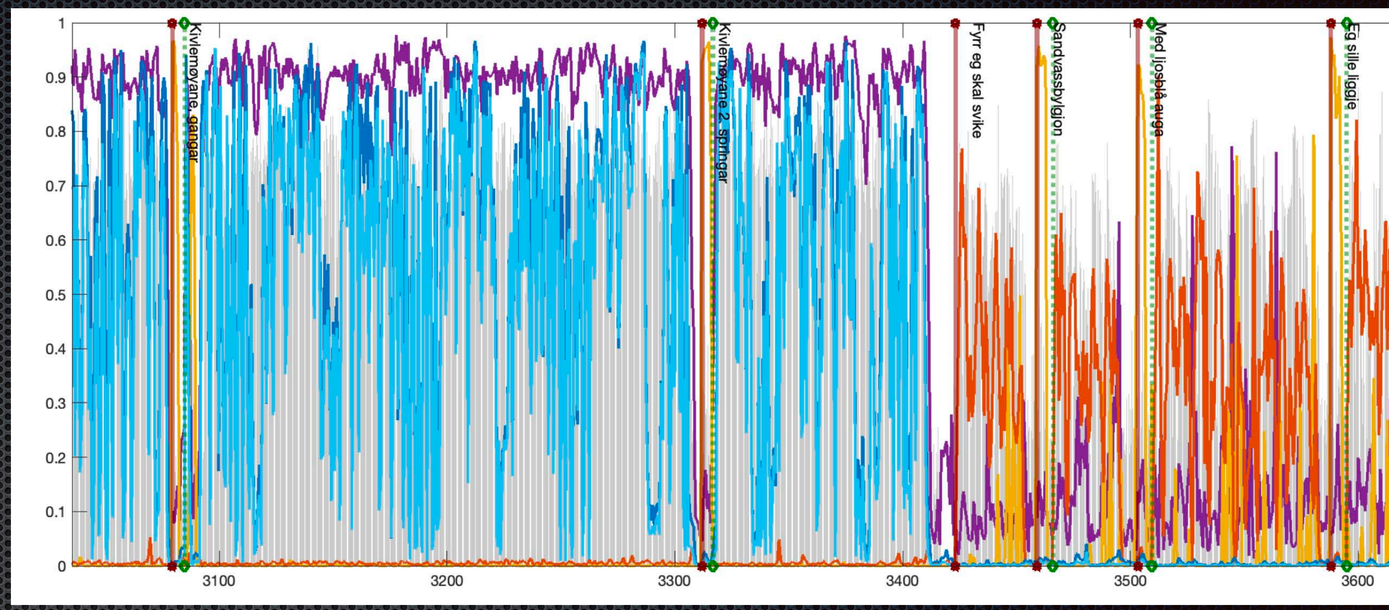


Figure 3: Speech and music type states and transitions between them. For each transition is indicated the required threshold for the score related to the destination state. See the text for further explanation.

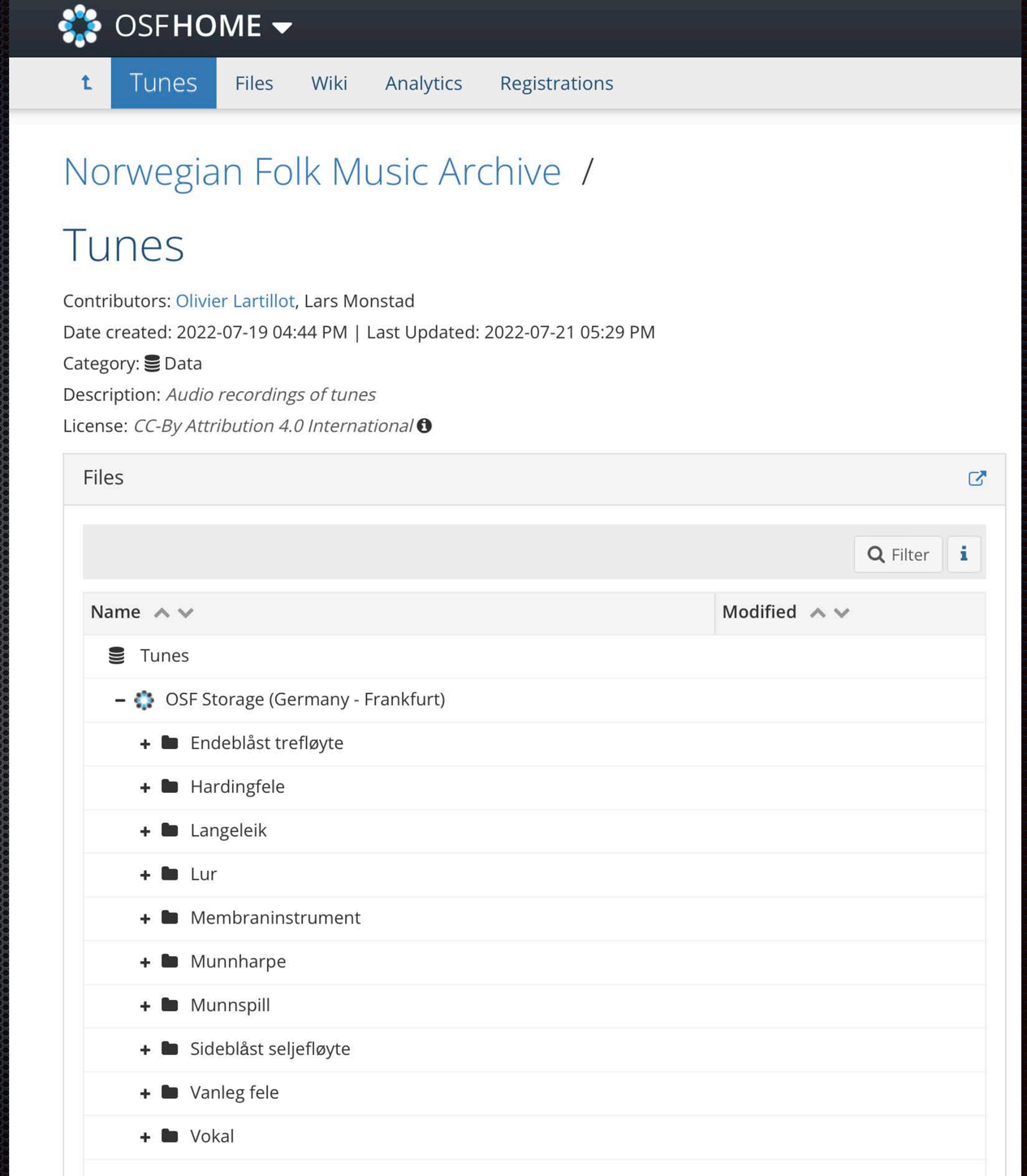
AudioSegmentor



- Each tune can contain an introductory speech
- Manual correction of time positions; playback; zoom
- Integration with catalogue metadata: titles & object ID associated with tune
- Easy correction of false-positive segmentation

OSF

- https://osf.io/s7mgp
- 80 tapes, 5000 tunes



Norwegian Folk Music Browser

- Online music catalogue, easily accessible
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- **Automated music transcription**
- Augmented music playback through visualisation and sonification
- Music analysis: structure, mode, motifs, form, etc. Intertextual analysis.
- Browsing within catalogue guided by analytical visualisations

Automated music transcription

- Finding note onset and offset time in seconds
- Beat (and metre) tracking, Metrical placement of each note
- Pitch spelling, “Key” signature
- Voice separation
- Bowing, performance indications

State of the art in automated music transcription technologies

- Software: Celemony Melodyne, Logic Pro Flex Pitch, Cubase Pro VariAudio, ScoreCloud
- No technology providing accurate transcriptions of Hardanger fiddle music

Automated music transcription

- **Finding note onset and offset time in seconds**
- Beat (and metre) tracking, Metrical placement of each note
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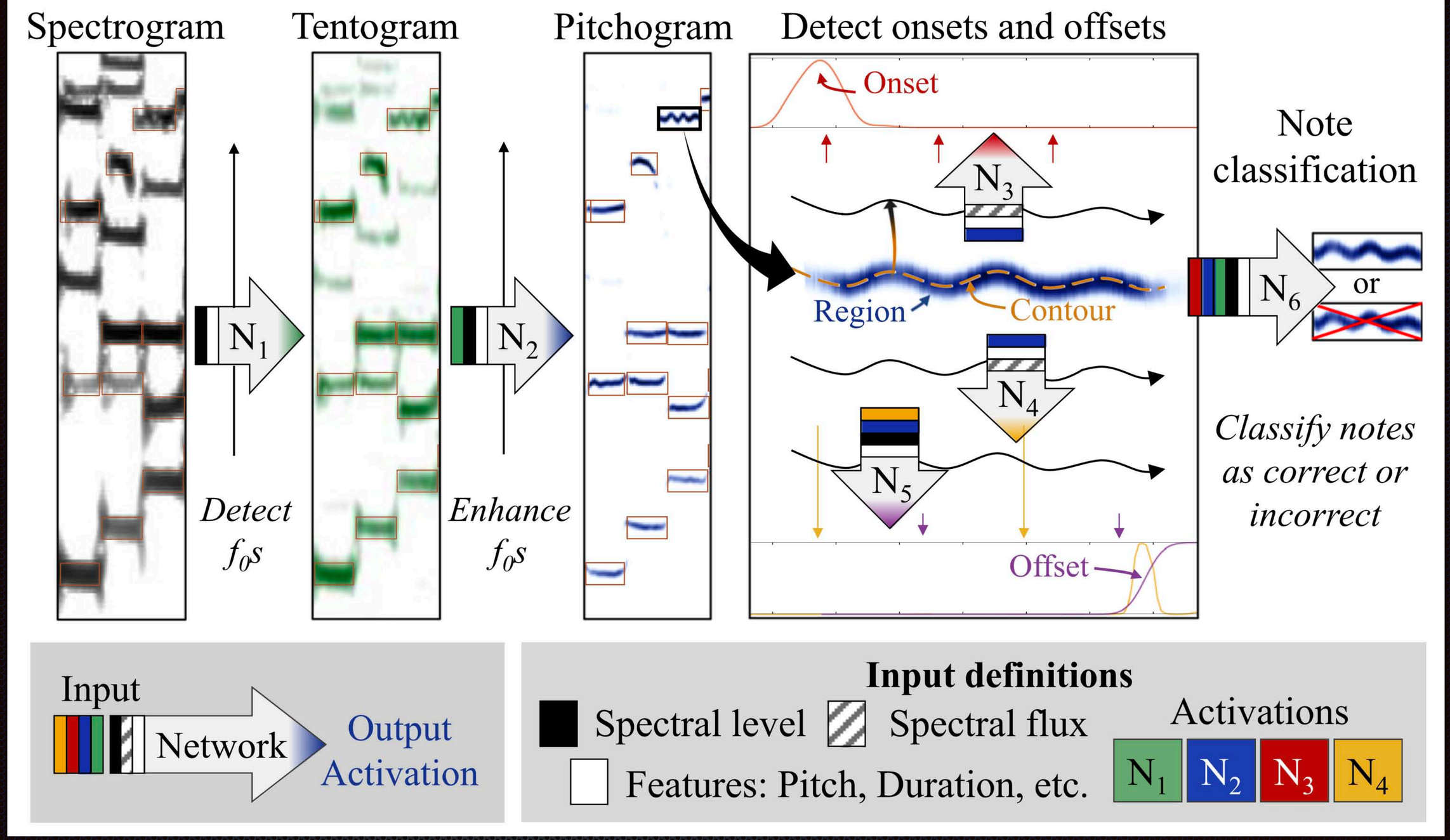
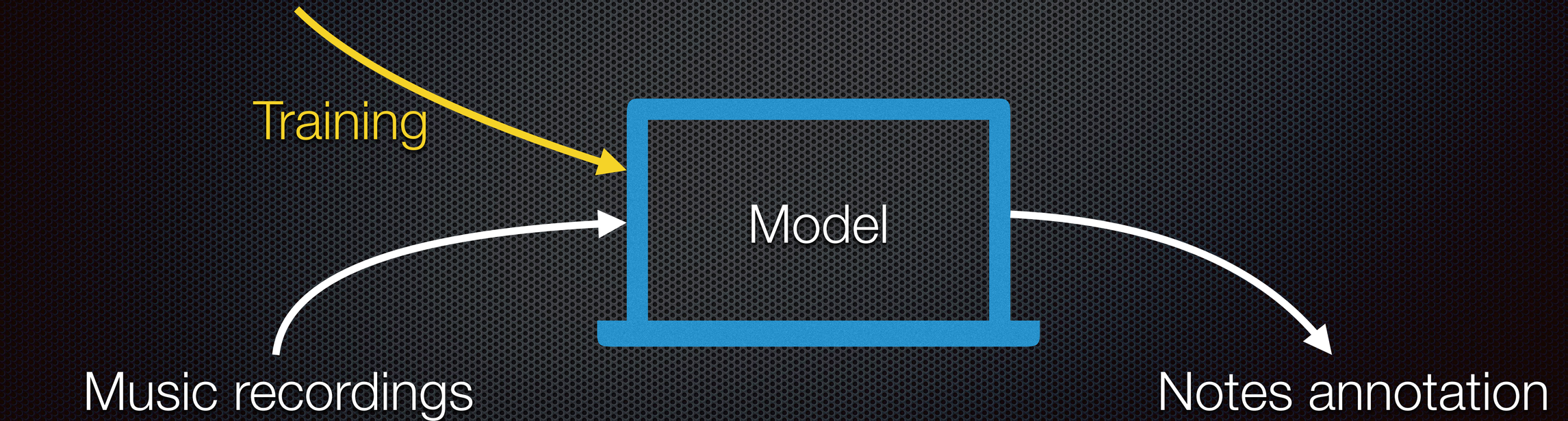


Anders Elowsson, “Polyphonic pitch tracking with deep layered learning”, JASA 2020

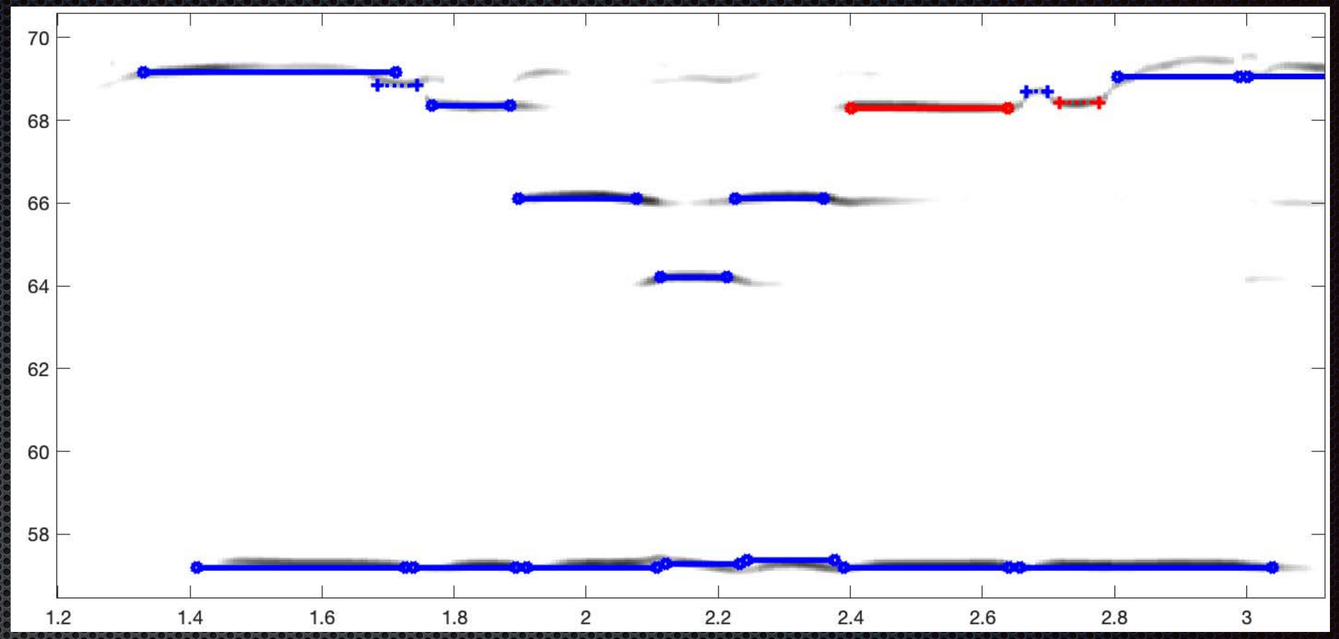
Machine learning

Music recordings
with notes annotation

- Very precise annotation required



Annotemus



- New software for precise note annotation
- Optimised sound representation as visual help
- Visual and audio zoom, slowdown
- Very precise playback capabilities
- Sonification of annotation
- Voice separation

Annotation campaign

- 2 students (fiddler) from Norwegian Academy of Music:
  - In total, 8 tunes (5 different versions each) recorded and annotated
- 1 professional fiddler, Olav Luksengård Mjelva:
  - 12 tunes (5 different versions each) recorded and annotated
  - 12 new tunes (5 versions) planned for end of 2022
- Automated alignment of different versions of same tune (ISMIR 2021)

Machine-learning-based note annotation: Schedule

- Training on a part of the dataset
- Currently: training on the current complete dataset
- Test and evaluation
- Resulting model progressively run on Hardanger fiddle pieces from the Norwegian Catalogue
- Constant evaluation, model further trained on corrected transcriptions

Automated music transcription

- Finding note onset and offset time in seconds
- **Beat (and metre) tracking, Metrical placement of each note**
- Pitch spelling, “Key” signature
- Voice separation
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Beat annotation (in Annotemus)

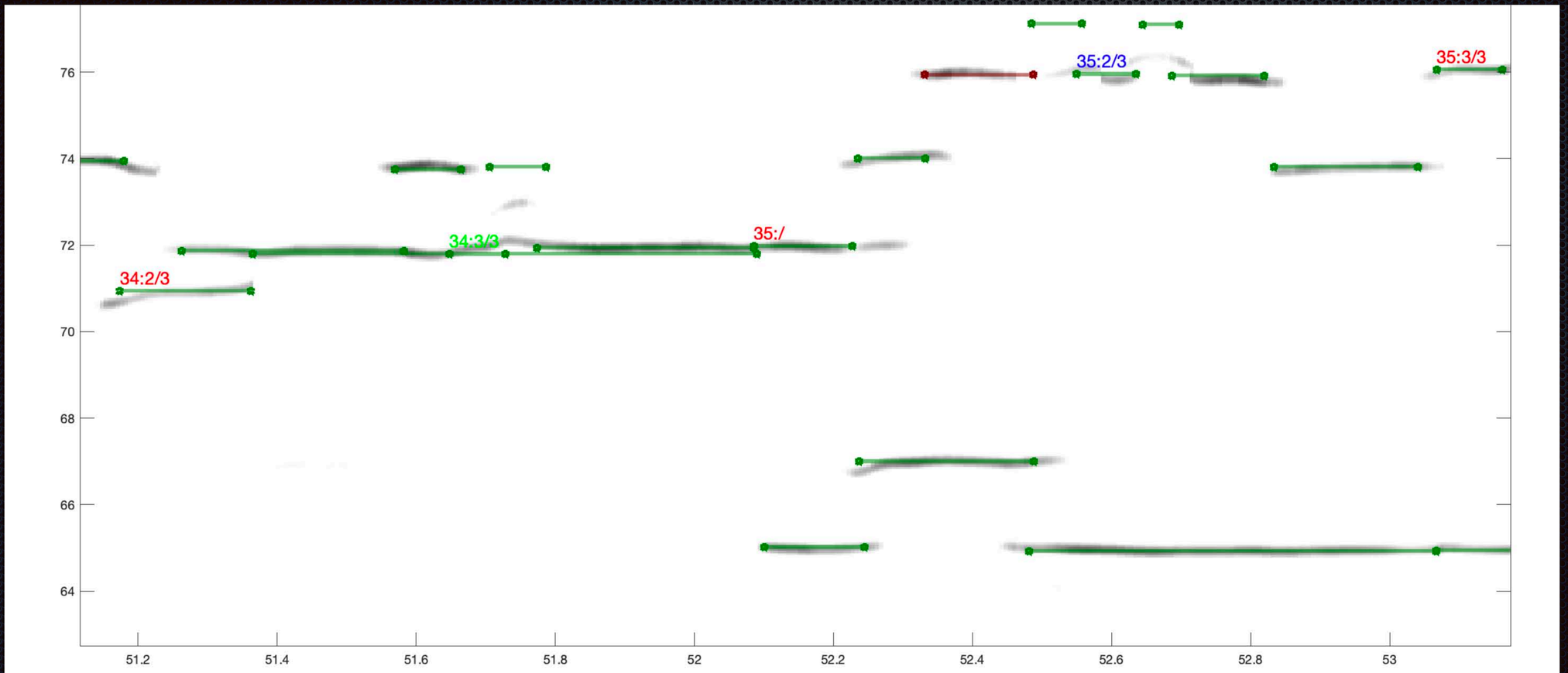
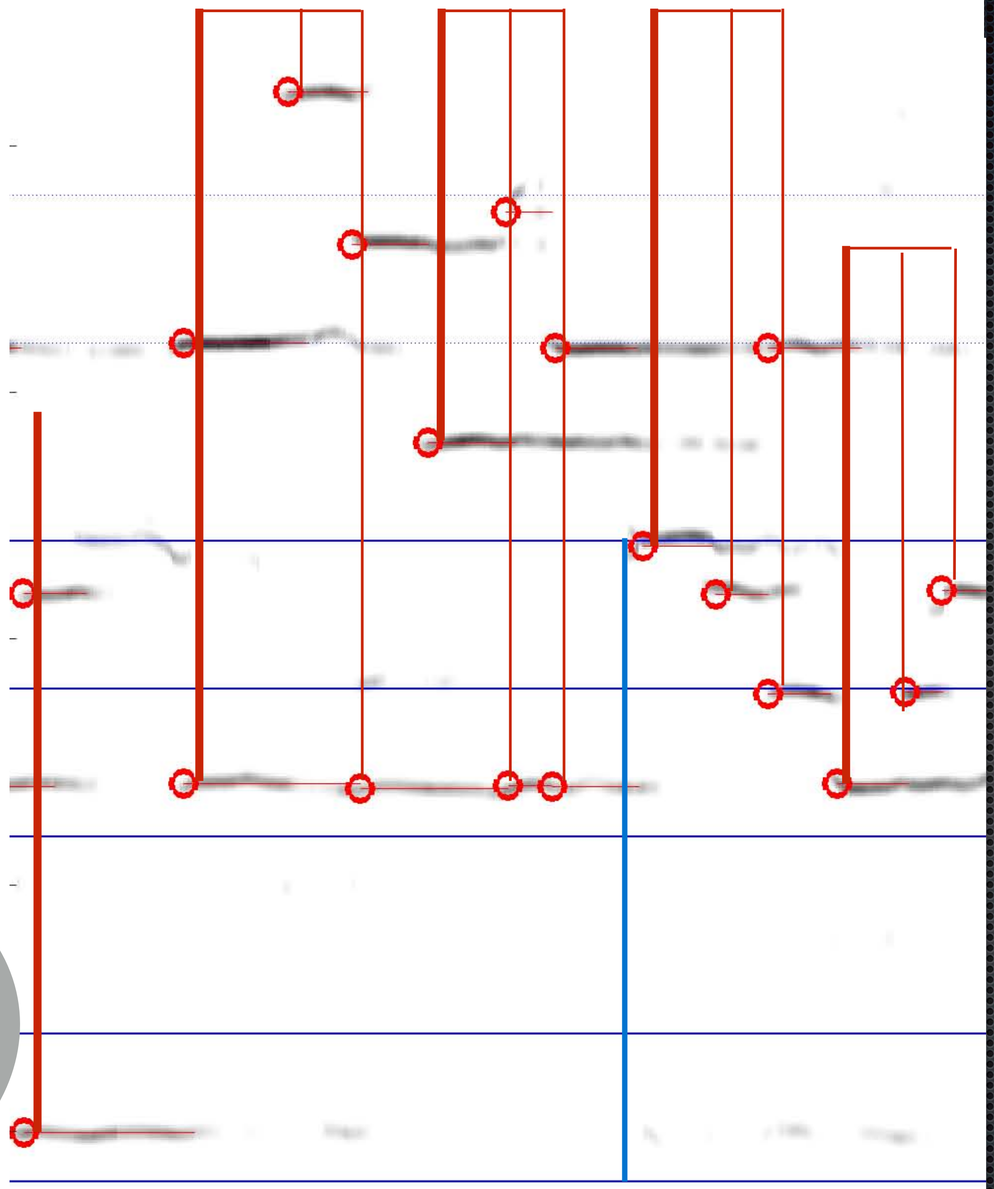


Figure 2: Screenshot of the software. In the background, the fundamental of each note is tracked over time and traced in grey, located as MIDI pitch over time in seconds. Note annotations are shown by green lines and beat annotations indicated above the selected notes. For instance the note starting around 51.2 seconds with pitch around 71 is the second beat of bar 34 (34 : 2/3). The screenshot shows the diff comparison between the beat annotations of P and S1. A misaligned note (missing in one of the annotations) is shown with a red line. Beat annotations common to both annotators are shown in red, while green and blue indicates annotations specific to one or the other annotators.

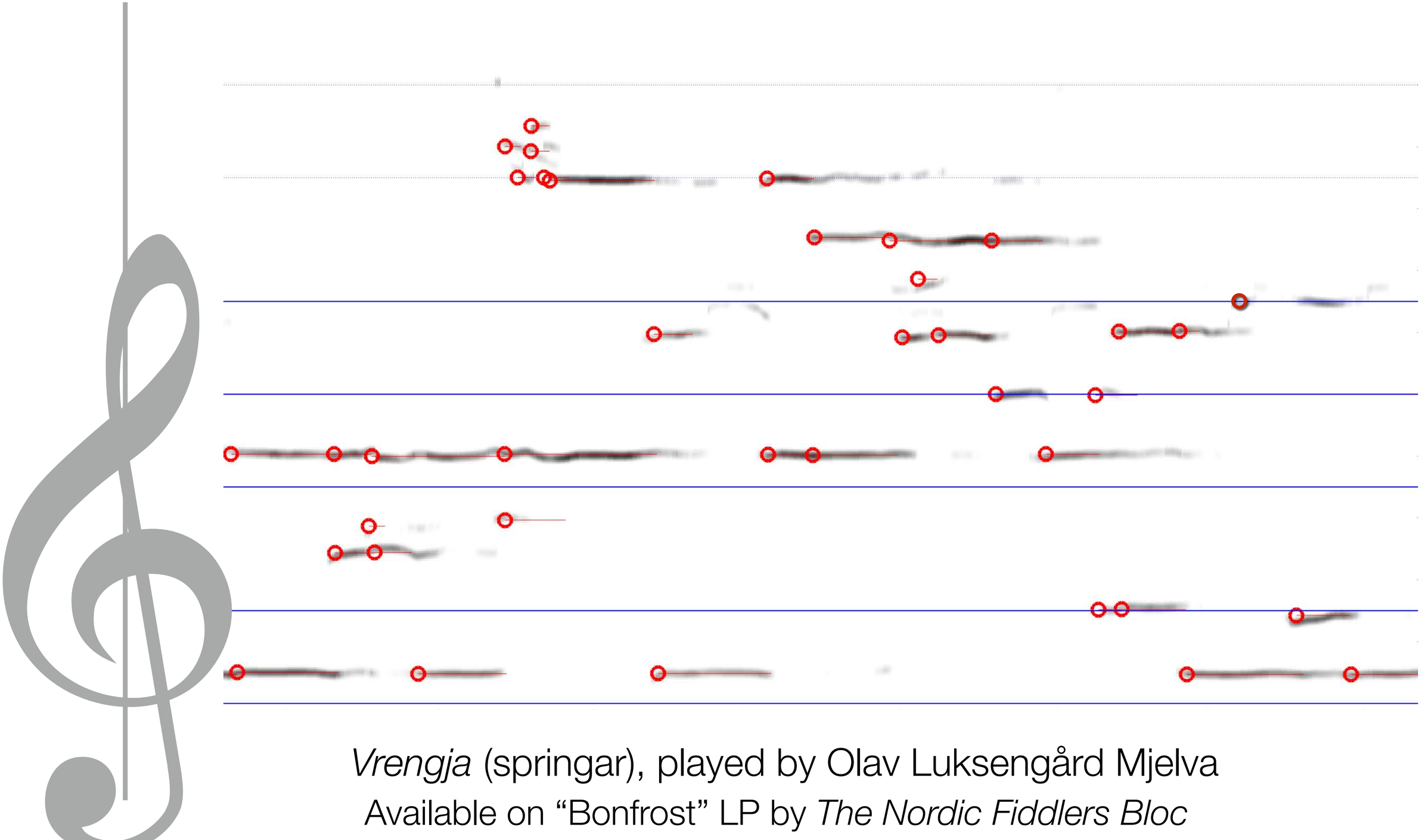
Beat annotation campaign

- On the 12 tunes recorded by Olav Luksengård Mjelva (OLM)
- Beat annotations by OLM and 3 experts
- 3 experts check discrepancy between their own annotation and OLM’s
- To be released as dataset, associated with journal article



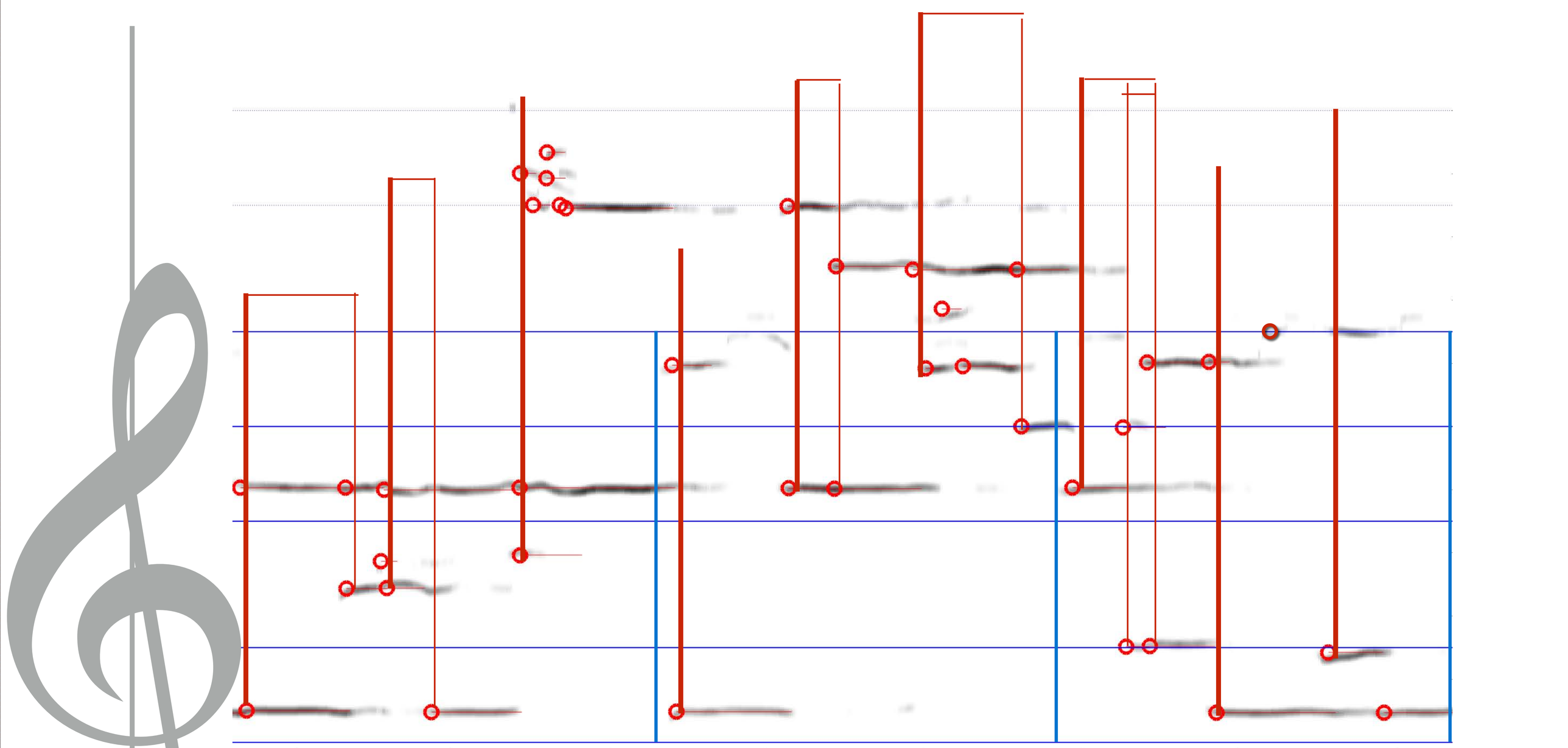
Challenges

- Beats of variable duration
- Beat does not correspond to clear accents



Vrengja (springar), played by Olav Luksengård Mjelva

Available on “Bonfrost” LP by *The Nordic Fiddlers Bloc*

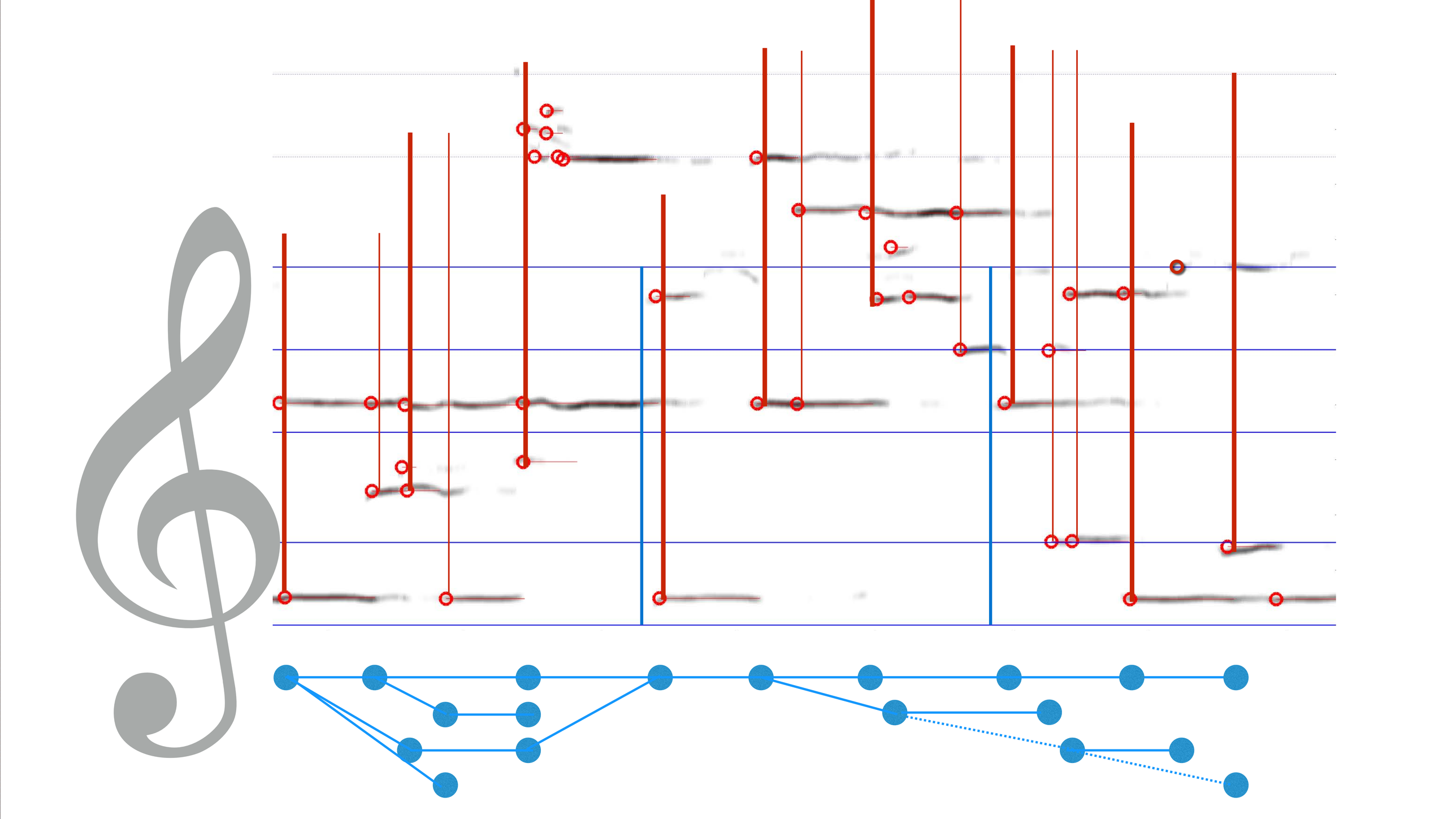


Vrengja (springar), played by Olav Luksengård Mjelva

Available on “Bonfrost” LP by *The Nordic Fiddlers Bloc*

Modelling beat tracking

- Modeling processes that progressively infer beats while scanning the music sequence chronologically
- Set of explicit rules, inspired by musicological and cognitive principles
- Models complex interdependencies between various musical dimensions
- Allows multiple hypothetical beat sequences in parallel, as long as core constraints are respected
  - Not too irregular beat durations
  - Not too irregular bar durations
  - Tempo within a certain range
  - …



Beat & meter tracking: Work in progress…

- Designing the model, establishing rules
- Small-scale experimentation
- Testing on progressively larger corpus
- Generalising to other music genres?

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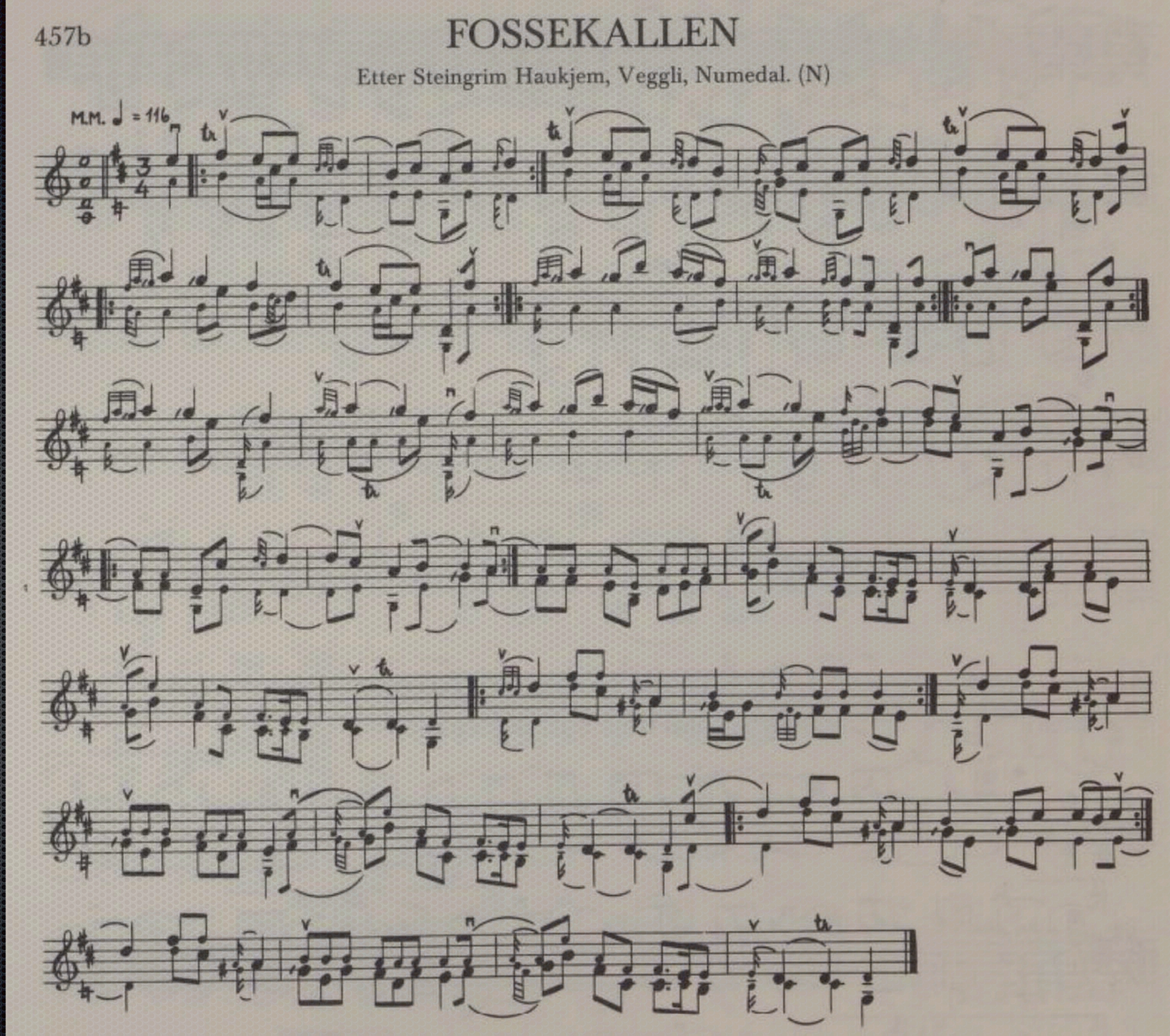
- Voice tracking: melody vs. drone
- Detection of ornaments
- Pitch spelling, pitch inflexion
- Bowing, melodic gestures, phrases
- Motivic cells, themes, form
- Modal, stylistic analysis
- Performance analysis (including timing, pitch inflexion)



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The *Norwegian Folk Music Browser*

- make the analyses easily accessible to musicians, musicologists and the general public
- interactive visualization/sonfication of the music content (including all the analyses) of each tune, while listening / browsing into the music
- visual distribution of the whole catalogue based on their intrinsic content, guided for instance by stylistic clustering, allowing to navigate into the catalogue
- to aid listeners to better understand and appreciate the richness of these catalogues

Release

- Norwegian Catalogue of Folk Music @ OSF
  - Audio recording of tunes, progressively added with transcriptions
- Recording by hired musicians and students with their annotations
- Software:
  - SoundSegmentor
  - Annotemus

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