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# CREATING EXPERIMENTS WITH COSMONOTE: ADVANCING WEB-BASED ANNOTATIONS FOR PERFORMED MUSIC

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## ABSTRACT

CosmoNote is a web-based application for visualizing and annotating expressive structures in performed music. This demo highlights the flexibility of CosmoNote’s reconfigurable interface, features, and toolsets to design experiments to advance knowledge in music science, music perception, and music expressivity. CosmoNote’s music pieces are organized into collections accessible by user accounts with defined roles. The music representations integrate synchronized visual layers representing recorded piano performance data and features to facilitate and inform annotations. The web app provides four annotation types: boundaries, regions, note-groups and comments. Through the selection of pieces, collections and user roles, CosmoNote’s features can be tailored to investigate diverse research questions about experimental design for music audio-based annotations.

## 1. INTRODUCTION

Expressive structures in performed music exist beyond the score, being communicated by the performer through the addition of acoustic variations like intensity, timing, pauses, and articulation. Automatic recognition and extraction of expressive music structures poses major computing challenges. To tackle this problem, CosmoNote [1] recruits the volunteer thinking of human participants, called citizen scientists, to annotate these structures in performed music. While it is possible to annotate some expressive music structures using sound alone, in order to help annotators discern these expressive structures, CosmoNote provides layered visual representations of the music as cognitive scaffolding [2]. Experiments designed using CosmoNote aim to develop better strategies to increase annotators’ awareness and appreciation of expressive nuances in recorded music performances. Here, we show how CosmoNote enables a variety of efficient study designs.

## 2. CONFIGURING COSMONOTE FOR A STUDY

CosmoNote’s tools and visuals are designed to be highly re-configurable for performed music studies. CosmoNote’s

input data organized into three main types of documents: pieces, collections, and user roles.

**Pieces:** Music data, called pieces, are the core researcher input of CosmoNote. Each piece incorporates visual layers that can be shown or hidden by the annotators or researchers, depending on the experiment. The recorded performances are encoded as MP3 audio (plotted as a waveform) and/or MIDI data (displayed visually in a piano-roll style with notes and pedal information). Musical descriptors are computed from the audio and MIDI recordings as well as the scores for the performances. These data curves include loudness (derived from the audio recording), tempo (derived from the score and the MIDI recordings), and harmonic tension data (derived from the score). CosmoNote also allows the visualization of optional supplementary data (e.g., ECG signals) synchronized with the music. CosmoNote allows experimenters to present pieces in one of three modes: visuals with audio (default), audio only and visuals only. These modes extend the scope of studies that are possible with the app.

**Collections:** Pieces are shown to annotators in a set, called a collection. Pieces in a collection are chosen because they share individual properties (e.g., performer, composer) or an overall theme (e.g., music from the romantic era). Participants navigate through collections and complete annotation tasks that are specific to that collection. Each collection can include customizable options for: presentation (show/hide piece information), navigation (change piece order and piece selection), controls (show/hide buttons), visualizations (show/hide visual representations), annotation types (allow one or more types), and writing to the database (grant/revoke saving privileges). Pieces in a collection can be displayed in a fixed order, or can be shuffled for each participant, storing the presentation order for later analysis.

**User roles:** To access CosmoNote<sup>1</sup>, annotators create a user account or are provided with one. User accounts allow annotators to have a personalized experience in which they can, for example, save their annotations between listening sessions. Each user account encompasses many associated properties (identification, account setup, among others), and is linked to data files containing all annotations marked by respective users in CosmoNote. For experimental design purposes, a user role property is associated with each account. User roles give experimenters the possibility to control precisely what type of access users have. There

<sup>1</sup><https://cosmonote.ircam.fr>

are three main types of roles: 1) super users, who can see all the content inside the CosmoNote server, which is hidden for everybody else; 2) public users, who can only see active public campaigns (this is the default role assigned when creating an account); and 3) custom users, who will see only a subset of the data that is different from the public campaigns (e.g., a set of pieces for a custom experiment).

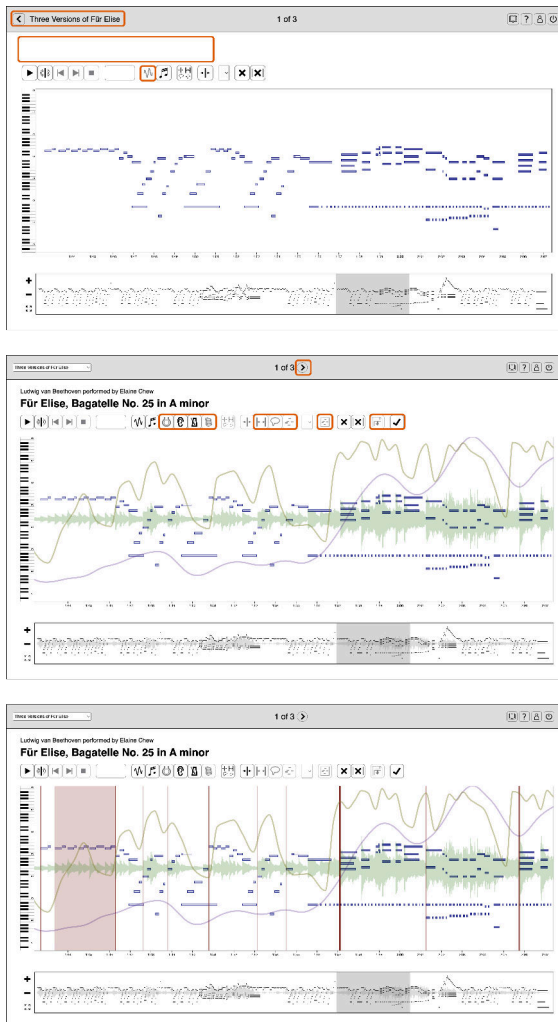


Figure 1. Variations of CosmoNote’s interface in two experimental cases: Few options enabled (top) vs All options enabled (middle). Orange boxes highlight the differences. Boundary annotations of different strengths and regions are displayed in shades of red in the last panel (bottom)

### 3. ANNOTATING IN COSMONOTE

For the demonstration, attendees will be invited to participate in a CosmoNote annotation experiment. Through selected example cases, participants will learn how to actively listen for the music structures that arise from the decisions and actions of a performer, and see how these structures correlate with the music and audio features displayed visually on the CosmoNote interface.

Annotators will obtain/create a user account integrating a common user role and will be shown a sample of CosmoNote’s collections. Pieces in each collection will contain different visuals to illustrate the information layer’s use in specific contexts. To show CosmoNote’s annotation capabilities, one visual layer has been created to show all four interactive annotation types: boundaries (vertical lines in time, with four levels), regions (time selections with start and end times), note-groups (selections of notes), and comments (miscellaneous indications).

The following examples are just a small selection of the configurations available in the CosmoNote interface. The example on Fig 1 shows two different configurations of CosmoNote’s interface. Fig 1 (top) is a restricted version of the app: Only two visualizations are possible (waveform –toggled off– and piano-roll), only boundary annotations can be placed, and navigation is forced (users cannot advance to the next piece until they finish annotating the current piece). In contrast, Fig 1 (middle) shows a complete version of the app: All visualizations, annotation types and navigation options are available to the user. Fig 1 (bottom) shows boundaries (red vertical lines) and regions (light-red rectangle) layered on top of the music data and feature visualizations (pedal data and harmonic tension are toggled off).

### 4. SUMMARY

CosmoNote was created for enabling people with diverse backgrounds to mark structures such as boundaries, accents, and salient melodies that they hear and experience while listening to recordings of performed music. Demo participants will learn about the conception and design of CosmoNote and its principal annotation methods. They will also learn about the possibilities for study design using this new tool. The demonstration is conceived to showcase the capabilities of CosmoNote and the study design options so as to equip annotators with the knowledge to make the most of the web app while creating an environment that fosters constructive feedback for the evolving design and use of CosmoNote.

### Acknowledgments

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### 5. REFERENCES

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