

Systemes non linéaires et Improvisation Collective Libre

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Outline

- 1 Introduction
- 2 Definitions and model
 - Time scales
 - Signal and information
 - Signal and intention
 - Objective
- 3 Results and Discussion
 - Collective sequences
 - Contributing factors to CFI's structuring in collective sequences
- 4 Future plans

Definition

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- free vs "referent-based" improvisation
- No pre-commitment in CFI
- 2 time scales

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→ this defines the "cluster of event"
- \Rightarrow free improvisation \neq "pure" improvisation, i.e. instantaneous *ex nihilo* creation.

Free Improvisation : referent-free

Free Improvisation can be defined as a **referent-free** improvisation.

According to Pressing, a referent is an underlying formal scheme or guiding image specific to a given piece, used by the improviser to facilitate the generation and editing of improvised behavior on an intermediate time scale.

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In CFI, as opposed to referent-based improvisation (like straightforward jazz), there is no founding act (like the common choice of a standard) that confers a given set of musical or extra-musical data the status of *common knowledge* in a group.

Pressing, J.: Cognitive Processes in Improvisation. In: Crozier, W. R., Chapman, A. (eds.) Cognitive Processes in the Perception of Art, pp. 345-363. Elsevier, Amsterdam (1984)

Free Improvisation : no pre-commitment

FI can include idiomatic borrowings: a given CFI can sound, at times, as a *be-bop* piece (with swing articulation, chords, tonal progression) or as a meditation on a *raga* (with a scale and a specific ornamentation).

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But a free improviser has *no pre-commitment* (Elster 2000) when the performance begins. His production is of course determined by several self-imposed restrictions, even stylistic restrictions, but he can modify these restrictions at any time.

Elster, J. *Ulysses Unbound: Studies in Rationality, Precommitment and Constraints*, Cambridge, Cambridge University Press (2000)

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- How can a collective structure emerge from CFI?

\Rightarrow Model

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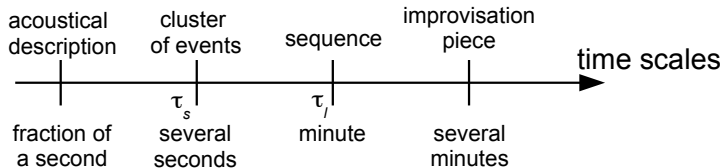
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- total length of the improvisation piece. Fixed in our model.

Times scales



The cluster of events

A cluster is a cognitive chunk that gathers a set of musical, acoustical, kinetical events that were decided at the same point in time; it can be pictured as the subsequent execution of a micro-plan, over its duration of the order τ_S .

τ_S is a short time, of the order of seconds. It is short because of the agent's cognitive limitations.

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The sequence

A sequence is defined by a set of processes and/or a number of features (acoustical, kinetical, musical...) holding for a given length. Improvisers try to establish successive identities and stable points in musical's stream. These identities are then developed, played with or eventually negated, until new identities finally emerge.

The sequence is related to the long time scale τ_I .

Nunn, T.: *Wisdom of the Impulse: On the Nature of Musical Improvisation*,
<http://www20.brinkster.com/improarchive/tn.htm> (1998)

Canonne, C.: *L'improvisation Collective Libre: De l'Exigence de Coordination à la Recherche de Points Focaux*. Thèse de Doctorat en Musicologie de l'Université de Saint-Etienne (2010)

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I^k : information delivered by musician k :

$$I^k = I_s^k + I_d^k \quad \text{with} \quad I_s^k = \frac{1}{2}(x^k)^2 \quad \text{and} \quad I_d^k = \frac{1}{2}\tau_i^2 \left(\frac{dx^k}{dt} \right)^2$$

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I : total information seen by any musician of the group

$$I = \sum_k I^k = \frac{1}{2} \|\vec{x}\|^2 + \frac{1}{2} \tau_i^2 \left\| \frac{d\vec{x}}{dt} \right\|^2$$

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Here, we choose $g = \text{Identity}$.

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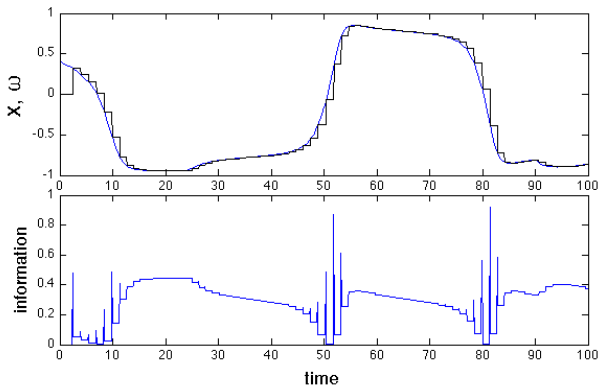
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Clusters of events are shorter when the signal is large, *i.e.* contains more information.

Illustration



Intention's dynamics

$$\tau_s \frac{d\omega^k}{dt} = \alpha^k x^k + \sum_{l \neq k} \beta^{k,l} x^l - h \|\omega_k\|^2 \omega^k$$

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Solutions vary on time scale τ_s

$\alpha^k > 0$: "self-sensitivity"

$\beta^{k,l}$: interactions

$\beta^{k,l}$ are of order 1, they can have any sign or vanish.

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We choose a discrete dynamics, and any change in the objective of a musician defines a new sequence for this musician. This dynamics requires the introduction of the *cognitive load* and the *boreness*.

Intention's dynamics

couplings are non-symmetrical : $\beta^{k,l} \neq \beta^{l,k}$.

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- if $\beta^{k,l} \simeq 0$, then player k is not paying any attention to the signal from player l : "independency".

Cognitive load

Total cognitive load of musician k : $C^k = C_{\text{monitor}}^k + C_{\text{prod}}^k \leq C_{\text{max}}^k$
 representing the maximal cognitive capacity of the musician k .

Musician's attention is shared between two tasks:

- monitoring other musicians' signals:

$$C_{\text{monitor}}^k = \frac{1}{2} (\alpha^k x^k)^2 + \sum_{l \neq k} \frac{1}{2} (\beta^{k,l} x^l)^2 = \frac{1}{2} \|\vec{\Omega}^k \cdot \vec{x}\|^2 .$$

- generating his own signal

$$C_{\text{prod}}^k = \frac{1}{2} (a^k)^2 I_s^k = \frac{1}{2} (a^k x^k)^2$$

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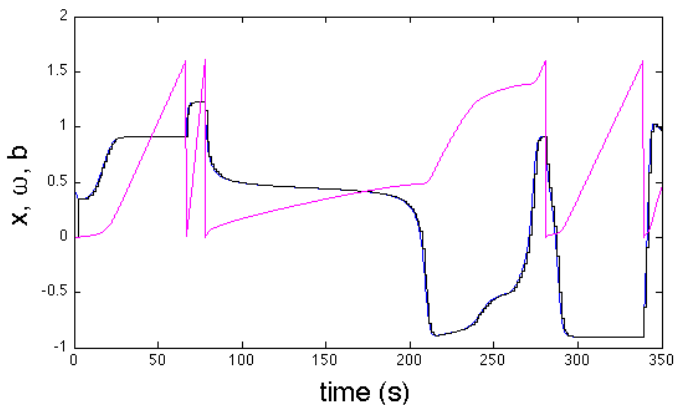
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- \Rightarrow change of objective **and** \Rightarrow change of (individual) sequence.

Boreness : example



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We also decide to project ω^k into x^k at the very same time

Collective sequences

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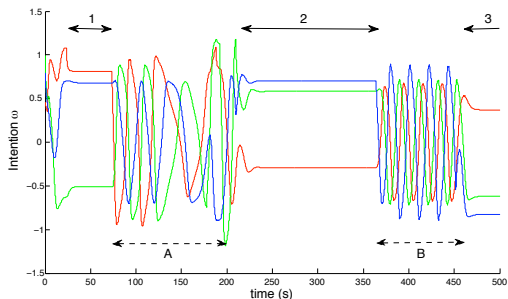
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If we find a lot of collective sequences, and if collective sequences are long enough, we will say that coordination amongst musicians in the group is good. One of the main interest of this model is to show the existence of collective sequences.

Collective sequences

If all objectives are constant, we expect a collective sequence.
This is not a **necessary** condition



Mathematical solutions

Two types of local structure in our model of CFI:

- A stable solution which can be seen as a "collective sequence" (labelled 1,2,3); this corresponds to a fixed point in the phase space of the system.
- An oscillating solution which can be seen as a phase of discoordination among the musicians (labelled B); this corresponds to a limit cycle.

Virtuosi

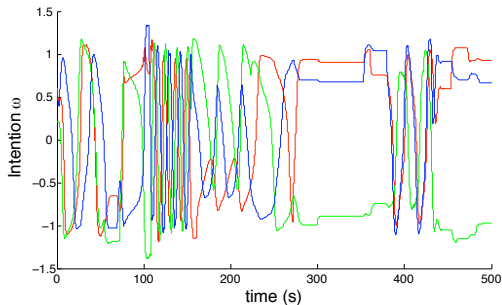
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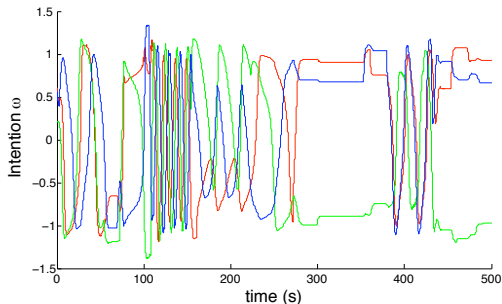
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Although collective sequences still exist, they occur less often.

Leaders

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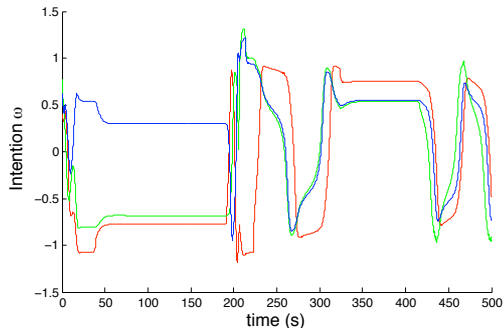
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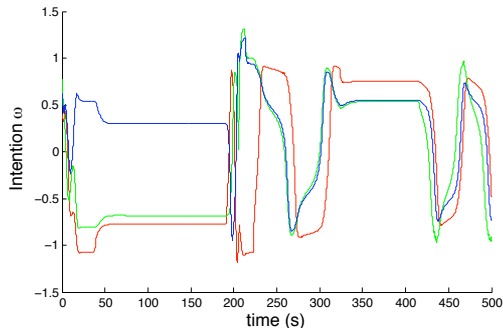


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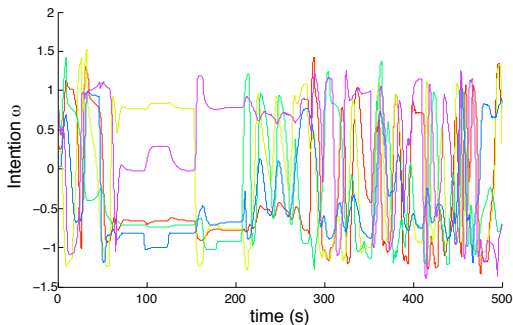


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The existence of leaders enhance the organization of CFI in collective sequences

Number of musicians

The fewer the musicians, the easier the collective organization:



5 musicians

Emergence of sub-teams

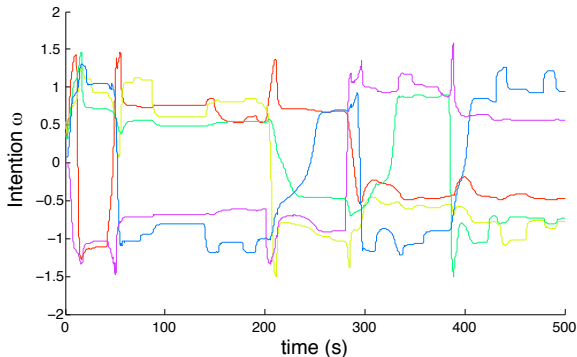
In large groups of musicians, we allow our improvisers to seek for the creation of sub-teams.

This can be done in two different ways:

- Improvisers look for symmetrical interactions:
if A is in imitation with B, B will also try to imitate A,
 $\Rightarrow \beta^{k,l}$ and $\beta^{l,k}$ with same sign and same order of magnitude.
- improvisers interact with 1 or 2 specific musicians only.
 $\Rightarrow 2$ non vanishing $\beta^{k,l}$ at most, for every musician k .

Emergence of sub-teams

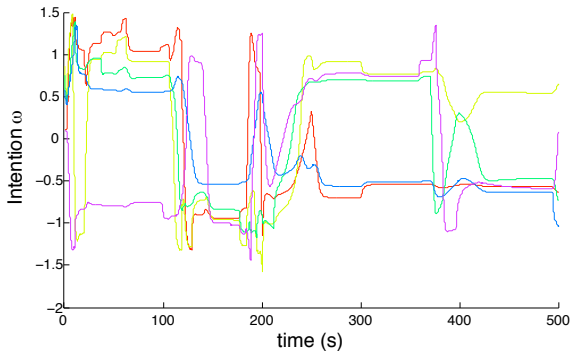
5 musicians ($a^k = 0.4$) which tend to have symmetrical interactions:



Emergence of sub-teams

5 virtuosi ($a^k = 0$) with 1 leader.

All improvisers are interacting with at most 2 other musicians.



Experiments

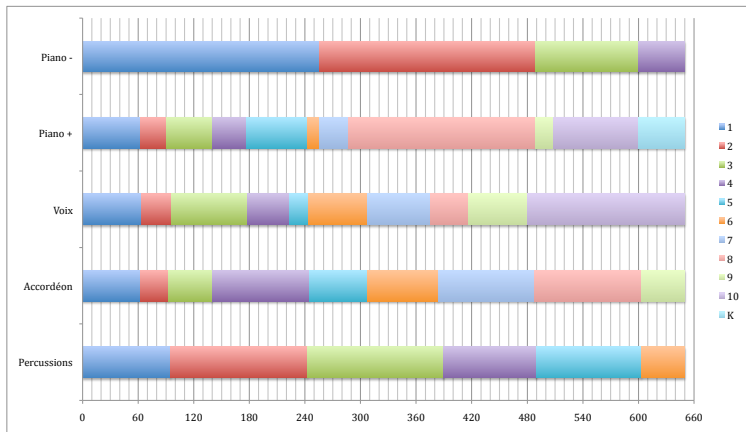
Paris, december 2011. 5 quartets, 1 trio, 1 duo.

Protocole :

- improvise freely together for 10 minutes,
- then (individually) suggest a segmentation of the improvisation in successive sequences.

Experiments

Exemple : quatuor (session 2)



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- more realistic dynamics for the objective, and possible inclusion of a long-term memory,
- **measure information from (realistic) signals ?**

Thank You

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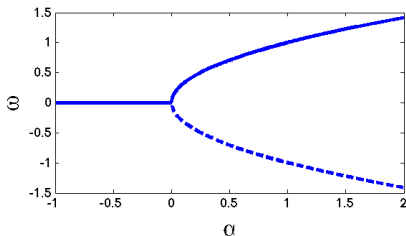
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Experiments

- pedal to record musicians' "internal" sequence / idea changes
- pedal to record "no idea" / "no identity"
- *a posteriori* decomposition of the improvisation piece by each musician

- complexity and information from signal : direct measurement ?