

# *MuBu for Max/MSP*

IMTR IRCAM – Centre Pompidou

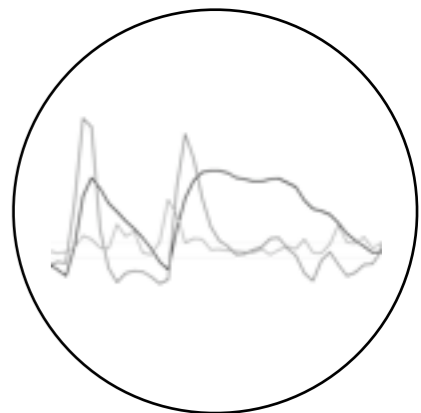
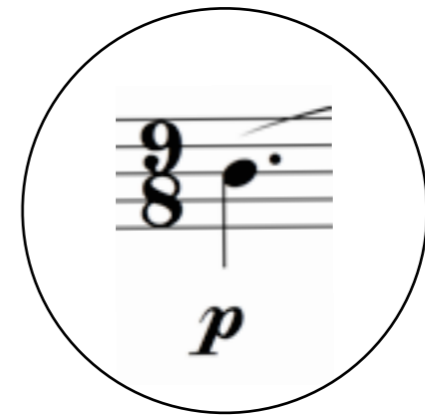
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# Motivation

Create a solid and open framework for the experimentation with recorded data streams of multiple representations in *Max/MSP*

- audio samples
- audio descriptors
- gesture and motion capture data
- spectral audio representations
- symbolic representations
- segmentation and annotations
- ... what else?



# Converging Applications

- **Analysis/re-synthesis** (*sound, music and speech*)
- **Corpus based granular synthesis** (*textures*)
- **Following and recognition** (*gestures/sounds and scores*)
- **Computer aided improvisation**
- ...

# Context

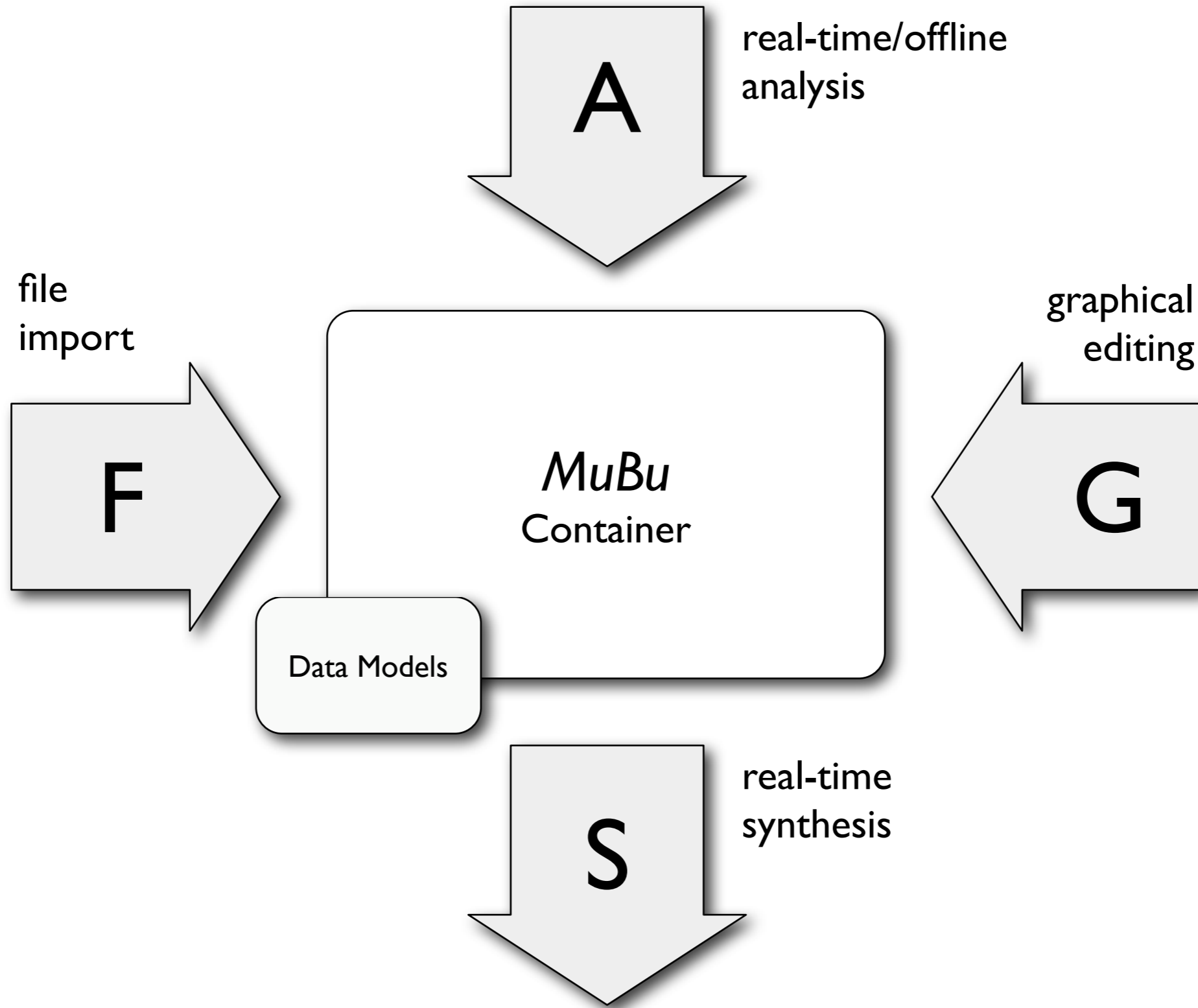
- *Créations IRCAM & Forum*
- *Recherche musicale*
- Prototyping of interactive real-time applications

# Relaxed Real-Time Analysis/Synthesis

- Real-time *analysis, recognition and classification*
  - *structured* sound and gesture data
  - “*emerging symbolics*”
- Content based audio *processing and rendering*
  - synthesis based on offline or real-time analysis
  - “*post-sampling*” and “*re-performance*”

# *MuBu* Container Functionalities

- Store *heterogeneous synchronous* data streams
- File import/export
- Visualization and editing
- Optimized congruent access to shared data
- Handling of dynamic configurations (data and references)

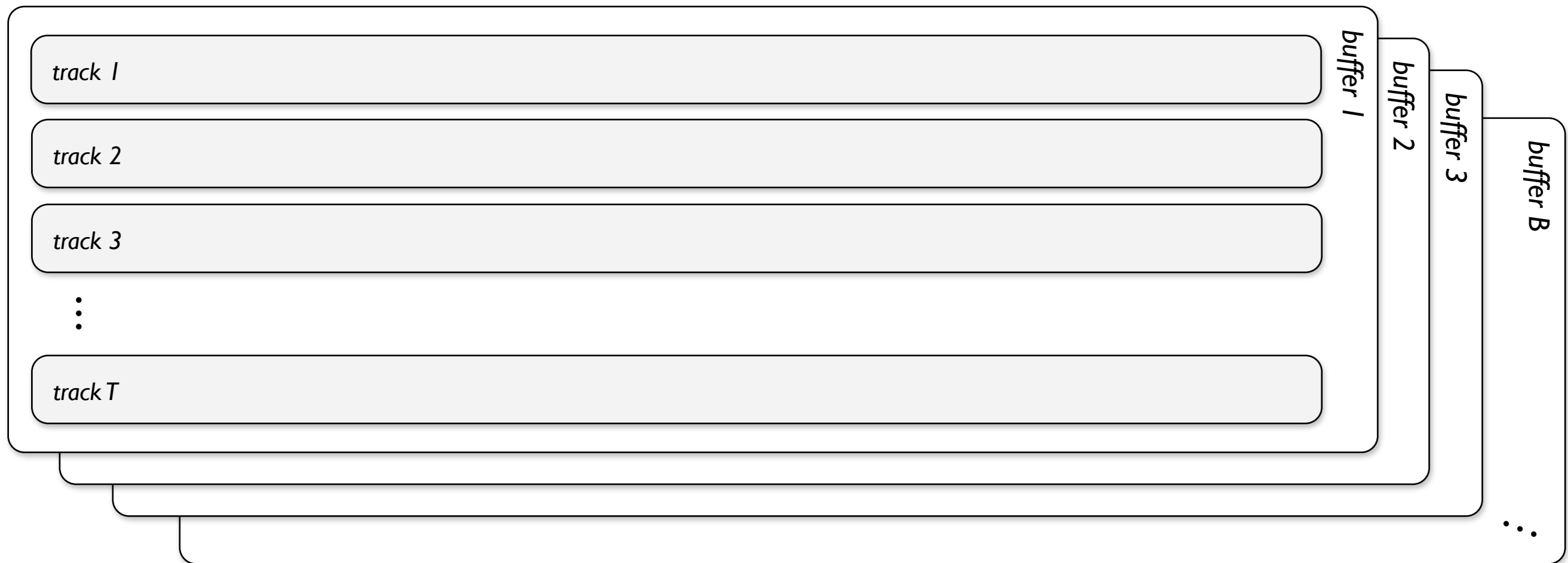


# *MuBu* Container Design

- *Simple* and *easy* to maintain
- *Minimizing* dependencies on other libraries
- *Thread-safe* and *lock-free* congruent data access

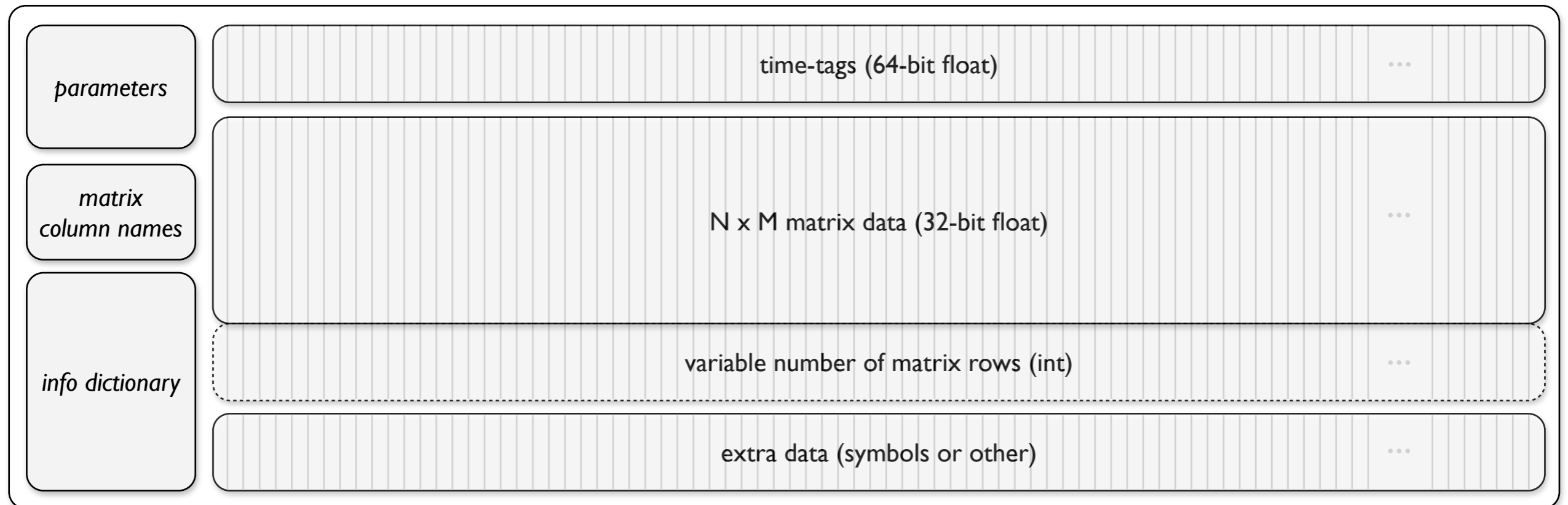
# Container Data Structure

- Array of *buffers* being arrays of *tracks*



# Track Data Structure

- Array of 2-dim matrix data (optional *time-tags* and *matrix rows*)
- Array of (non-matrix) “extra” data (currently *labels* only)
- Track meta-data



# Modularity and Thread-Safeness

- Distinction of *configuration* and *real-time* access
  - *thread-locked* access to container (using *pthread r/w locks*)
  - *lock-free* access to track data (using *compare-and-swap*)
- Track implemented as *immutable* data structure
  - fixed capacity
  - re-configuration by copying data into a new track
- Container manages dynamic track configuration
  - locked *callbacks* to modules that refer to a container
  - simple *garbage collector* (by reference count)

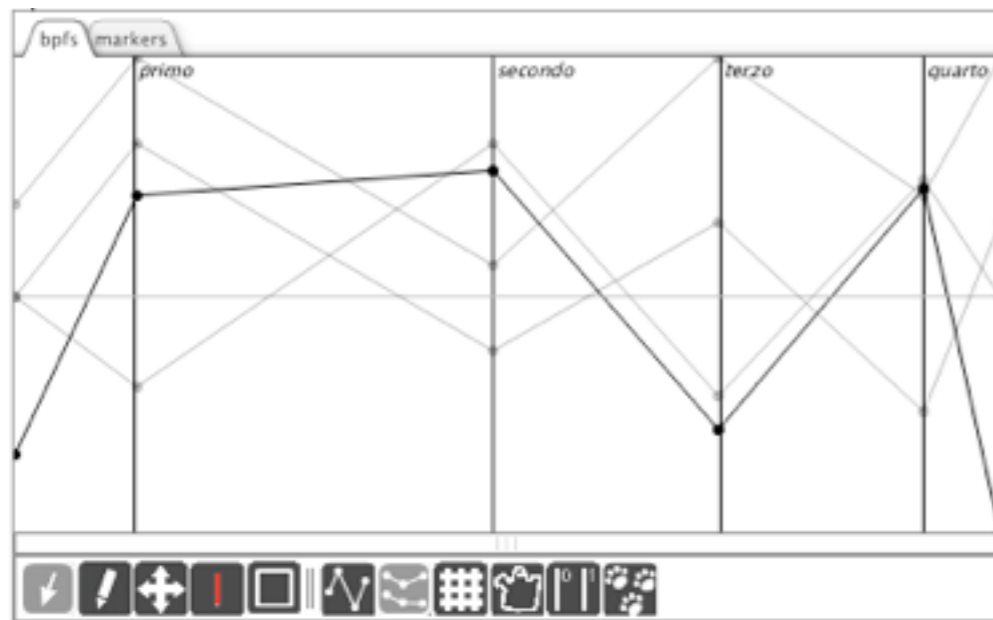
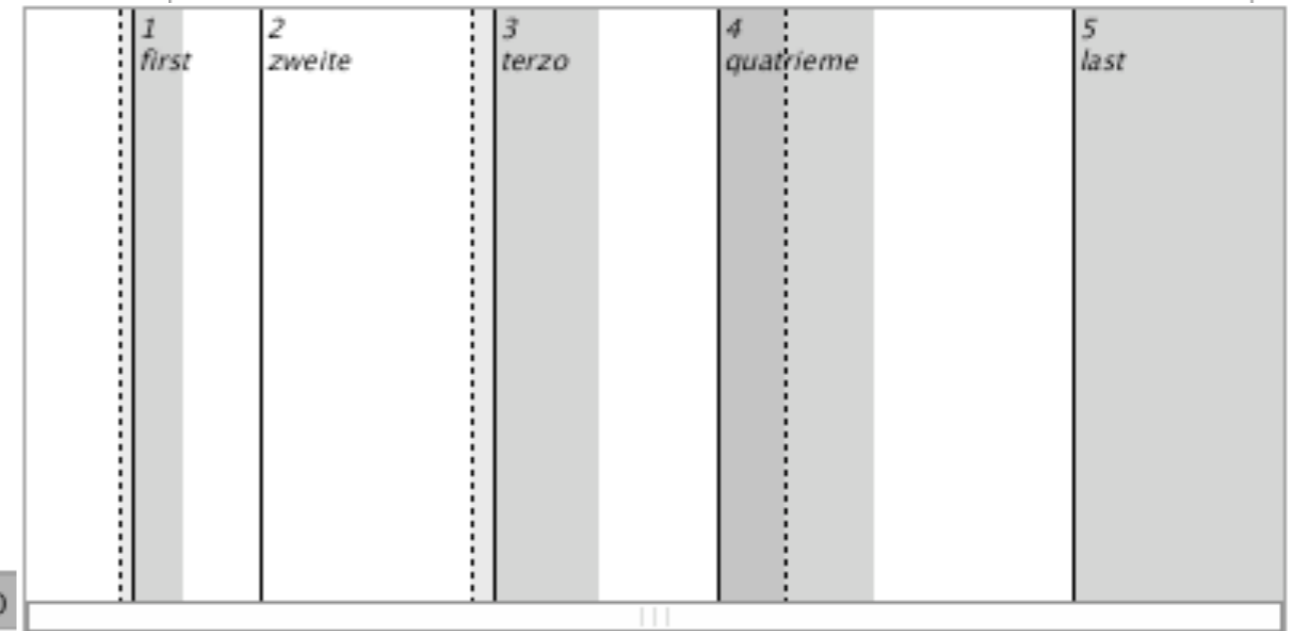
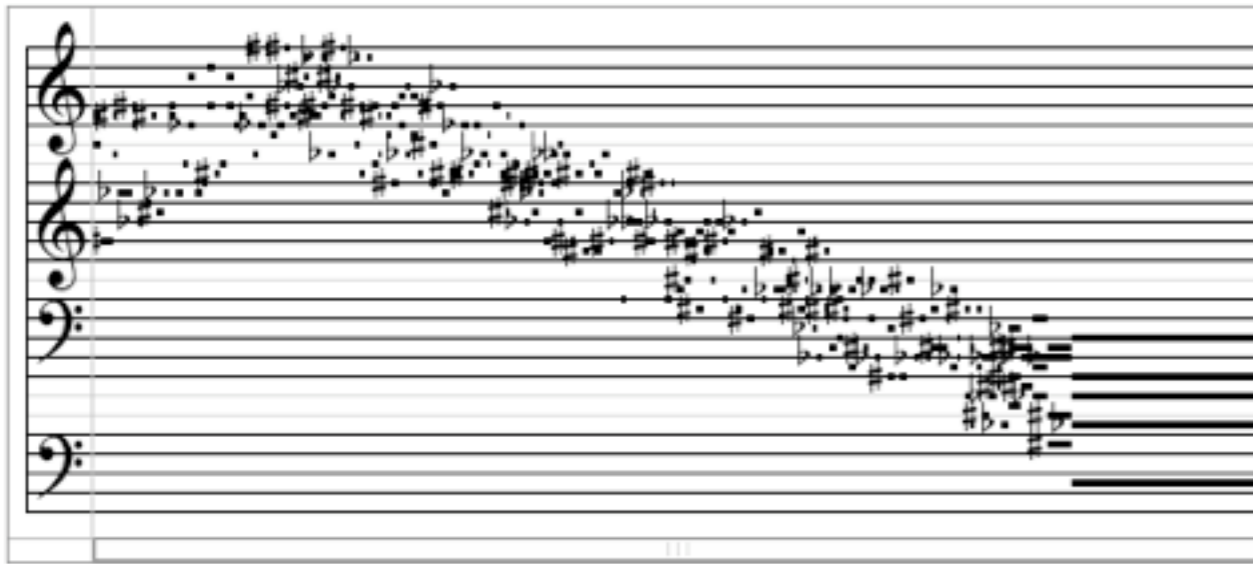
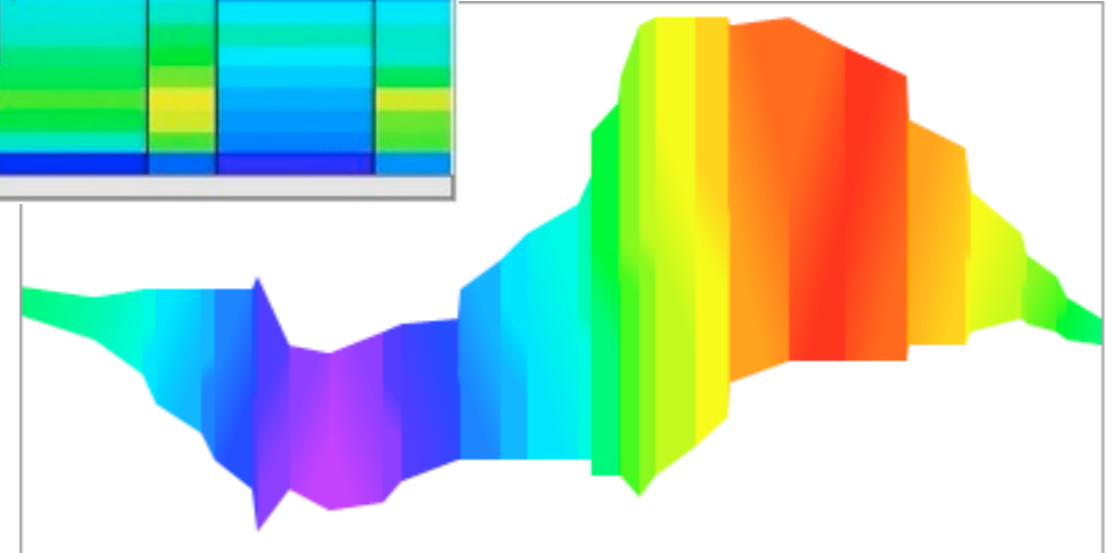
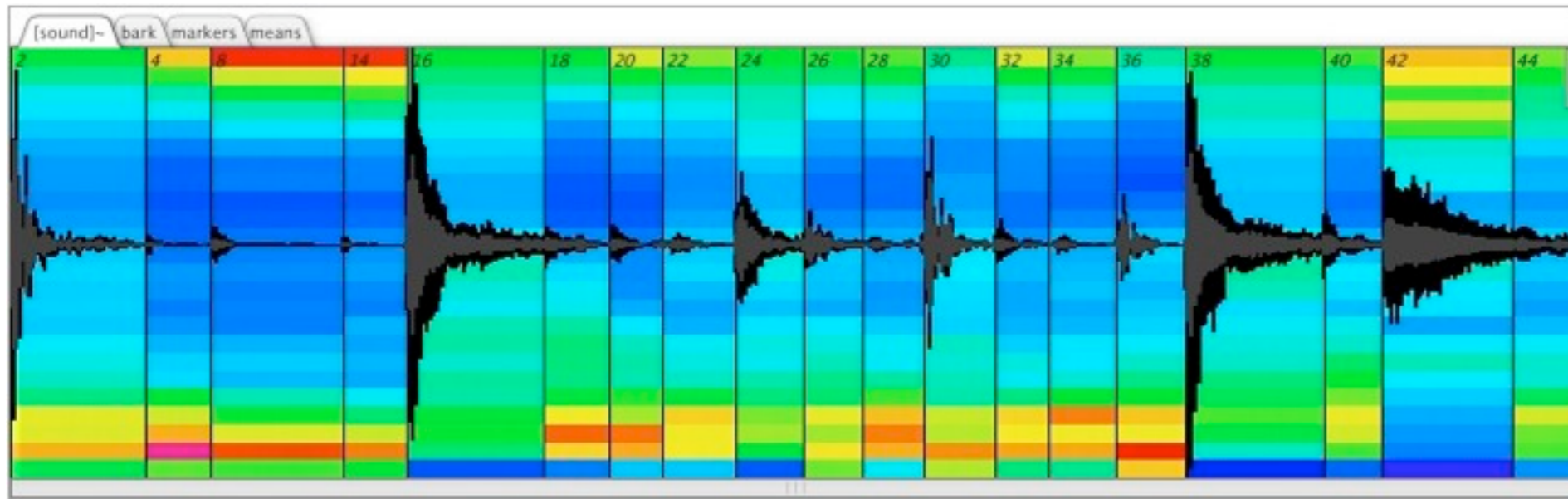
# File Format Support

- *SDIF* import and export\*
- Plain text file import and export
- *MIDI standard file* import
- *MusicXML* import
- Save/load data with Max patcher (for small amounts of data)
- \* ... what else?

\* *features to be implemented*

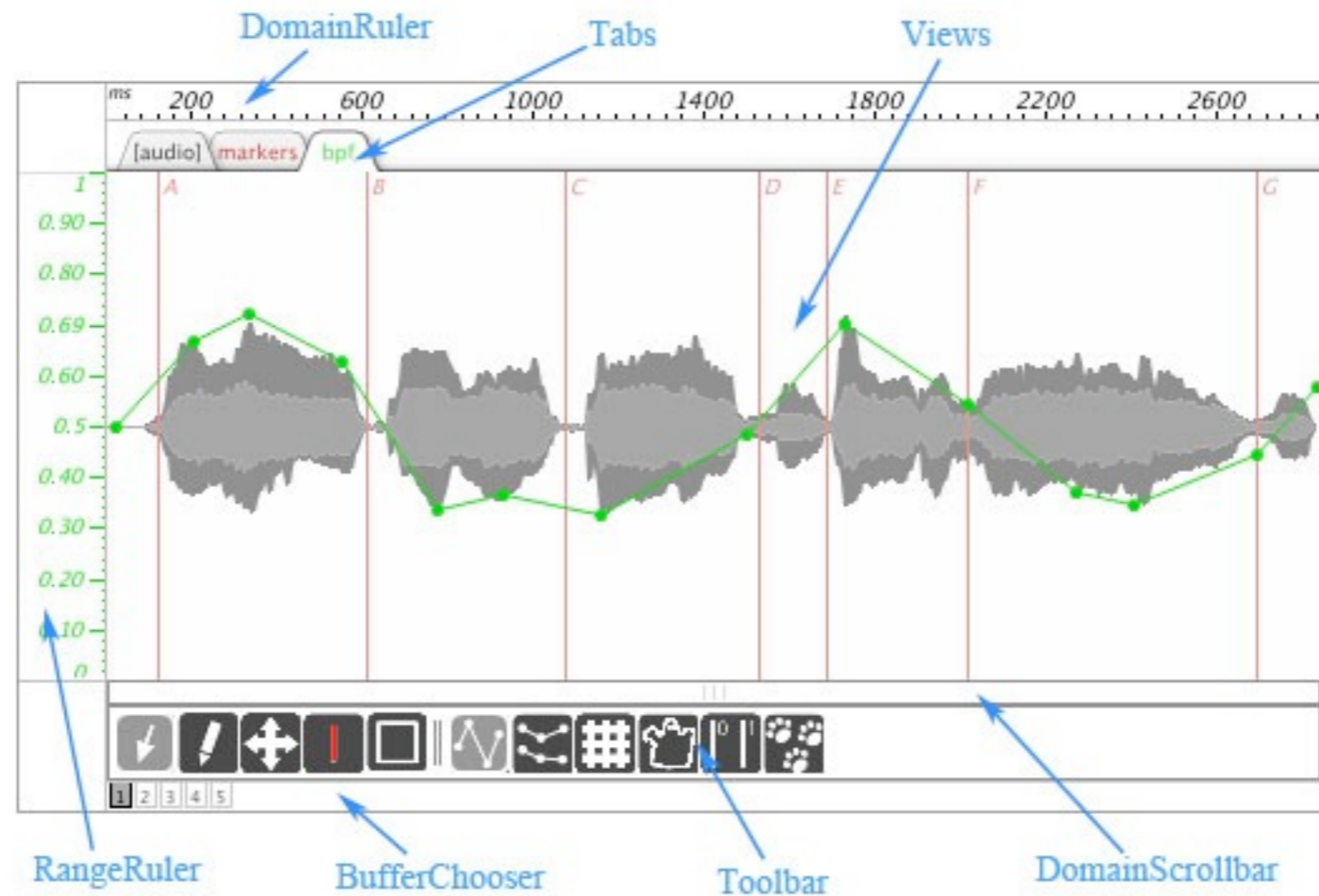
# Visualization and Editing

- Based on the *Juce* framework
- **Abstract data interface** (also implemented for *FTM* data structures)
- **Set of editor/visualization components**
  - **waveform** (single or multi-channel)
  - **break-point function** (single or also multi-channel)
  - **sonogram** (of sampled or time-tagged data)
  - **markers** (with *duration* and *offset*)
  - **textual tables/matrices**
  - **piano roll** (or simplified staves)
  - **traces** (waveform or bpf with *color* and *thickness*)
- **Control components** (*scroll bar, rulers, toolbar, tabs, buffer chooser, etc.*)

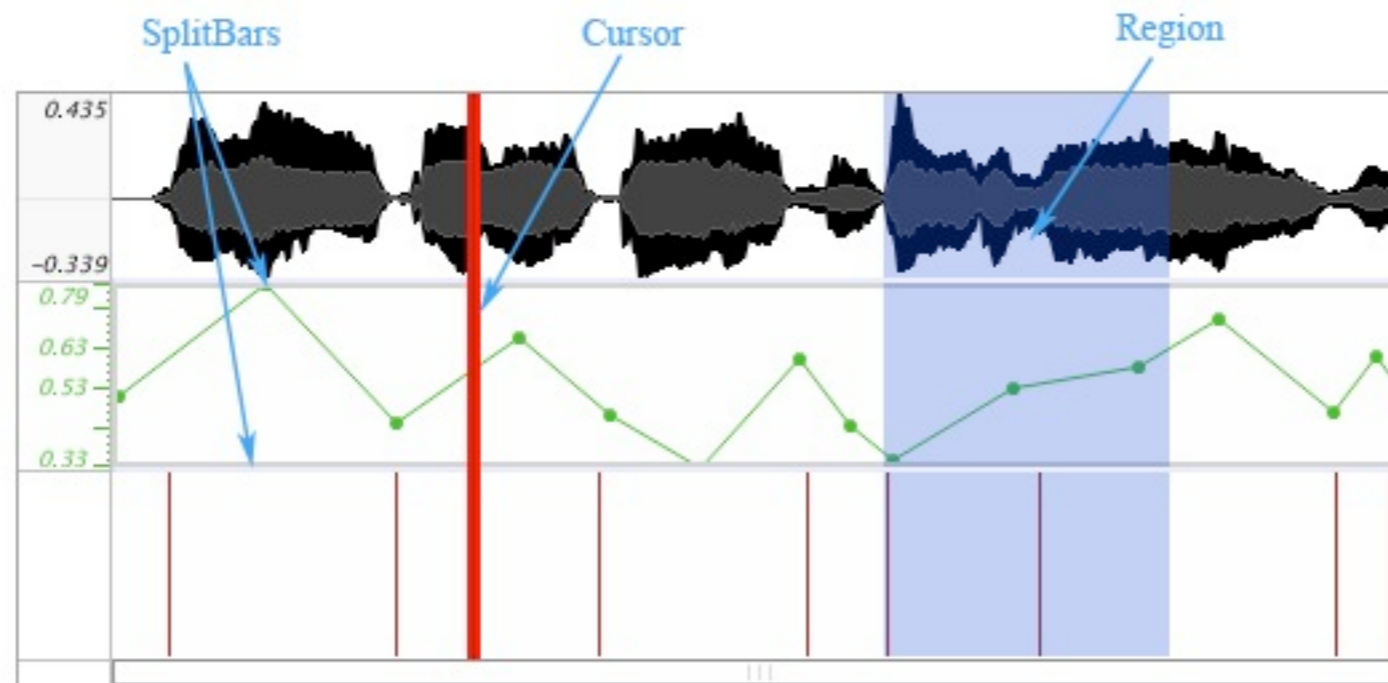


		0			
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# Editor Control Components (1/2)



# Editor Control Components (2/2)



# Generic Data Access

- Generic data container
  - mubu* ... basic multi-buffer container
  - imubu* ... container with graphical user interface
- Reference to a specific track
  - mubu.track* ... optimized access to track data
- \* Generic *record* and *play* externals
- \* JavaScript interface

# Analysis

- *FTM & Co* prototype patch
  - loudness
  - power spectrum and spectral moments
  - MEL bands & MFCC coefs
  - YIN
  - loudness based segmentation
- \* PSOLA markers
- \* Partial and harmonics
- \* *SuperVP*

# Synthesis

- *ZsaZsa* overlap-add engine
    - concatenative synthesis
    - granular synthesis
    - \* PSOLA
  - \* *FFT-I* based additive synthesis
  - \* *SuperVP*
- “*spectral/hybrid concatenative synthesis*”

# Data Models

- KD-tree based k-nearest neighbors
- \* N-Grams?
- \* Factor oracle?
- \* ... what else?

# Current Release

- Beta version of first set of externals
  - *mubu* ... container
  - *imubu* ... container with graphical interface
  - *mubu.track* ... optimized access to track data
  - *mubu.knn* ... k-nearest neighbors
  - *mubu.concat~* ... concatenative synthesis
  - *mubu.granular~* ... granular synthesis

# Future Developments

- Finalize SDIF export
- Integrate analysis and segmentation (real-time/offline)
- Integrate spectral analysis/synthesis (real-time/offline)
  - PSOLA (*ZsaZsa* synthesis)
  - additive (FFT-I synthesis)
  - phase vocoder (*SuperVP* and *simple*)
- Implement further data models

# Links

- *MuBu* on the IMTR web pages  
→ <http://imtr.ircam.fr/imtr/MuBu>
- *MuBu* beta-test mailing list (subscription required)  
→ <http://listes.ircam.fr/www/info/mubu-beta>