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DE LA RECHERCHE SCIENTIFIQUE

C N M A T

CARMINE-EMANUELE CELLA

COMPOSING WITH ORCHIDEA

A PRACTICAL OVERVIEW ON DYNAMIC TARGET-BASED ASSISTED ORCHESTRATION
IRCAM FORUM - MONTREAL, JAN. 2021

PART 0: DISCLAIMERS!

I will not teach you
orchestration!

Ceci n'est pas l'orchestration...



INSTRUCTOR

Carmine-Emanuele Cella

Assistant professor, CNMAT/Music
University of California, Berkeley

Musical composition
Applied mathematics
Computational creativity

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www.carminecella.com

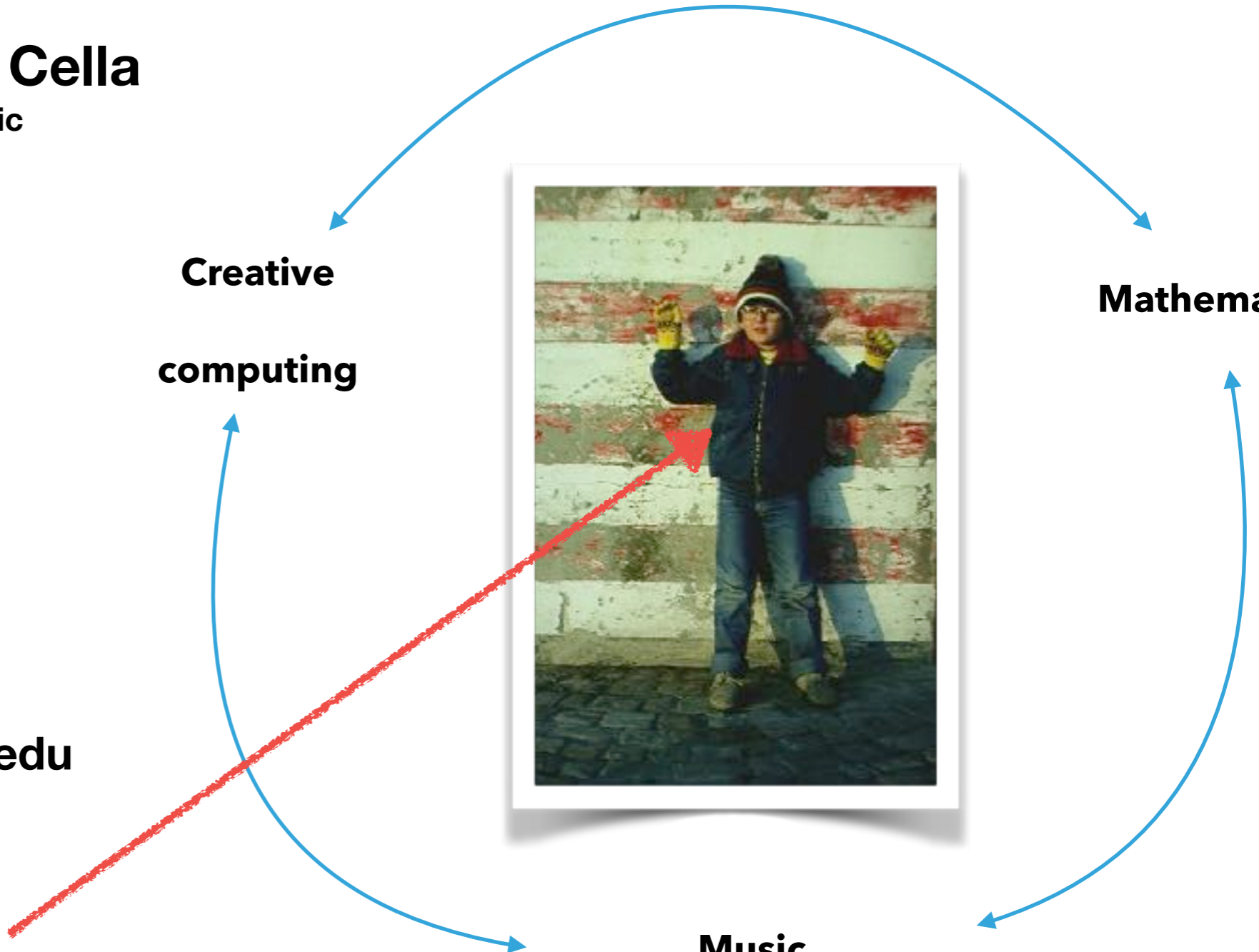
Call me Carmine!

**Creative
computing**

Mathematics



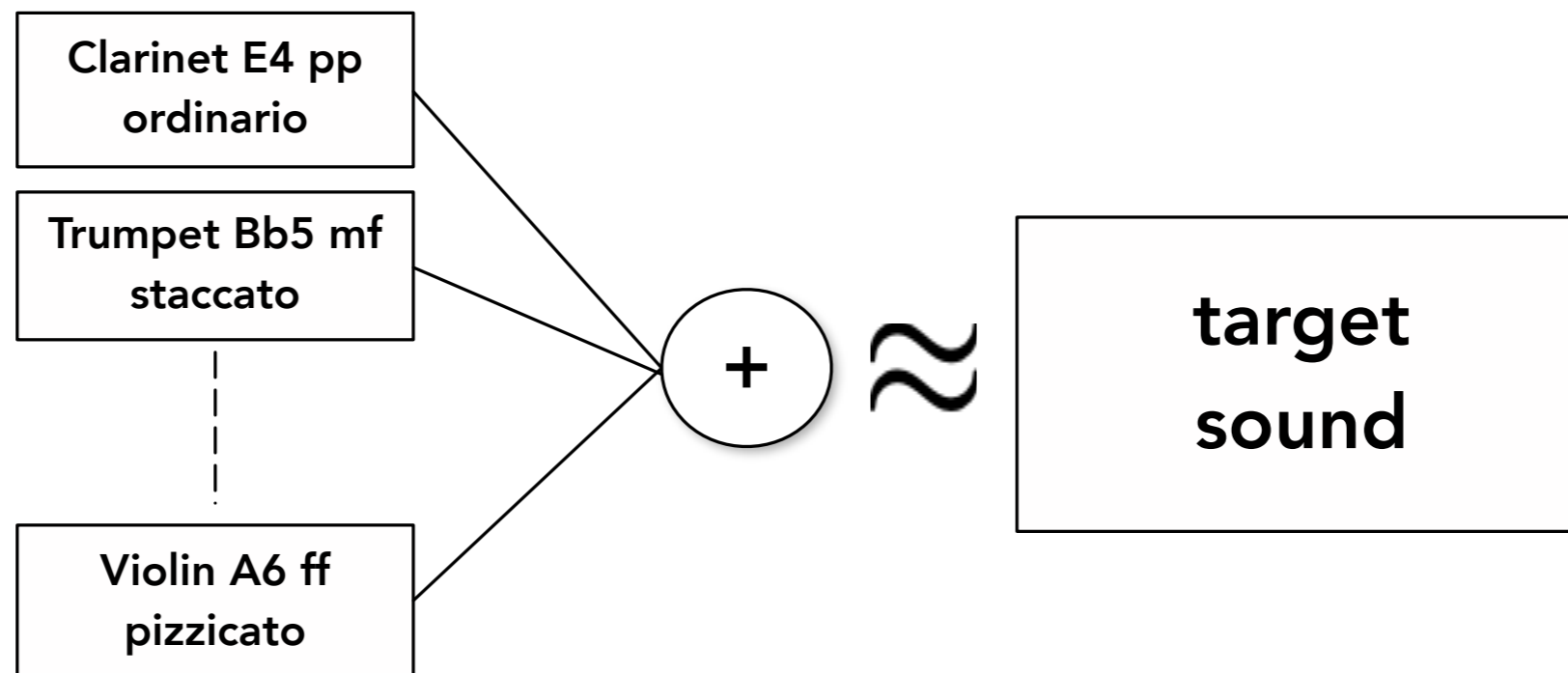
Music



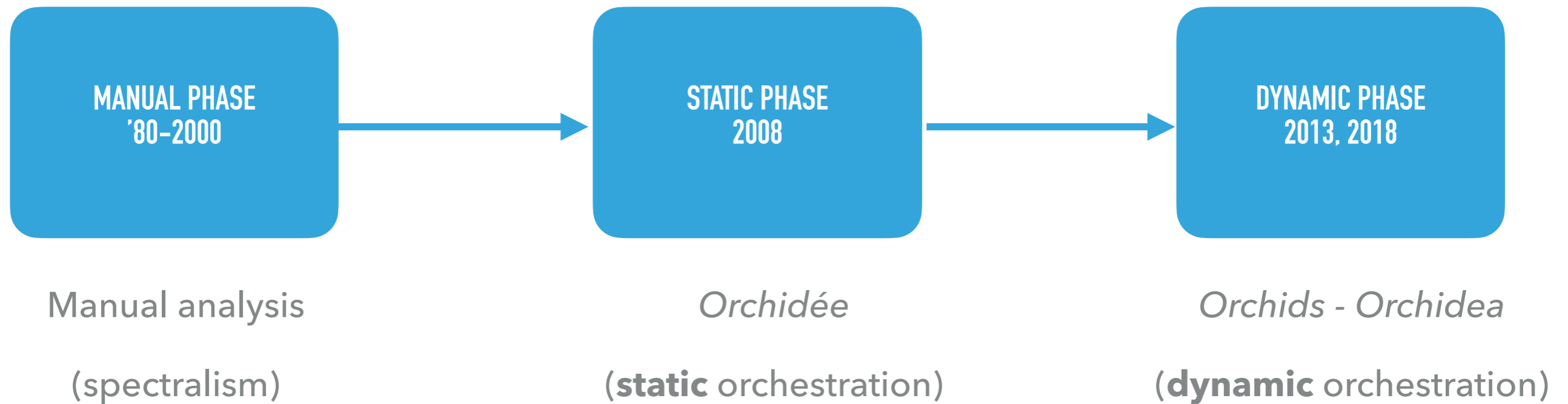
PART 1: TARGET-BASED ORCHESTRATION

A PRELIMINARY DEFINITION

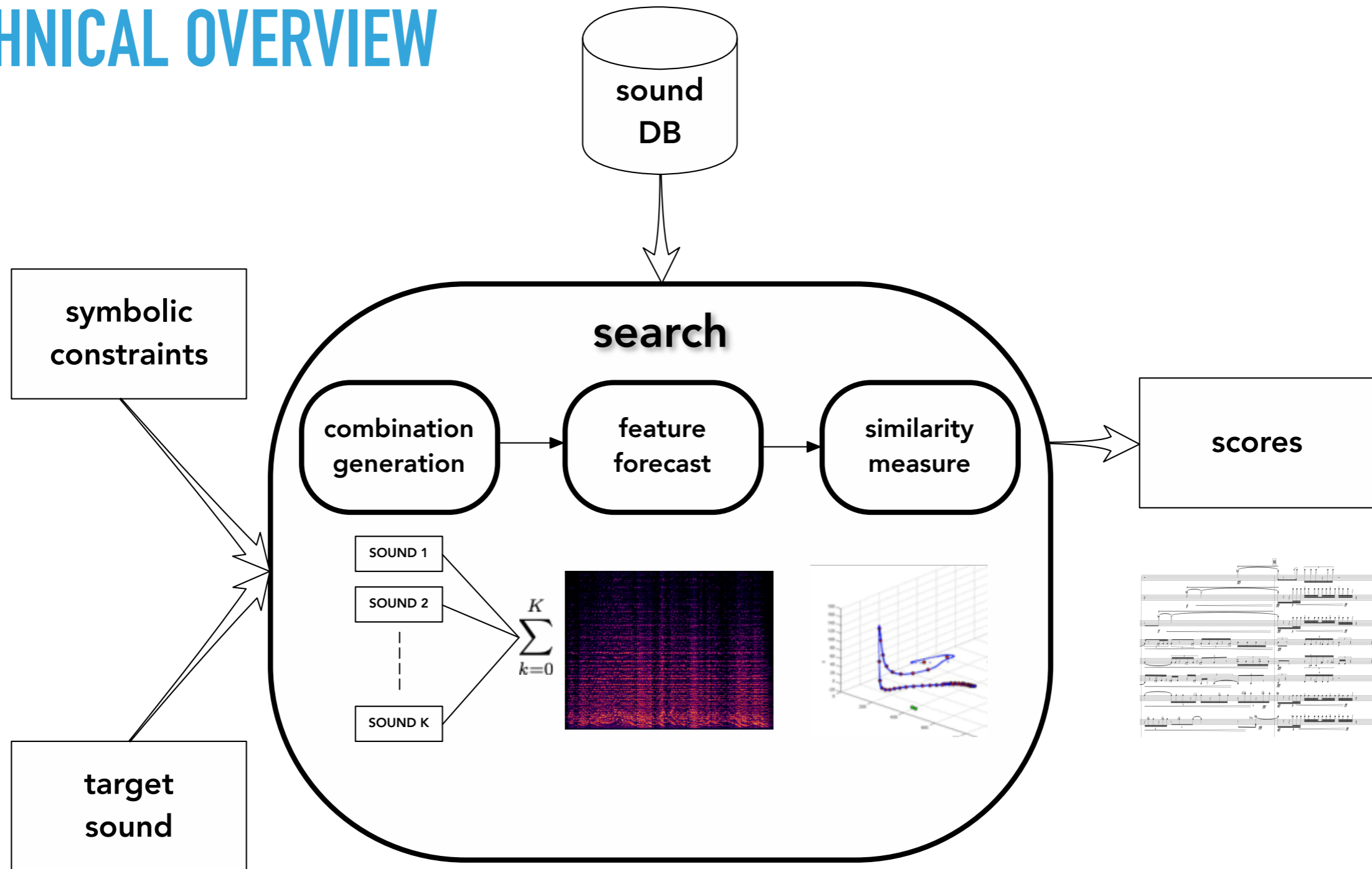
The process of searching for the best combinations of orchestral sounds to match a target sound under specified metric and constraints.



HISTORIC OVERVIEW



TECHNICAL OVERVIEW



PART 2: ORCHIDEA

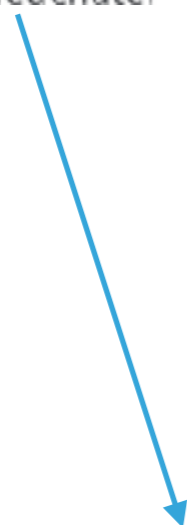
JOINT PROJECT

hem

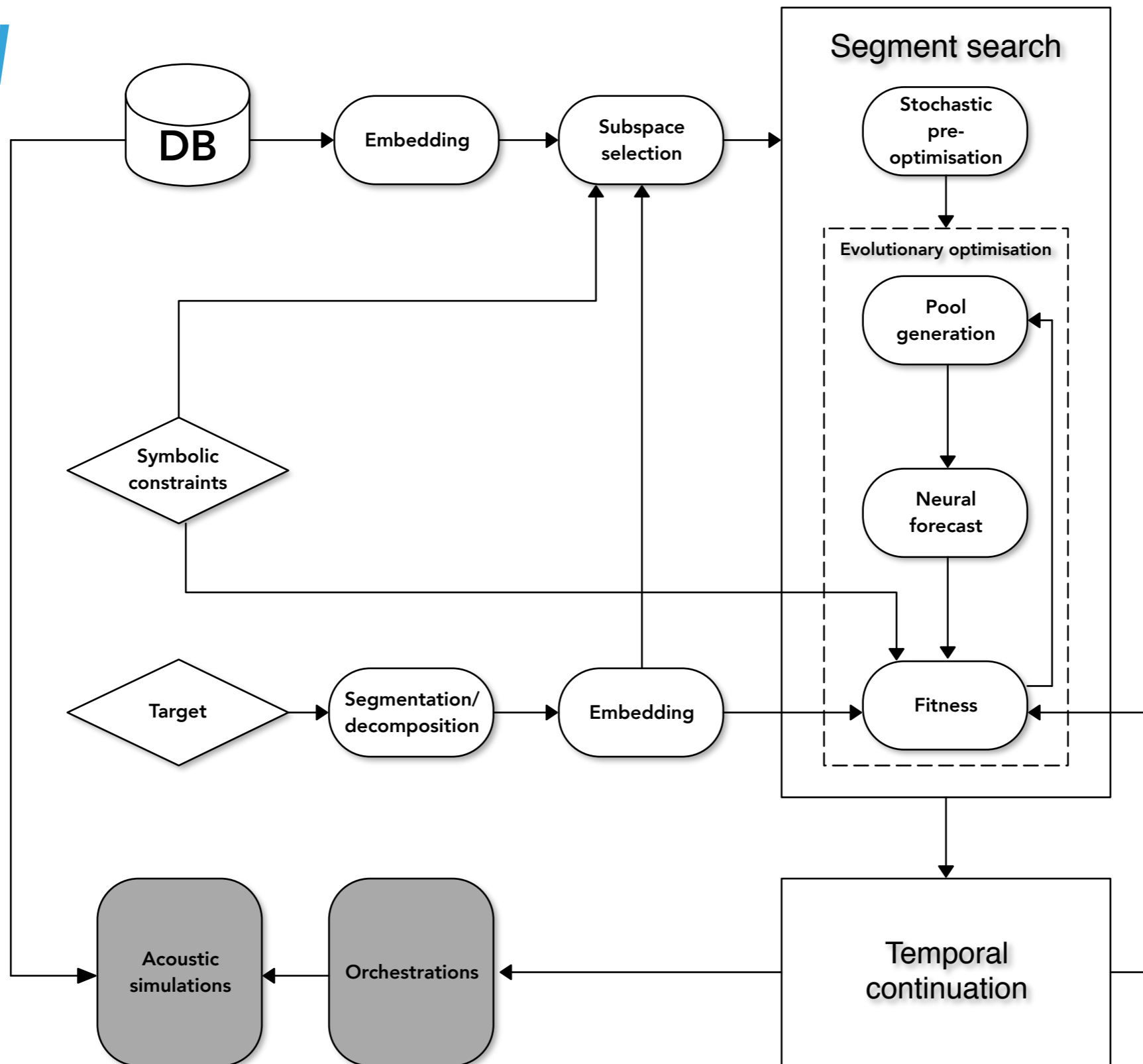
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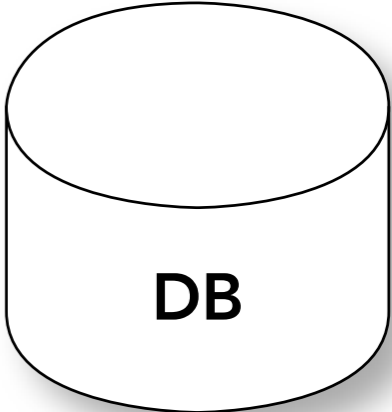
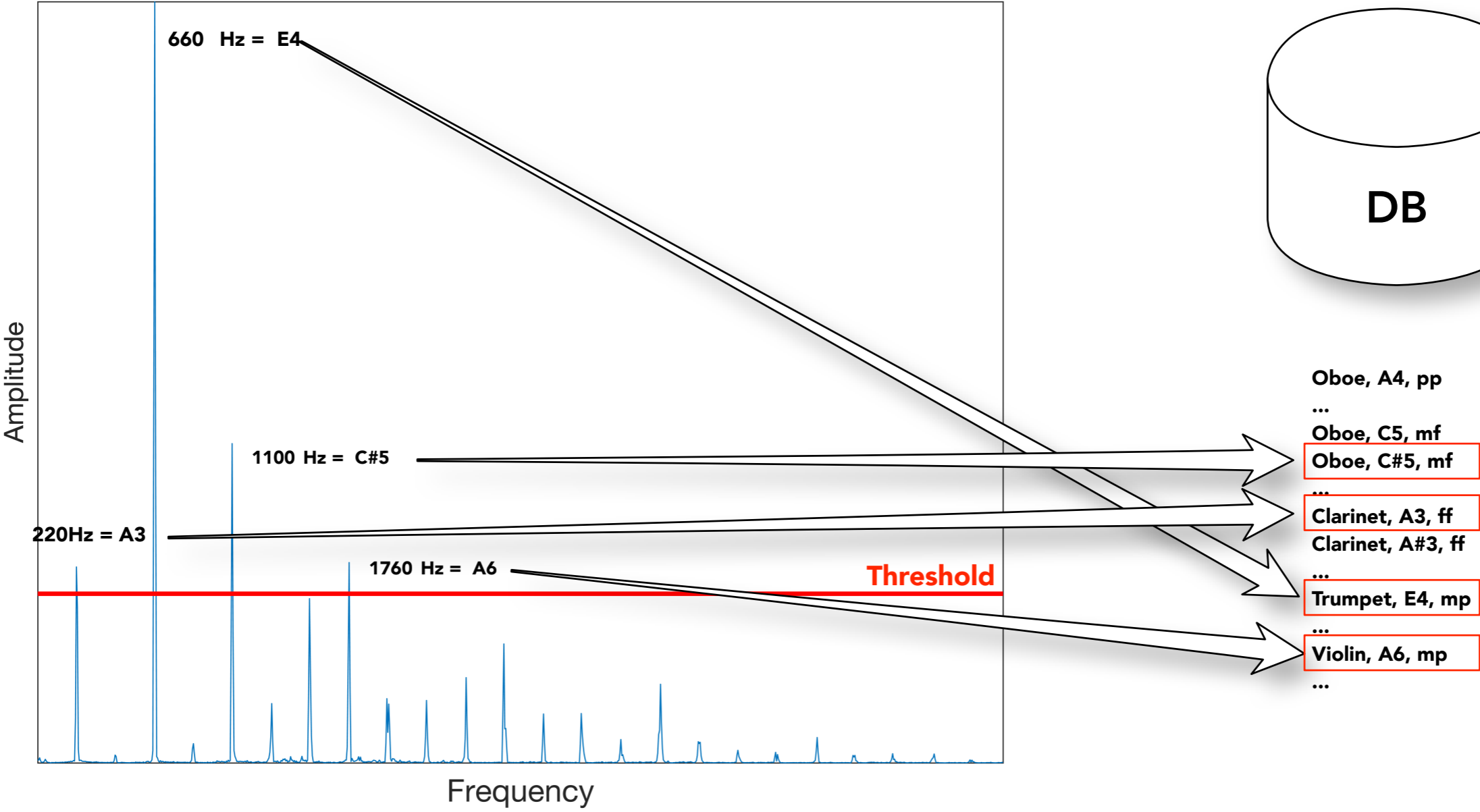


OVERVIEW



PARTIALS FILTERING

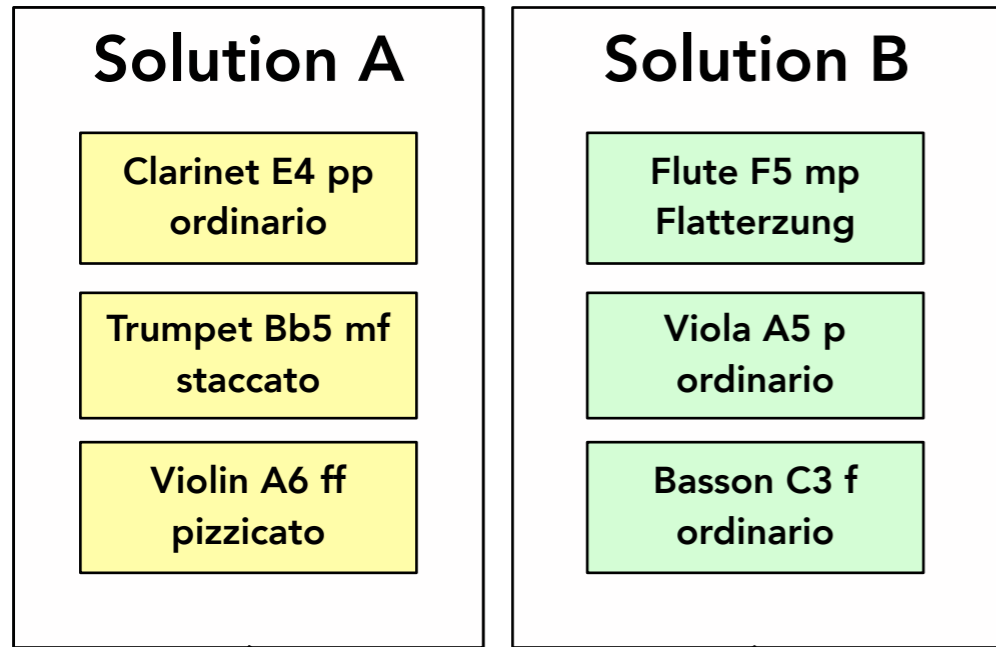
Target spectrum



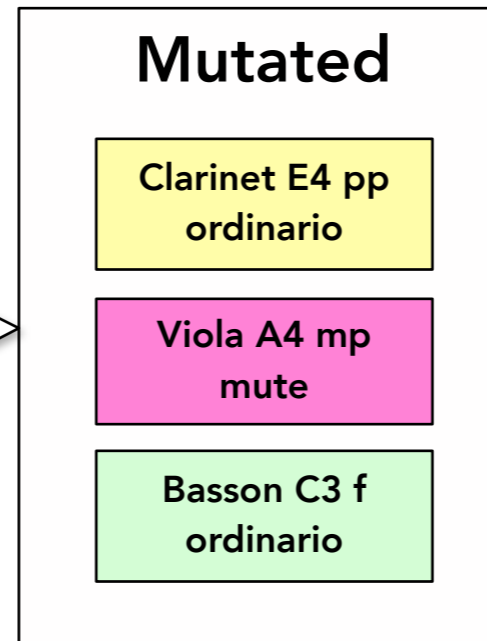
- Oboe, A4, pp
- ...
- Oboe, C5, mf
- Oboe, C#5, mf
- ...
- Clarinet, A3, ff
- Clarinet, A#3, ff
- ...
- Trumpet, E4, mp
- ...
- Violin, A6, mp
- ...

OPTIMISATION

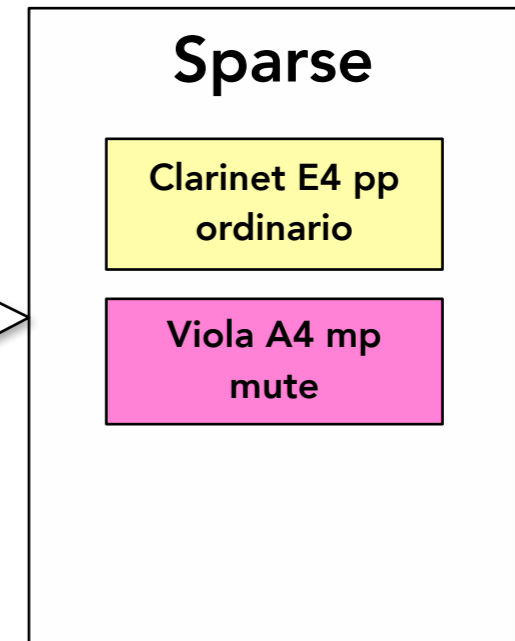
Crossover



Mutation



Sparsity

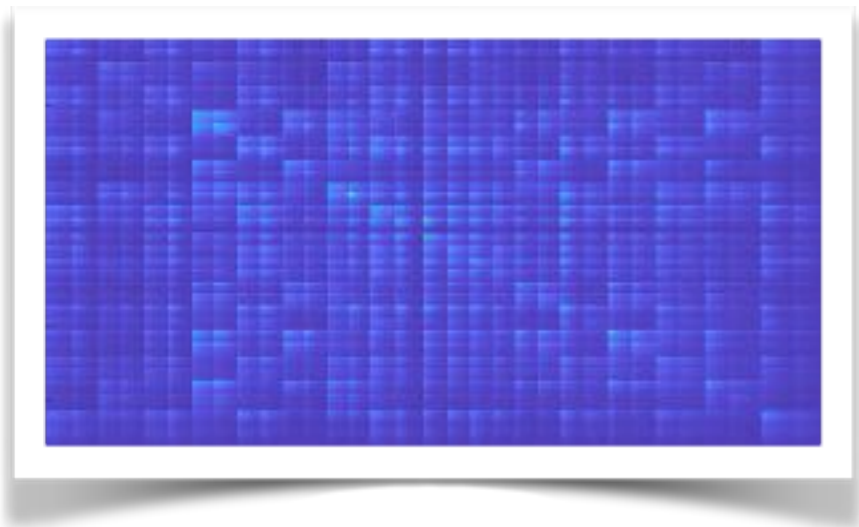


THE DOVETAIL EFFECT

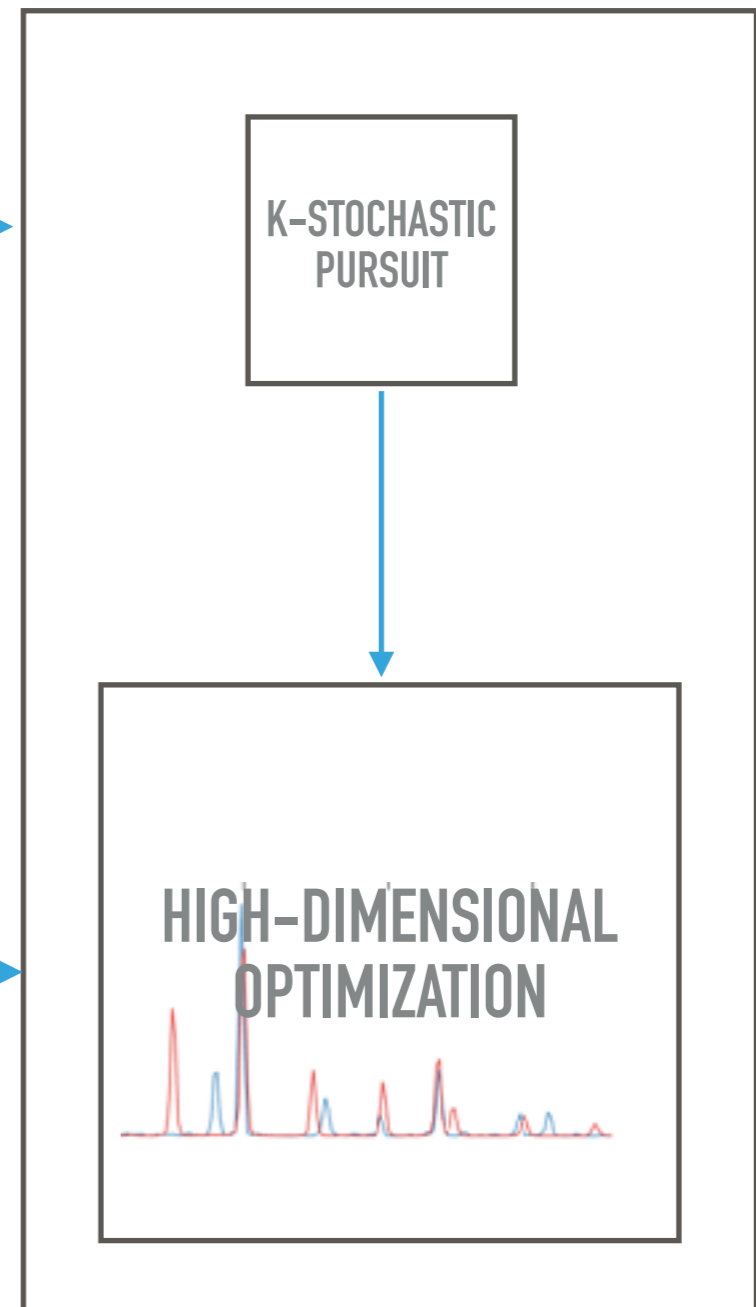
The image displays a musical score for four instruments: Flute, Oboe, Violin, and Viola. The score is written in a single system with four staves. The key signature is one flat (B-flat), and the time signature is 4/4. The Flute and Oboe parts are in treble clef, while the Violin and Viola parts are in treble and bass clef, respectively. The score illustrates the dovetail effect, where the Flute and Oboe parts are silent for the first two measures and then enter in the third measure, overlapping with the Violin and Viola parts. The Viola part begins in the first measure, while the Violin part begins in the second measure. The Flute and Oboe parts enter in the third measure, with the Oboe part overlapping the Violin part and the Flute part overlapping the Viola part. The score ends with a double bar line at the end of the fourth measure.

TEMPORAL MODELING

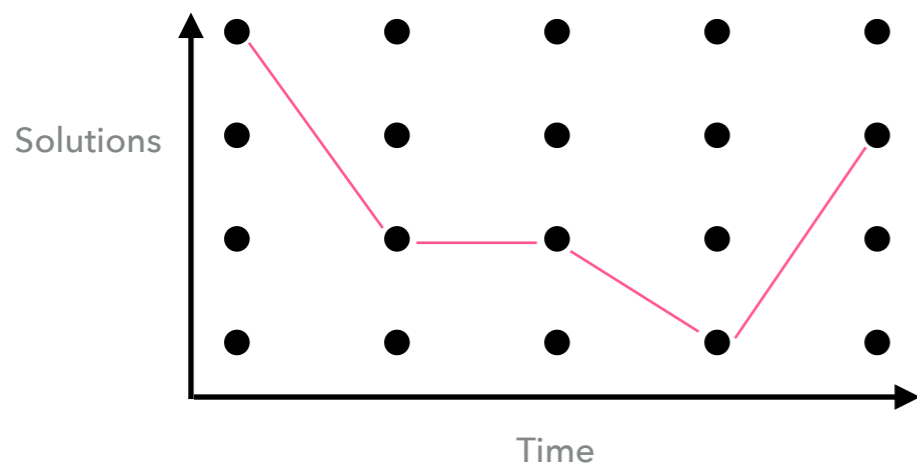
Target segmentation



For each segment....



Shortest-path continuation

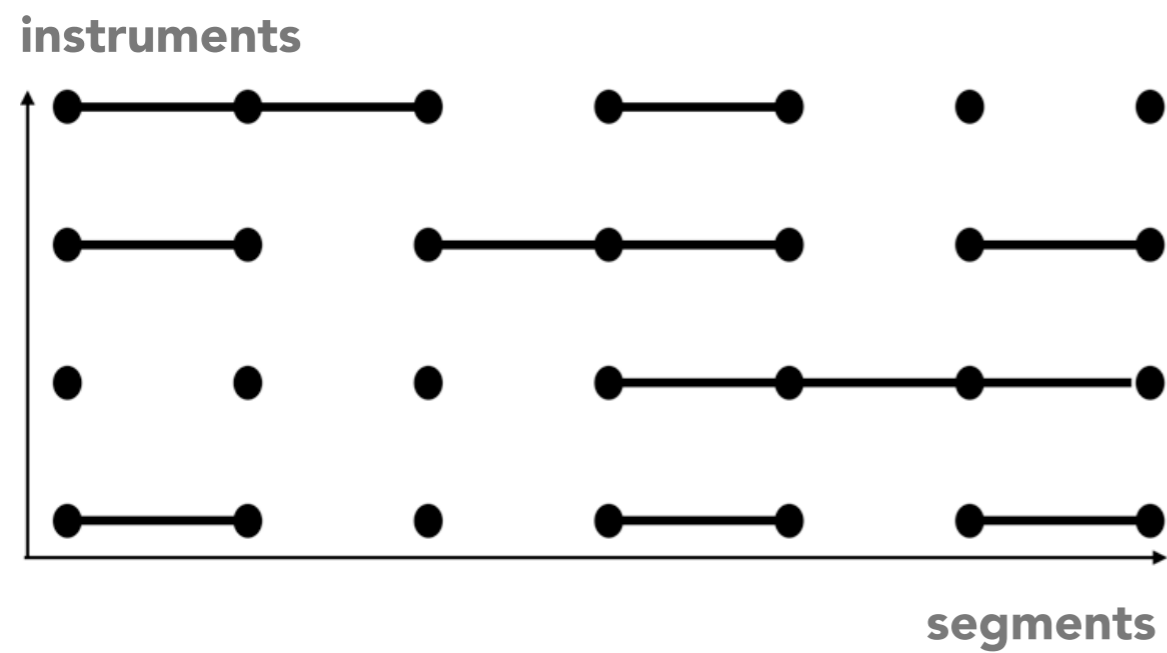


Joint-optimisation

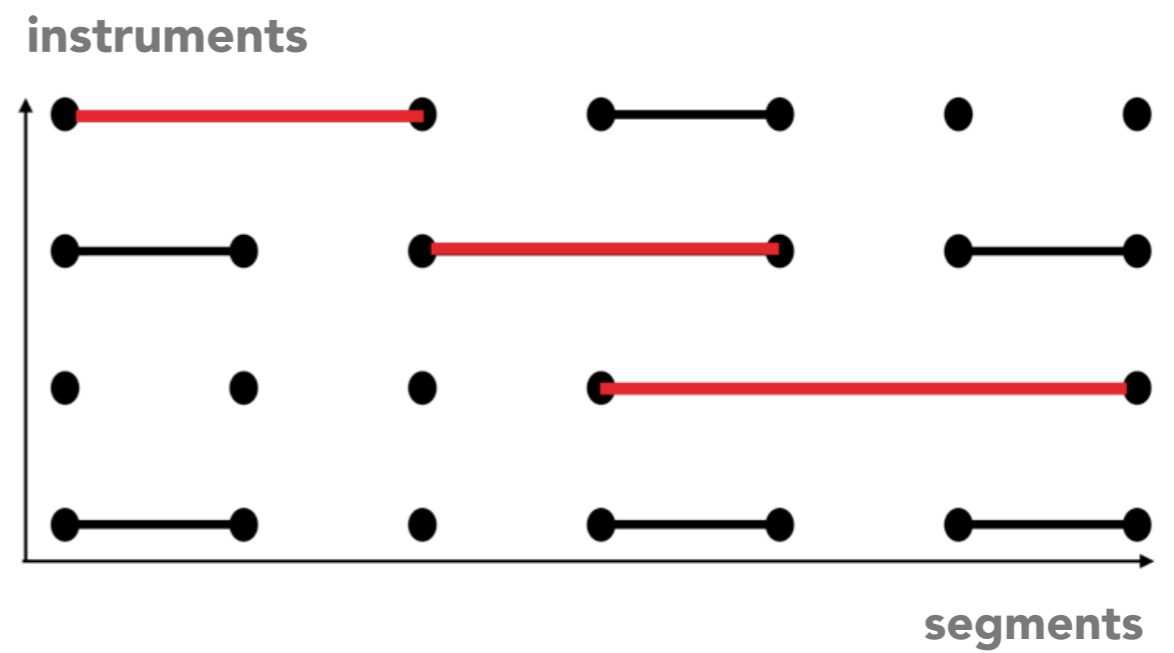


ONSET CONTINUATION

Before onset-continuation



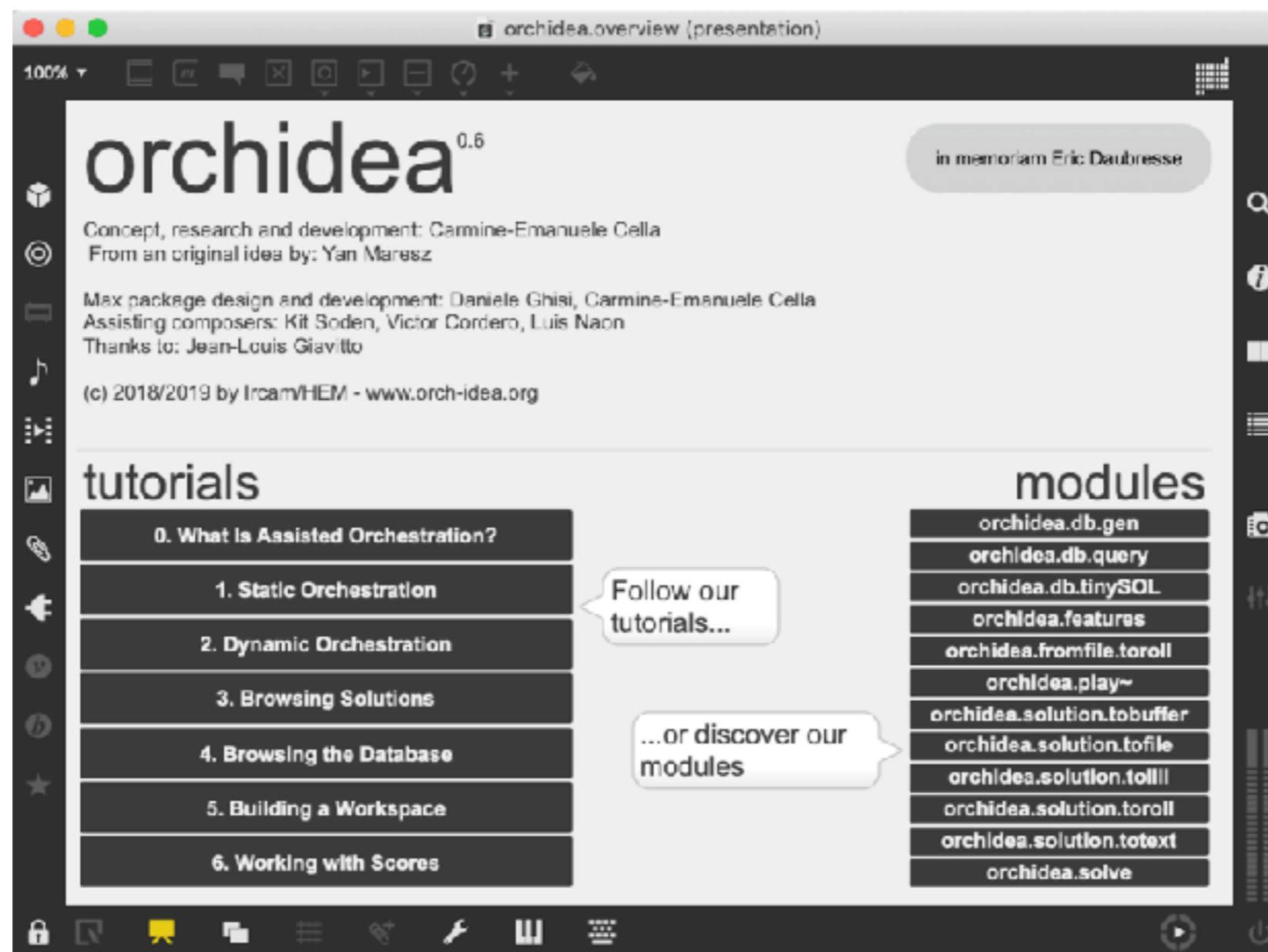
After onset-continuation



PART 3: APPLICATIONS

ORCHIDEA MAX PACKAGE

Carmine-Emanuele Cella, Daniele Ghisi



www.orch-idea.org

ORCHIDEA STANDALONE

Alessandro Petrolati, Daniele Ghisi, Carmine-Emanuele Cella

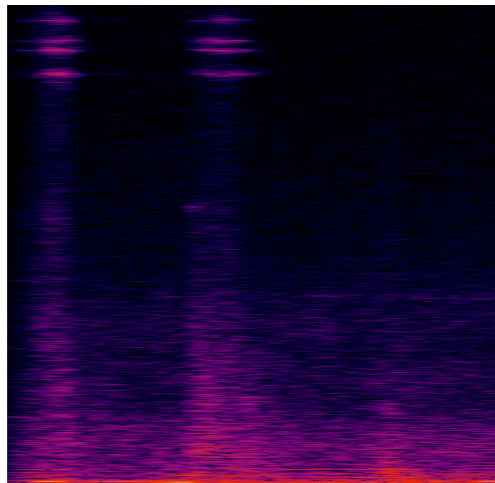


The screenshot displays the Orchidea software interface, which is used for music analysis and score generation. The interface is divided into several sections:

- Target Audio Source:** Located at the top left, it shows a waveform of the audio source being analyzed.
- Properties:** A section below the waveform with buttons for 'Target' and 'Colour', and a 'Solve From Script' button.
- Optimization:** A section with a 'Solve' button and a 'Orchestration' dropdown menu. It includes parameters for 'Quality' (Medium), 'Initialization' (Random), 'Sparsity' (0.01), and 'Sparsity' (0.001).
- Analysis:** A section with a 'Purify Filtering' parameter set to 4.10.
- Segmentation:** A section with a 'Threshold' parameter set to 0.1 and a 'Reimage' parameter set to 1.0.
- Score:** The main area of the interface, showing a musical score for an orchestra. The score is written in staff notation and includes various instruments: ASax, ACl, RTb, ITb+S, Ba, Cl, Cb+S, CIBb, Fl, and Gt. The score is divided into measures, and the time axis is marked at 0:00, 0:10, 0:20, 0:30, 0:40, and 0:50.

www.orch-idea.org

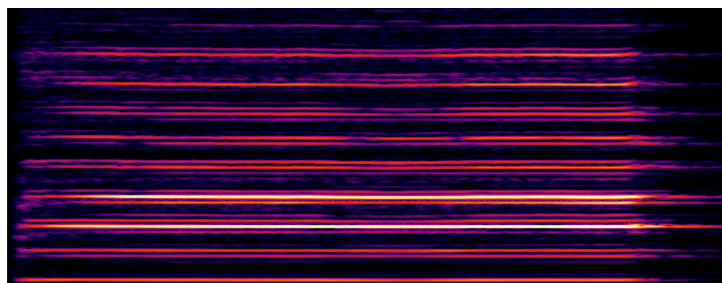
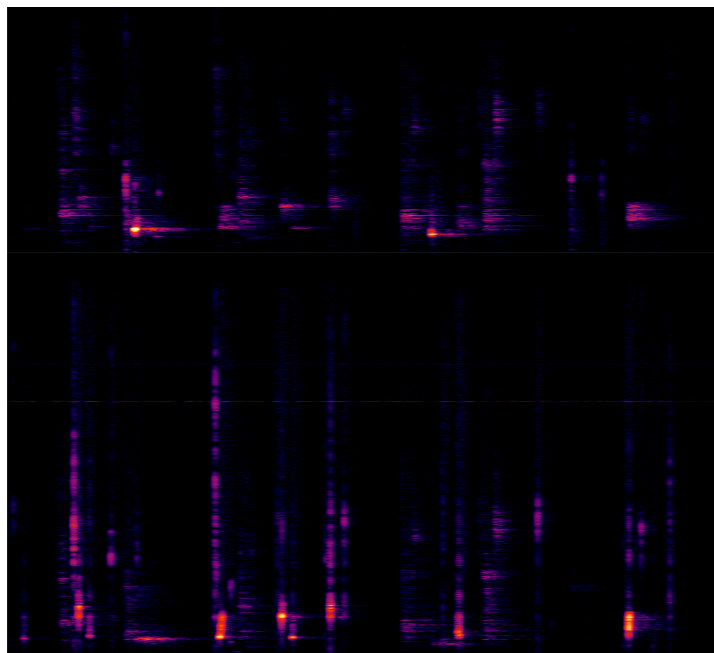
C. E. CELLA, STADES D'OMBRE, STADES DE LUMIÈRE (2018)



Handwritten musical score for "STADES D'OMBRE, STADES DE LUMIÈRE" by C. E. CELLA. The score is divided into sections A and B, with various musical notations and performance instructions. Red boxes highlight specific sections: "ARCHES BEL", "Drops", "YAN MULTI", and "WIND HARP". Arrows point from these sections to corresponding audio visualizations on the left.

Section A: **REUMBRA** (Misterioso), **ANTUMBR**, **UMBRA**. Includes instructions like "pizz", "ppp", "mp", "percussions + winds", "DB + LOW WINDS + BRASSES", "Strings Winds Perc", "Scolite", and "SPEED UP!!".

Section B: **IRIDESCENTES** (Mosso), **TRMELQUES**, **ANAPORPHOS**. Includes instructions like "piano + STRINGS p/ff (hard) + perc (wood)", "brasses", "horn + multi ph.", "high pitched", "brasses + percussions + pf", and "SPEED UP!!".



EXAMPLES

Target sound

Orchidea solution

Real orchestration

(longer excerpt)

The image displays a musical score for the piece "Stades d'ombre, stades de lumière" by Luigi Siccardi. The score is arranged in a standard orchestral format with multiple staves. The instruments included are Flute (Flauto), Oboe (Oboe), Clarinet in B-flat (Clarineta Bb), Bassoon (Fagotto), Horns (Corno), Trumpets (Tromba), Trombones (Trombone), Percussion (Percussion), and Strings (Violini, Violoncelli, and Contrabbassi). The score is written in common time (C) and includes various musical notations such as notes, rests, and dynamic markings. The title "Stades d'ombre, stades de lumière" is prominently displayed at the top, along with the composer's name "LUIGI SICCARDI". The score is presented as a "longer excerpt" as indicated by the text on the left.

EMULATION OF BAROQUE INSTRUMENT

N. GIMENÉZ, AD LIMAEN CAELI (2018)

Nuria Giménez Comas uses *orchidea* to emulate baroque instruments via a modern orchestra. The starting point is a collection of passages from a recording of J.S. Bach's Mass in B minor, whose timbre was adapted to fit with modern instruments.

Violino I.
Violino II.
Soprano I.
Soprano II.
Alto.
Tenore.
Basso.
Continuo.

Et in car- na- tis
Et in car- na- tis
Et in car- na- tis est in car- na- tis
Et in car-

The image shows a detailed musical score for the string orchestra, with three vertical color-coded sections: red, green, and purple. Arrows from the top score point to these sections. The score includes parts for Violino I, Violino II, Viola, Violoncello, and Contrabbasso. The notation is dense, with many notes and rests, and includes dynamic markings like *pp* and *mf*.

L. GOLDFORD, TELL ME, HOW IS IT THAT I POISONED YOUR SOUP? (2019)

Louis Goldford combines target-based orchestration with computer-aided composition techniques at large (both in OpenMusic and in *bach*). His aesthetic goal is to use segmentation of dynamic targets as a magnifying glass, the perceptual distance between target and orchestration relating to a distance, proposed by Lacan (1978), between subject and object

Target sounds are mostly field recordings of sound environments in Taiwan; the finer the segmentation grains, the perceptually closer the orchestration often appears to the sounds—an approach that also somehow relates to electroacoustic practices such the ones of Iannis Xenakis and Curtis Roads

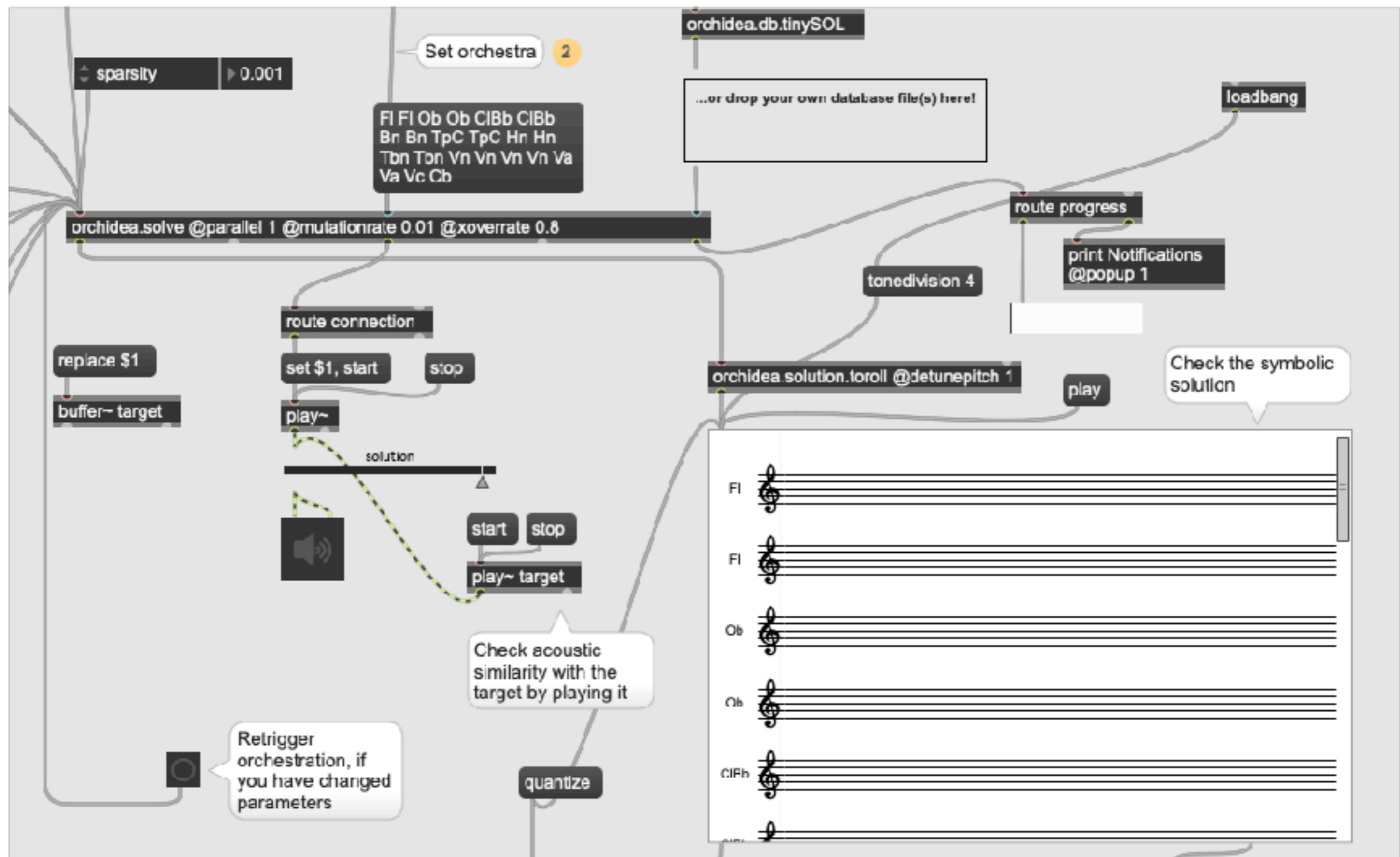
DANIELE GHISI, ORCHESTRAL SUITE

The screenshot displays a software interface for analyzing orchestration and metascoring. The interface is divided into several sections:

- Metascore:** A timeline at the top left showing a score with markers at 4, 1350, 1341, 1341, and 1188. A tempo marking of $\text{♩} = 50$ is visible.
- Orchestration palette:** A scatter plot in the center showing a distribution of purple dots on a grid. The x-axis is labeled with values from 700 to 3000, and the y-axis is labeled with values from 0.05 to 0.5. The plot is titled "Orchestration palette".
- Rendered output:** Musical staves on the right showing notation for Flute (Fl), Oboe (Ob), Clarinet (Cl), Bassoon (Bsn), and Trombone (Tbn). The notation includes dynamic markings like *pp*, *p*, and *f*, and performance instructions like *fat*, *harm. flageo*, and *harm. flageo*.
- Control panel:** A vertical panel on the far right containing buttons for "play both", "exportxml (directions kits 1)", "clefs auto", and a list of clefs: "clefs G G G G F F F F F F G G G G G G F F G G F F Bb".
- Left sidebar:** A vertical panel on the left containing a "dump all" button, a "measure:" field with a value of 0, a "play" button, and a list of audio files: "s1.aif", "s2.aif", "s3.aif", "s4.aif", and "s5.aif" (with a checked box). Below this are several "xfield" and "yfield" labels with associated parameters like "centroid", "inharmonic", and "loudness".

The last episode of the collection is based on a database of several hundreds orchestrations of an audio fragment featuring a distorted voice and an electric guitar. The orchestrations are analysed using standard descriptors (centroid, inharmonicity, spread) and explored via the graphic user interfaces provided by the *dada* library

HANDS ON!



GENERAL STRATEGY

- Understand your target sound!!! (**How would you orchestrate without *orchidea*?**)
- Build a workspace by using: tutorials, `orchidea.solve`
- Focus on static orchestration first:
 - Determine the orchestra and the database
 - Determine *partials filtering*
 - Determine *sparsity*
 - Adapt symbolic filters: e.g. playing styles, dynamics, etc.
- Work on segmentation (threshold and timegate)

WEB RESOURCES

- **Main page:** www.orch-idea.org
- **IRCAM forum page:** <https://discussion.forum.ircam.fr/c/orchidea/49>
- **YouTube channel (Orchestration Idea):** <https://www.youtube.com/channel/UCvQqqpZmCWSly6k4urWKjlw>

PAPERS ON ORCHIDEA

- Carmine-Emanuele Cella, Daniele Ghisi, Alexandre Teiller, Yan Maresz, Philippe Esling, **Dynamic aided orchestration with Orchidea: a practical overview**, Computer Music Journal, in preparation, 2021
- Carmine-Emanuele Cella, **Orchidea: a comprehensive framework for target-based computer-assisted dynamic orchestration**, Journal of New Music research, under review, 2021
- M. Caetano and C. E. Cella, **Generative Computer-Aided Musical Orchestration with Biologically Inspired Algorithms**, book chapter, in Handbook of Artificial Intelligence for music, Springer, to appear in 2021
- Carmine-Emanuele Cella, Luke Dzwonczyk, Alejandro Saldarriaga-Fuertes, Hongfu Liu and Helene-Camille Crayencour, **A Study on Neural Models for Target-Based Computer-Assisted Musical Orchestration**, Joint conference on AI Music Creativity, 2020, Stockholm, Sweden
- Carmine-Emanuele Cella, Daniele Ghisi, Vincent Lostanlen, Fabien Levy, Joushua Fineberg, Yan Maresz, **OrchideaSOL: a dataset of extended instrumental techniques for computer-aided orchestration**, ICMC 2020, Santiago, Chile
- Jon Gillick, C. E. Cella and David Bamman, **Estimating unobserved audio features for targeted-based orchestration**, ISMIR 2019, Delft, The Netherlands
- C. E. Cella and P. Esling, **Open-source modular toolbox for computer-aided orchestration**, Timbre conference, 2018, Montreal, Canada