An Exploration of Real-Time Visualizations of Musical Timbre

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Structure:

1. Introduction / Motivation

2. The Patches

3. Examples
   3.1 Analysis: Visualizations of Grisey's *Modulations*
   3.2 Performance: The Audio Control Patch

4. Conclusion

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1. Introduction / Motivation

"The role of timbre has extended to that of central subject of the music. Then, paradoxically, the very notion of timbre, this catchall, multidimensional attribute with a poorly defined identity, gets blurred, diffuse and vanishes into the music itself."

- J.-C. Risset & D. Wessel, 1999

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1. Introduction / Motivation

- Timbre, the "famous" American Nation Standarts Institute definition (1973):

"Timbre is that attribute of auditory sensation in terms of which a subject can judge that two sounds similarly presented and having the same loudness and pitch are dissimilar."

- Defines timbre by what it is not
- Leaves out non-pitched sounds

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1. Introduction / Motivation

- Increasing relevance of timbre in composition:
  - Schönberg: *Klangfarbenmelodie*
  - Electronic studios: "sounds from scratch"
  - E.g. with Ligeti, Grisey, Murail: timbre central in instrumental music as well
  - Murail, 2005: "The Revolution of Complex Sounds"

- Problem for music theory:
  How to analyse timbral relations in music?

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1. Introduction / Motivation

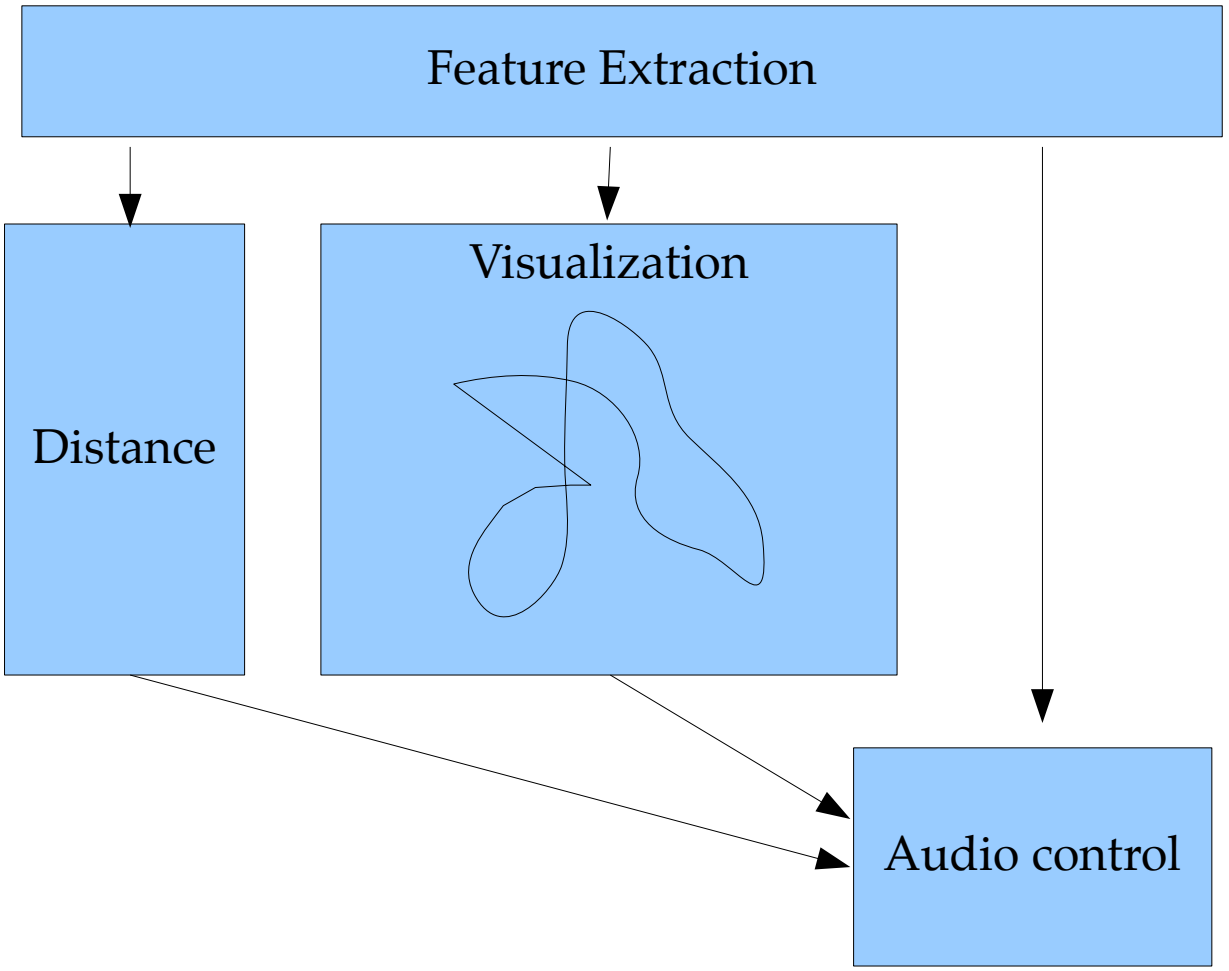
- Exploratory approach:
Timbre analysis by visualization and control

- Visualization of audio features relevant for timbre perception (see e.g. MDS studies by McAdams)

- Patches for extraction of audio features, their visualization and feature based audio control

- Real-time

2. The Patches



Feature Extraction.

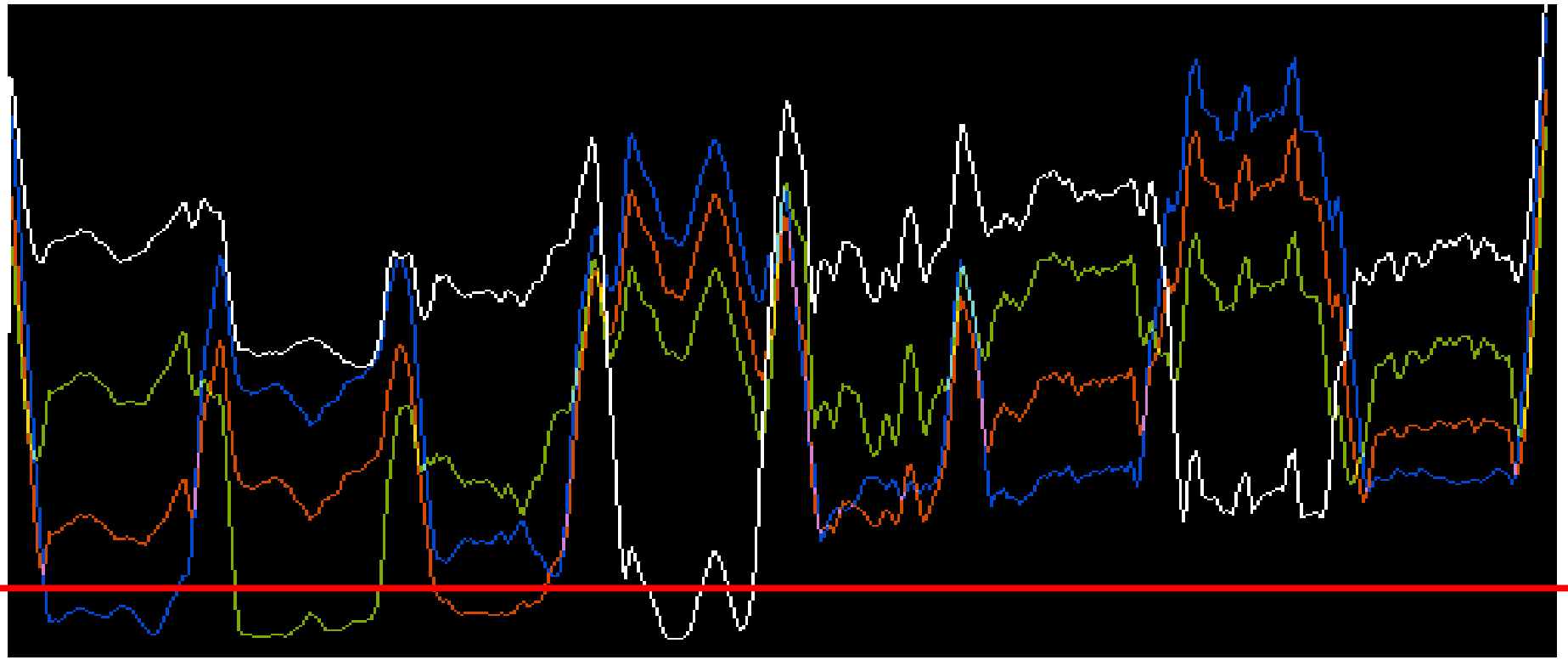
- zsa.descriptors
- CNMAT Analyzer (loudness, noisiness, roughness)
- Compound descriptors (bark-flux, centroid-flux, bark based spectral crest factor, ...)
- Defaults: FFT window size: 512, 50% overlap, 44.1 kHz

2. The Patches

Visualization.

2. The Patches

Distance.



Example: last section (no.44 - end) of Gerard Grisey's:
Modulations for 33 Instruments

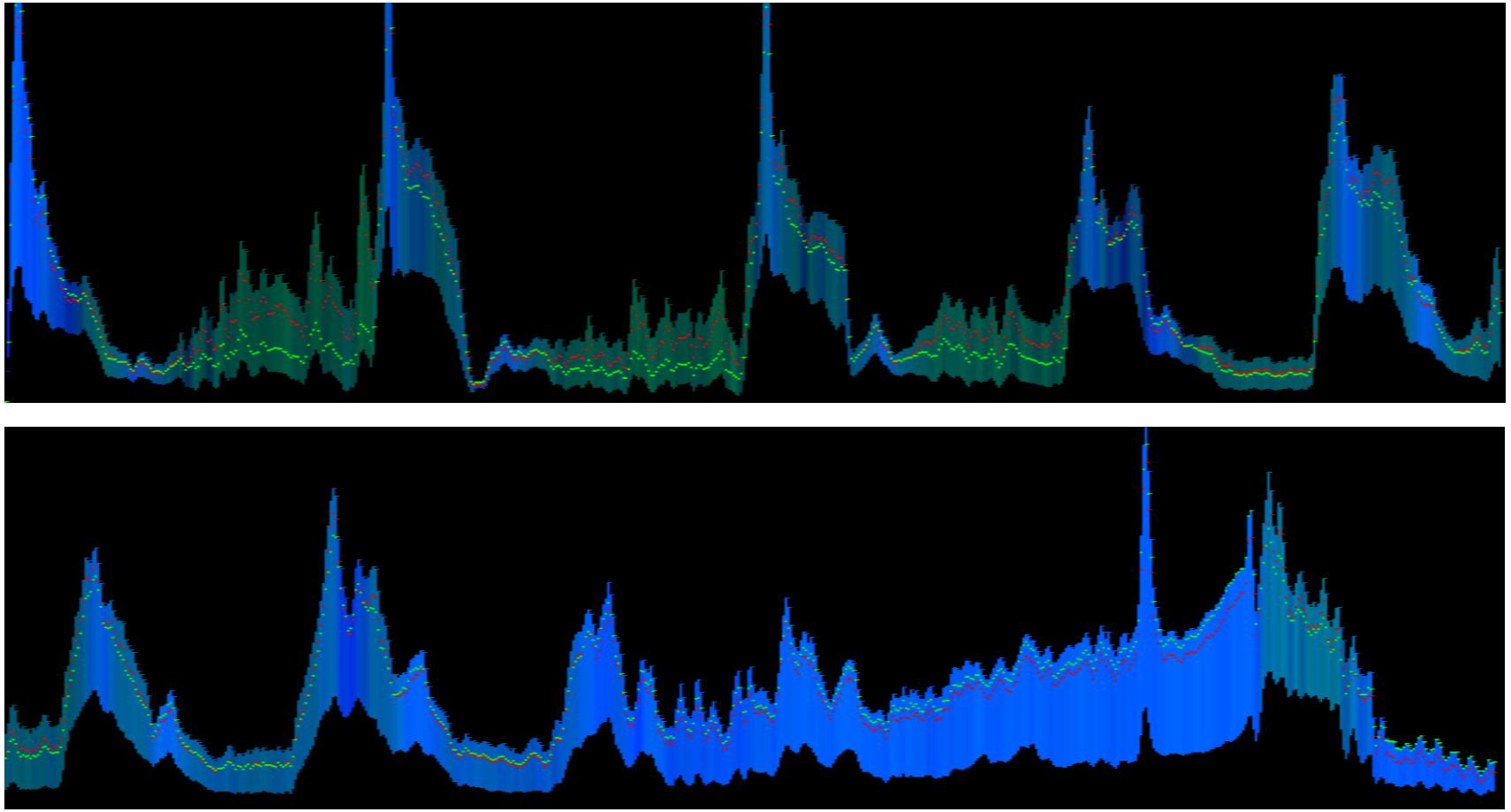
- Musical process from harmonicity to inharmonicity with a crescendo in ten steps

- 3 evolving sound objects: continuous string section, high chords by woodwinds, "subharmonic" chords in brass

- Process ~ convergence of these sounds

3. Examples. 3.1 Analysis: Visulizations of Grisey's *Modulations*

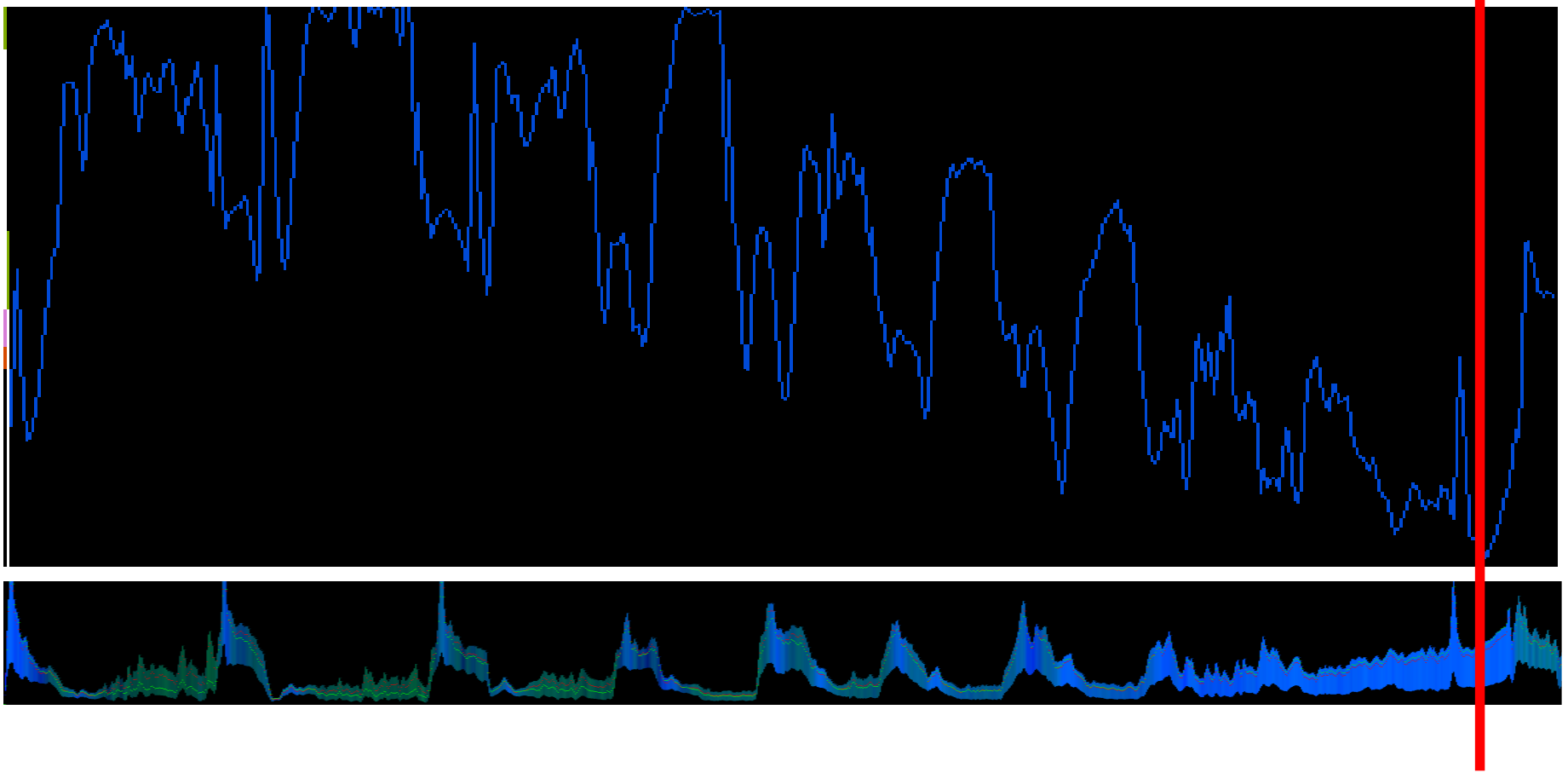
River-visualization.
lower bound: centroid, width: spread, intensity of blue: bark based flux, intensity of green: flux, red dots: noisiness, green dots: loudness



3. Examples. 3.1 Analysis: Visulizations of Grisey's *Modulations*

Distance

reference point



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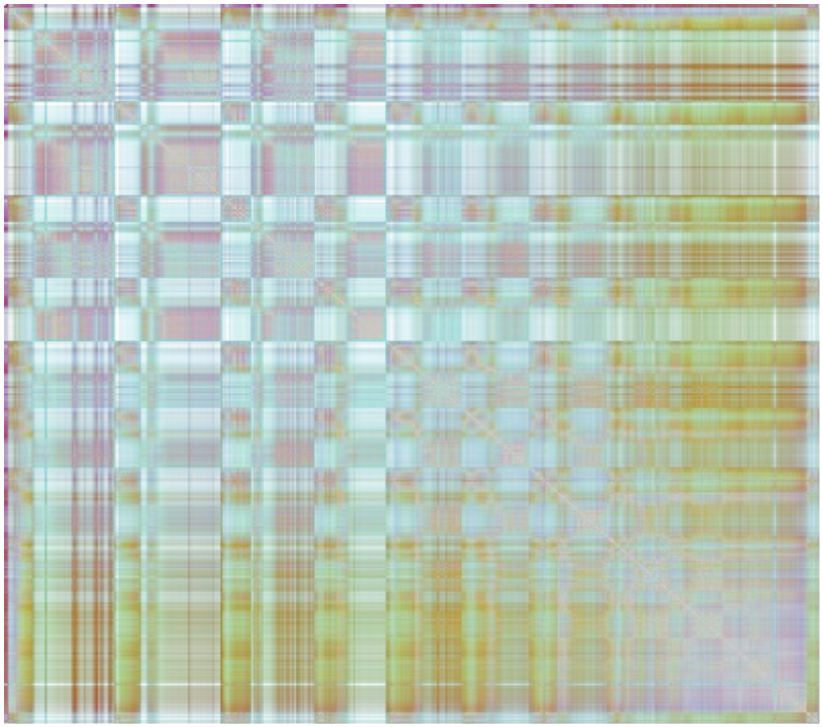
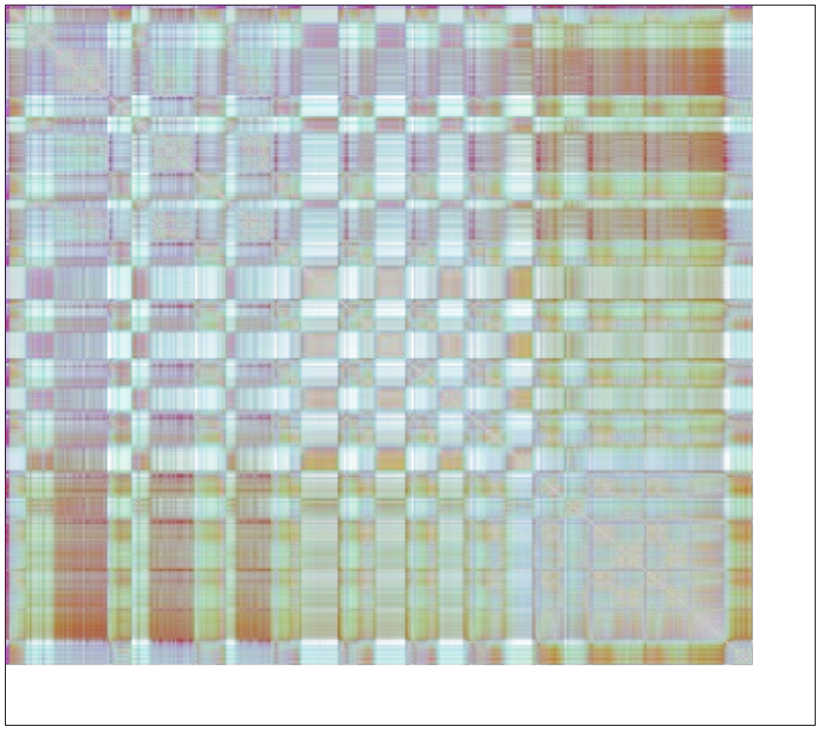
3. Examples. 3.1 Analysis: Visulizations of Grisey's *Modulations*

Similarity matrices of two different recordings*:
Turquoise: spectral envelope, Magenta: loudness, Yellow: flux





Left: Gerard Grisey: Les Espaces Acoustiques, Kairos, 2005.
Right: Gerard Grisey: Les Espaces Acoustiques, Accord 2001

Audio Control.

Conclusion.

- This project an attempt to find high dimensional visual representations of timbre related audio features to analyse the role of timbre in composition more systematically.

- Visual representation as a "listening/analysis aid" in music pedagogy and research.

- Real time methods suited for artistic exploration...

4. Conclusion

Future Directions.

- *Feature Extraction*: Better higher level perceptual features

- *Visualization*:
  -open GL
  -without real time constrains for analysis purposes

- *Distance*: systematic testing and comparison