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# On the *Perceptual Fusion* in Grisey's *Partiels*: a Comparative Audio-Descriptor Analysis of Two Recordings

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## The context

- Intermediary step of the *ANTISCOPE PROJECT* which aims to study the perceptual features of spectral music compositional strategies [1].
- This study focuses on *instrumental synthesis* [2] to investigate features related with *perceptual fusion* [3, 4, 5].
- The main goal is to generate audio representations [6, 7] enabling the development of a *sound corpus* to support empirical studies on orchestration.

## The research question

Far from being a fixed formula, though, each recording of Grisey's *Partiels* leads to different sensations in terms of *perceptual fusion*. That being the case, one might argue that an overlooked aspect of auditory fusion pertains to the domain of interpretation. Thus, *how could we take into account those unwritten features of the musical realization?* We propose an audio-based analysis approach [6, 7] to address this question.

## Theoretical background

In the literature we find different elements related to perceptual fusion, such as:

- *Acoustical properties* linked to spectral features, like the spectral centroid; to spectrotemporal features, such as the spectral flux; and with the similarity of temporal features, like the attack time [3].
- *Psychoacoustical features* linked with the neurosensorial properties of hearing are involved in the process of fusion, like tonal fusion, masking, and co-modulation of pitch, among others [4].
- *Analytical elements of the sound signal*, as the sense of fusion is dependent on the synchronization of modulations in sound spectra, afforded by elements of musical performance such as vibrato or tremolo [5].

## Methods

The analytical procedure consisted in:

1. Segmentation of the audio according to Grisey's score.
2. Subdivision of each segment in 2 parts (trombone and bass attacks vs. ensemble textures) by using *sound flux* data.
3. Audio feature extraction according to **Table 1**.
4. Human-conducted comparative analysis and evaluation.

Audio descriptors	Definition	Interpretation
Spectral Flux	Rate of change of the spectral content, computed by the $L_p$ norm of the difference of two adjacent fft window analysis [8]	Detections of onsets in the musical texture
Spectral Flatness	Computes the level of randomness in the sound signal through entropy estimation [9]	Noise level in the musical texture
Spectrogram	Time-frequency representation of audio computed by the Short-time Fourier transform	Spectrotemporal description of the musical texture

Table 1. Audio descriptors and analytical interpretation.

We argue these three audio representations provide clues for an exploratory approach to the sense of *perceptual fusion* in the musical texture. Thus, the stronger the level of *musical onsets*, the higher the *noise content*, and the higher the *dissimilarity between microtemporal fluctuations*, the lower the tendency of the musical texture to afford the sense of *perceptual fusion*.

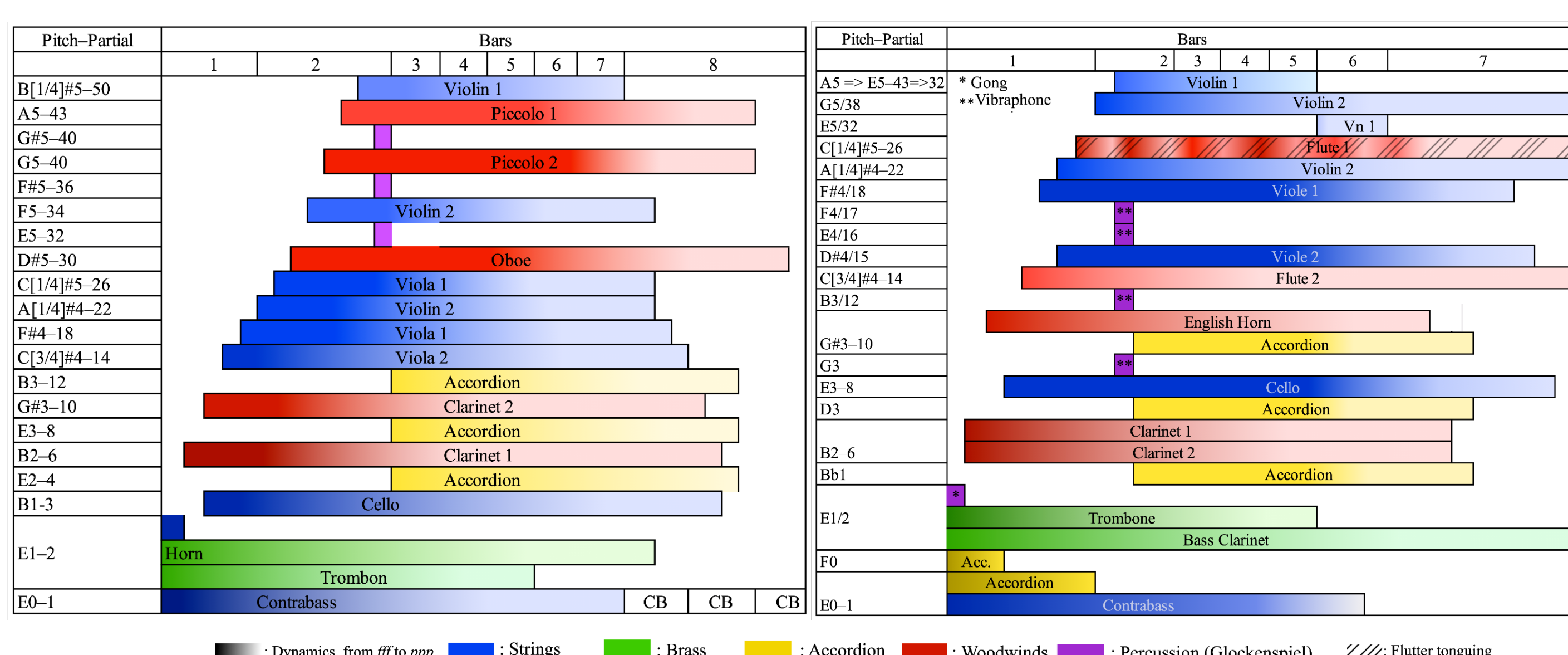
By studying the performance through the recordings, we are aware that our analysis engages with features from both the composition, performance and musical production [10]. The 2 chosen recordings are:

	Album	Ensemble	Date
Recording 1	Gérard Grisey – Les Espaces Acoustiques	Ensemble Court-Circuit	1999
Recording 2	Gérard Grisey – Les Espaces Acoustiques	Asko Ensemble	2005

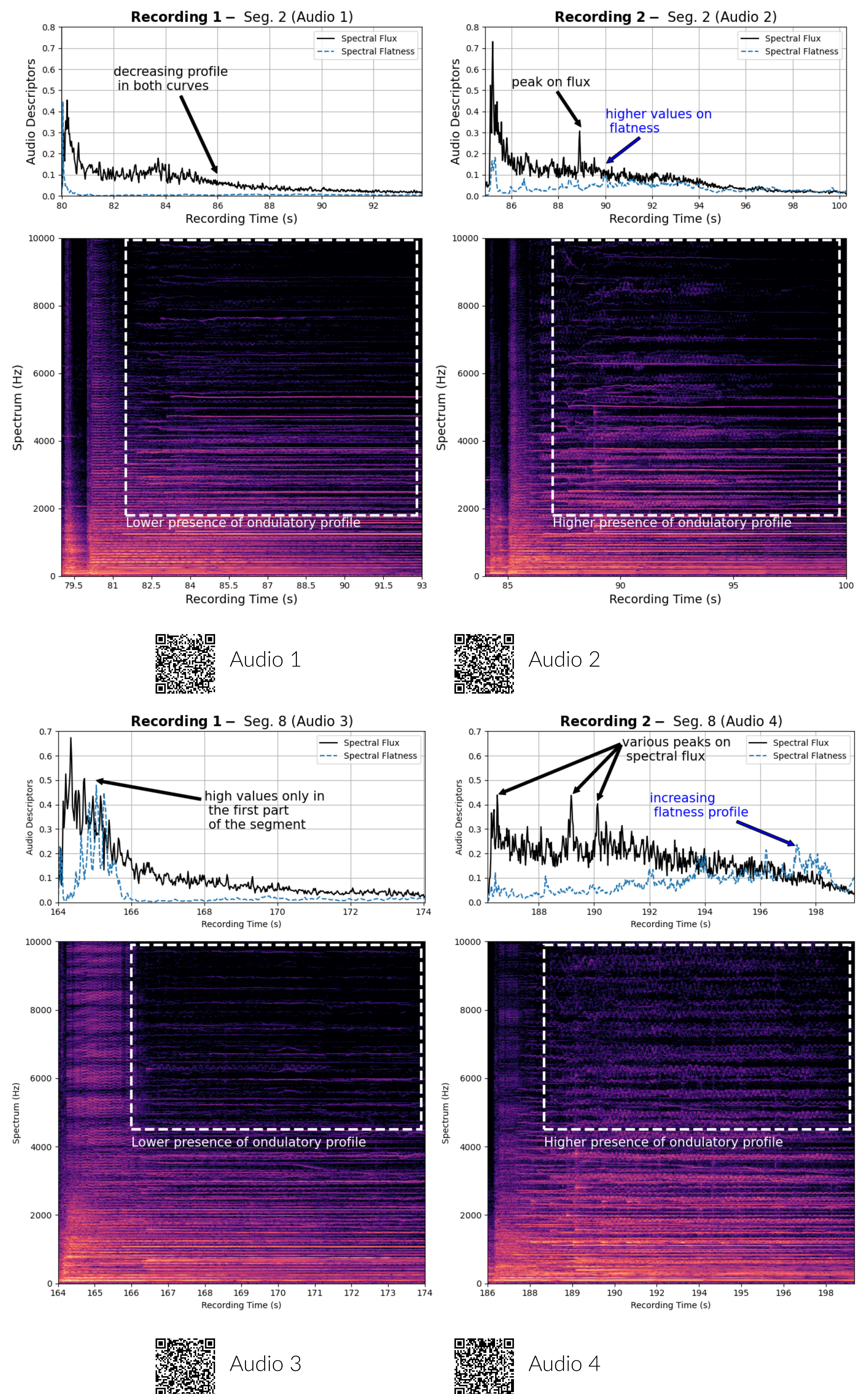
Table 2. Album, ensemble, and date of the chosen recordings.

## Results

### Score-based symbolic representation of segments 2 and 8.



### Audio representation of segments 2 and 8.



## Conclusion

- By analyzing these audio representations, we may notice that a higher sense of *perceptual fusion* is afforded by **Recording 1** while **Recording 2** explores more variety and novelty in the musical texture.
- These preliminary results show that it is possible to identify some audio representations that are significant to an exploratory approach to *perceptual fusion*, offering new insights into musical analysis and interpretation studies.
- Future steps need to expand the analytical *corpus* and audio feature data to obtain perceptually relevant fusion-related representations.
- Additional analyses combined with sound synthesis and listening tests might also provide new intuitive controls of fusion between sound sources and textures, which is not only of interest for musical composition but also for sound design and other related areas.

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