Orchidea

intelligent assisted orchestration

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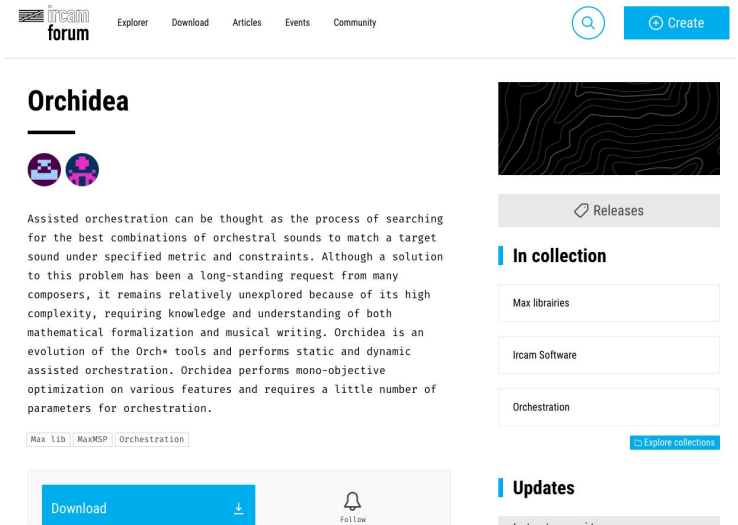
What is Orchidea?

Orchidea

- intelligent assisted orchestration tool developed in IRCAM. Works in **Max/MSP.**
- Orchidea performs mono-objective optimization on various features and requires a little number of parameters for orchestration.
- website: https://forum.ircam.fr/projects/detail/orchidea/



A bit of History

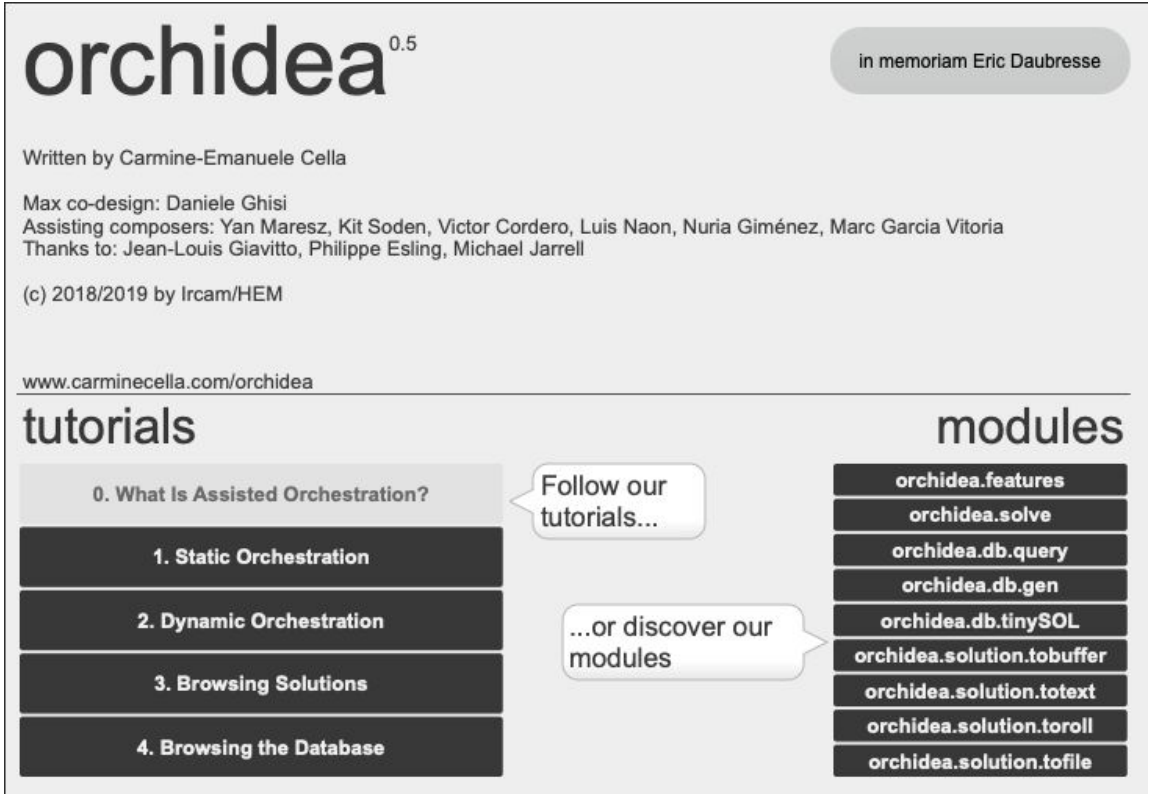
- English composer **Jonathan Harvey**, "Mortuos plango, vivos voco" (1981)
  - The first ante-litteram version of this problem has been investigated by Jonathan Harvey
  - In his work "Mortuos plango, vivos voco" (1981), where he tried to simulate the sound of a bell by a specific model of sound synthesis.
  - It is not by chance that this problem found fertile terrain at Ircam, in Paris, where the influences of the **spectralism music** were very strong around that period.

- A systematic approach developed in 2003, when the French composer **Yan Maresz** proposed a more formalized statement of the problem

- Since then, the problem has been researched at Ircam for more than 15 years and several outcomes have been produced: different tools (Matlab frameworks, Max/MSP interfaces, C++ standalone command line tools, etc.), several PhD thesis including G. Carpentier, D. Tardieu and P. Esling and several journal papers.

Orchidea Tutorial in Max/MSP

Contents of today's presentation is based on orchidea official tutorial



What is assisted orchestration?

Introduction

- The relation between **signals** and **symbols** is a central problem for acoustic signal processing.

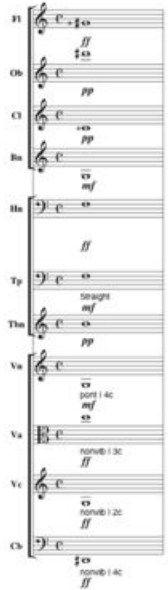
- Which connections can we make between the **symbolic space** and the **signal space**?
  - Symbolic Space(score) <---> Signal Space(timbre)

- **Assisted orchestration** finds its root in this context and can be considered as a possible answer to the previous question.

- **Target-based assisted orchestration** can be thought of as the process of
  - searching for the best combinations of orchestral sounds to match a target sound
  - under specified metric and constraints.

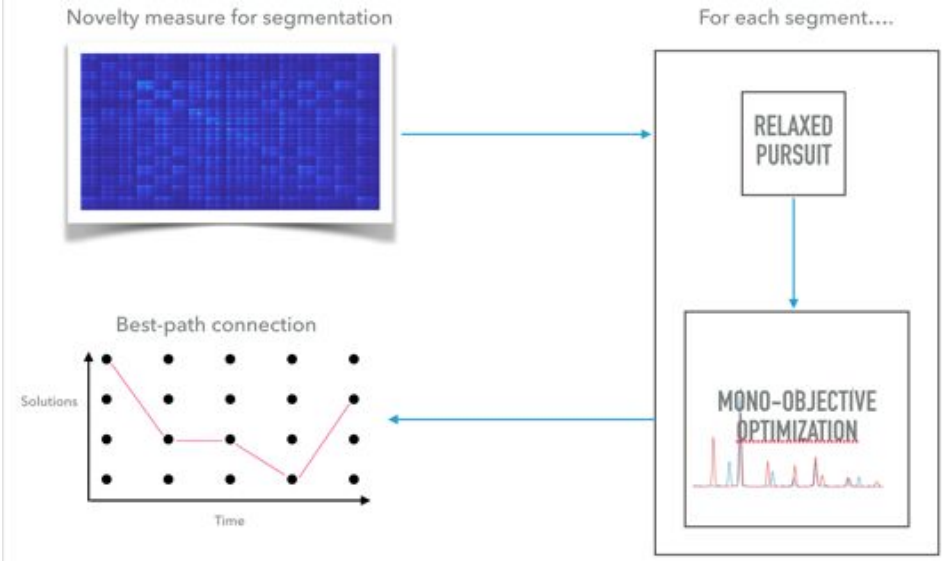
Problem statement

- By playing a score, you can convert (project) a representation existing in the symbolic space into a representation in the signal space. Is it possible to perform the **inverse operation**?



Implementation

- The target-based assisted orchestration problem can be split into two joint problems:
  - A **combinatorial optimization problem** defined on a multidimensional timbre description.
  - A **constraint solving problem** on the variables of musical writing.



Static orchestration

Calculation, not musical decision

- This toolbox is meant to give you some help in orchestrating: this help is more about making **calculations** at your place than taking musical decisions. These **calculations**, of course, are driven by some pre-compositional choices that either you or the designer of the tool that you are using must take.

Mimesis and katharsis

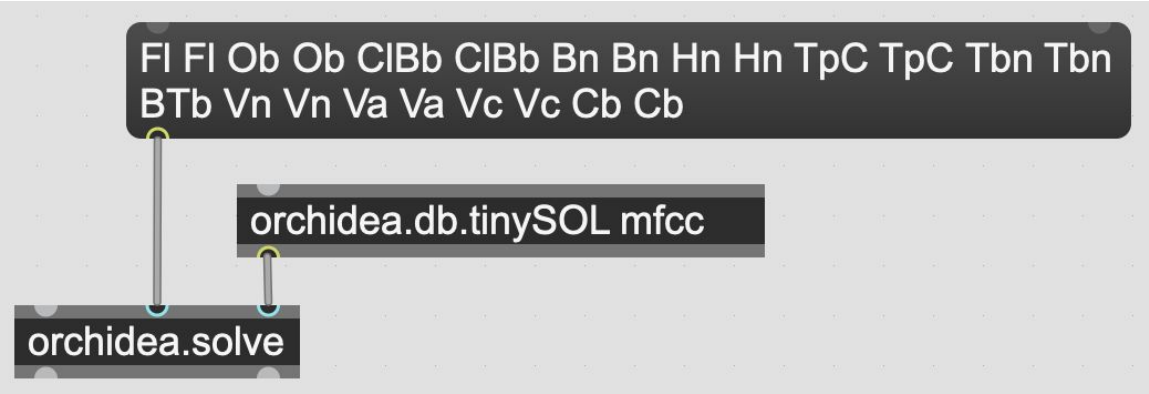
- It is hard to determine which assisted orchestration approach is preferable or not. Orchidea follows the path which mimics the input sound character.

- However, we have several parameters that control the mimesis and catharsis.
  - Feature selection: Pitch vs. Timbre
  - Pitch -> **Fourier spectrum** as the feature to be optimized
  - Timbre -> **MFCC** (Mel frequency cepstral coefficients) as the feature to be optimized

- Orchidea uses **database** as its features for problem solving.

Orchestra Setting

- The first important parameter to choose is the orchestra.
- A **message** specifies the instruments of the orchestra to be used; the names depend on the **database** used.
- Even you can set a specific subset of **articulations** and **dynamics**

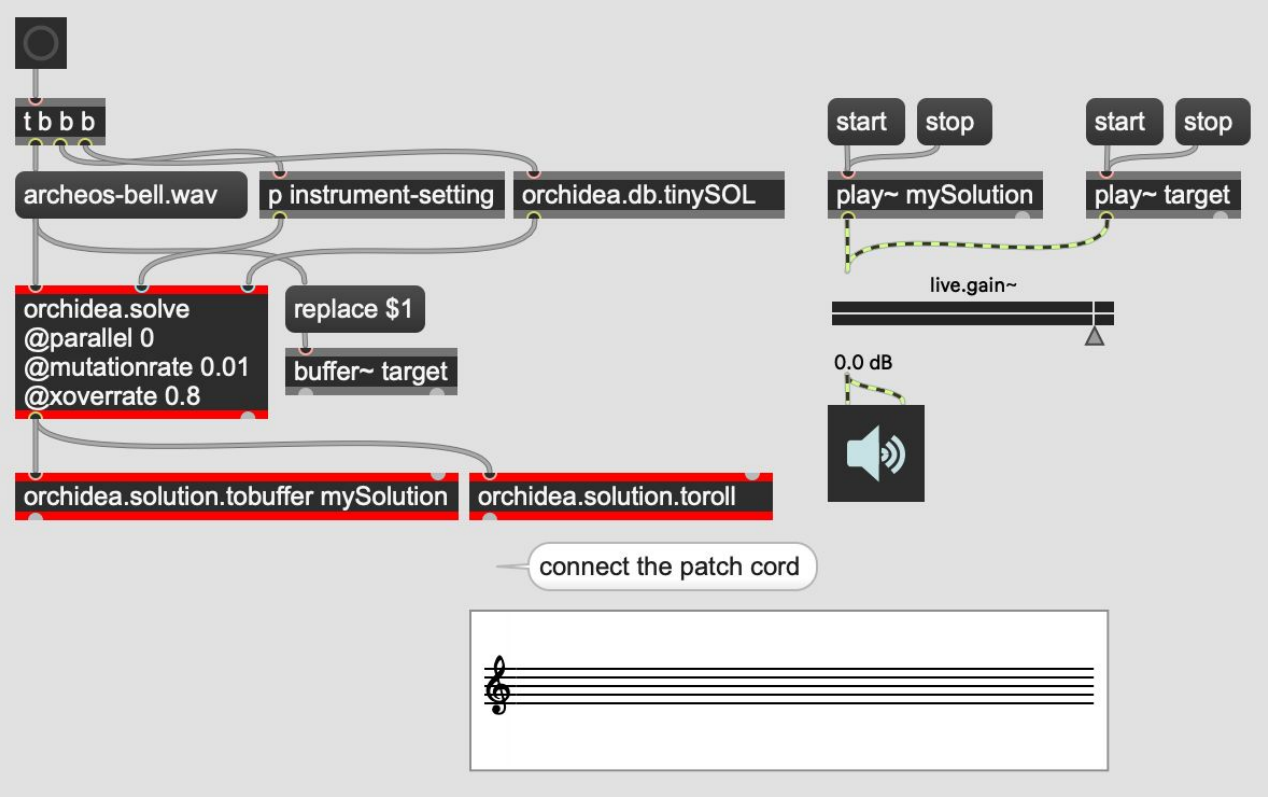


Optimization Setting (technical)

- Computation mode selection for using separate thread or not.
- The **population size** and **the number of epochs** determines the width of the search.
- **Initial population** for the optimization: random, relaxed pursuit, etc.
- **Crossover** and **mutation rate** for genetic optimization.
- The parameters for the optimization are really important, but normally you don't need to change them unless the solutions are not satisfactory.

```
orchidea.solve @parallel 0 @onsetthreshold 0.1
@onsettimegate 100 @partialswindow 32768
@partialsfiltering 0.1 @popsize 200 @maxepochs 200
@exportsolutions 0 @negativepenalization 10
@positivepenalization 0.5
```

1st Example


t b b b
archeos-bell.wav
p instrument-setting
orchidea.db.tinySOL
orchidea.solve
@parallel 0
@mutationrate 0.01
@xoverrate 0.8
replace $1
buffer~ target
orchidea.solution.tobuffer mySolution
orchidea.solution.toroll
start
stop
play~ mySolution
start
stop
play~ target
live.gain~
0.0 dB
connect the patch cord

More Parameters

- **Sparsity** determines the freedom that the algorithm has to remove instruments of the given orchestra from the solution. If sparsity is 0, each solution will use all instruments; if this value increases, the probability of dropping an instrument increases correspondingly.

- **Partials filtering**: if it is 0 there is no filtering and all the sounds in the database are used. If it is between 0 < x < 1 than the database is reduced by removing the sounds that does not correspond to the partials in the target. Increasing this value produces a stricter selection and only strongest partials (dynamically) are retained.

2st Example

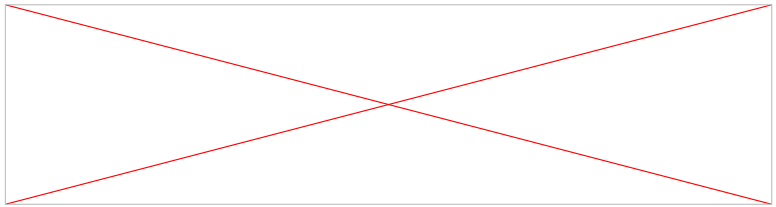

0.
0.01
0.1
0.
0.2
0.4
sparsity $1
partialsfiltering $1
t b b b
archeos-bell.wav
p instrument-setting
orchidea.db.tinySOL
orchidea.solve
@parallel 0
@mutationrate 0.01
@xoverrate 0.8
replace $1
buffer~ target
orchidea.solution.tobuffer mySolution
orchidea.solution.toroll
connect the patch cord
start
stop
play~ mySolution
start
stop
play~ target
live.gain~
0.0 dB

Dynamic orchestration

More Parameters

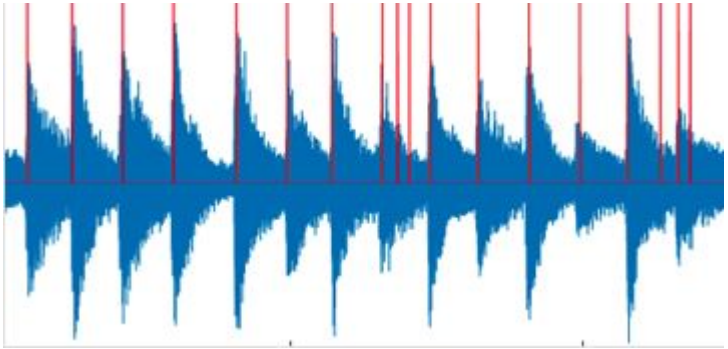
- The basic principle is to **cut** a dynamic target into static segments and **reconnect** them after the orchestration.

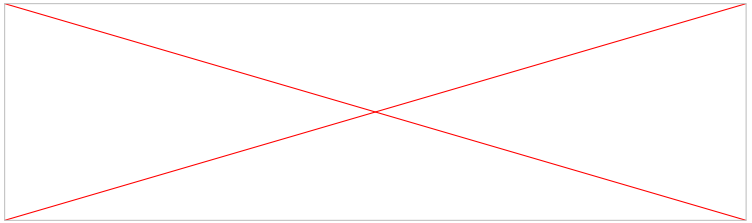
- The current segmentation model uses **thresholds** and **timegates** on specific spectral features to determine onsets. Timegates are specified in seconds, thresholds are absolute values between 0 and 1.



Segmentation policies: frames vs. flux

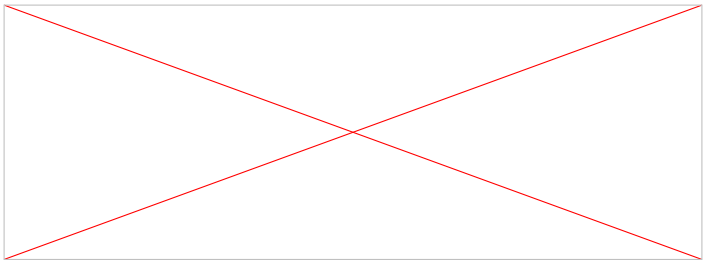
- There are two different policies to segment the target (attribute @segmentation): frames and flux.
- Fames will produce segments of equal length (called frames)
- Flux will use a specific 'novelty' measure to cut the target in significant chunks. In most of the cases you may want to use the second policy, the flux.



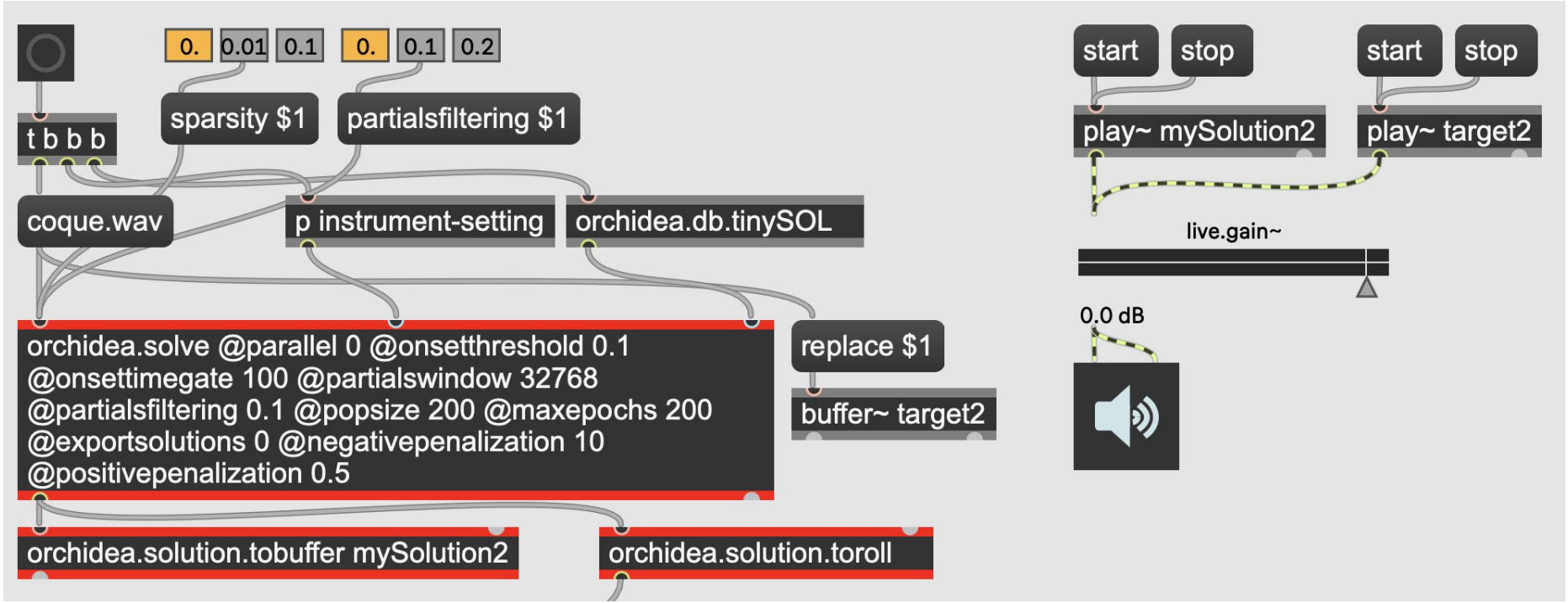


Connection policies: best vs. closest

- There are two policies to connect the solutions in time (attribute @connection): best and closest.
- “best” will connect the best solution of each segment (the solution that best matches the target).
- “closest”, instead, will connect the solutions that minimize movements for each instrument (for example by keeping the same instrument and the same note across segments).



3rd Example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Thank you