

CM0340: Multimedia Tutorial 3 Samplers, Samples and Beat Slicing

Prof. David Marshall

School of Computer Science & Informatics

February 20, 2013

Samplers, Samples and Beat Slicing

In this tutorial we will look at a few case studies of Software Samplers. We focus on three basic software samplers:

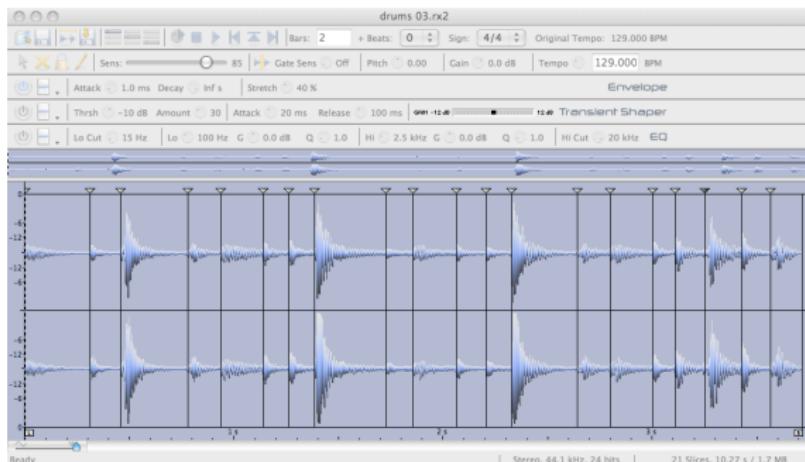
- Recycle
- Intakt
- Kontakt

We will also look at how beat slicing and sampling is achieved in Cubase.

We will focus on basic sample manipulation, beat slicing and organising samples.

This should give you some good ideas for attempting the coursework

Recycle



Recycle is a beat slicer:

- Originally designed to work with hardware samplers — no longer supported
- Today, Recycle v2 files (REX 2) can be played back directly by many audio software apps.

[Good Recycle demo on You Tube](#)

[Another Good Recycle demo on You Tube](#)

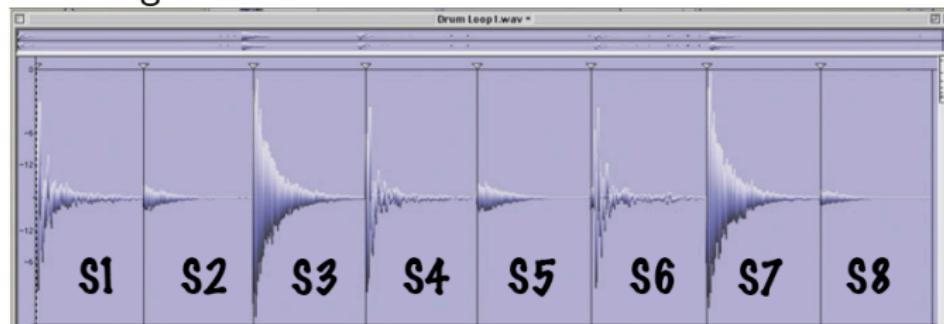
Recycle — Overview

Main purpose:

- Take a drum/percussion loop or other sample,
 - Automatically chop it into sections using transient detection.
 - Each 'slice' is loaded into a sample playback device of some kind and assigned a MIDI note number.
 - A MIDI file generated that plays through the loop one slice at a time with the original order and timing.
 - Now your drum loop will run at any tempo you set.
 - **No audio** has to be stretched because all you're doing is changing the intervals between individual hits being triggered.
 - Additionally can also alter with the sequence, triggering the slices in any order you like, or removing parts altogether.
 - Having individual slices opens up many other possibilities.

Beat Slicing Simple Example

Recycle Slicing:

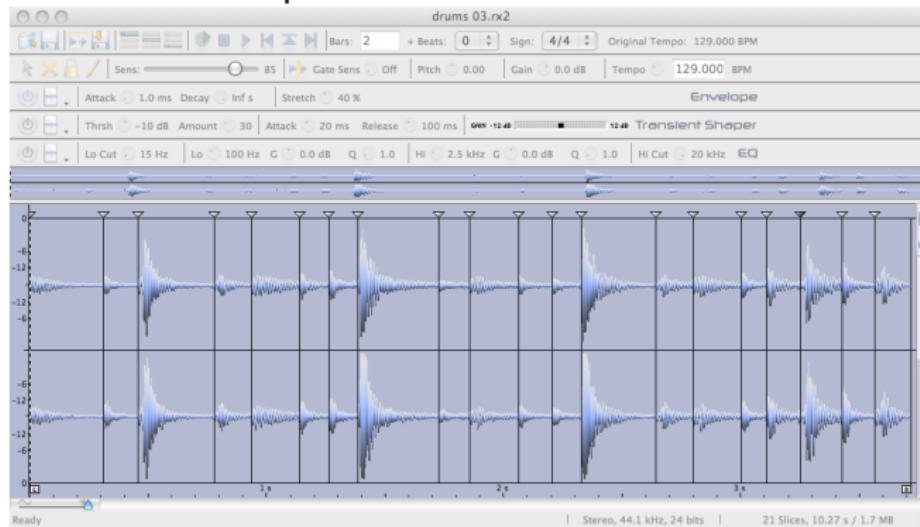


Midi Mapping/Triggering of Slices:



Using Recycle — Slice Creation

- Launch ReCycle and select and open a file.
- In the main window, you may click the Play button to hear the entire loop, from start to end (repeating until you click the Stop button.)
- **To create slices:** Adjust the Sensitivity slider to the right — the exact value depends on the audio.



Using Recycle — Selecting a Bar

- Position the mouse pointer over the “L” handle (the Left Locator) and drag it to the left a bit and release it. Playback now starts from this point.
- Set the Right Locator similarly.
- Drag the Left and Right Locators until the loop is exactly 1 bar long (or any multiple).



- To hear individual slices:** With playback turned off, move the pointer over the waveform view. The pointer changes to a speaker symbol. Click with the Speaker pointer on the slices in the waveform view.

Using Recycle: Further Slice Processing (1)

- **To work out tempo of loop:** Click in the “Bars” field, type “1” (or bar length), and hit [Return].
 - Also may need to enter number of beats and/or time signature

The *calculated tempo* is now shown as the “Orig. Tempo” on the Toolbar.



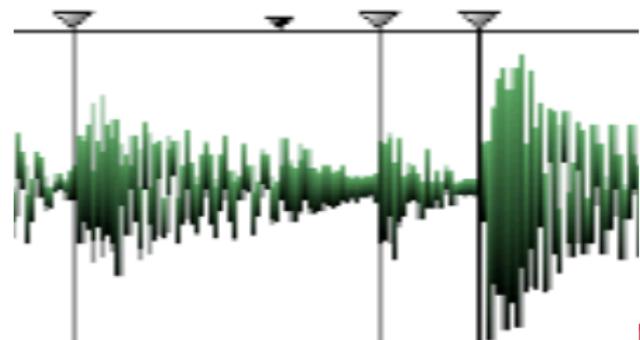
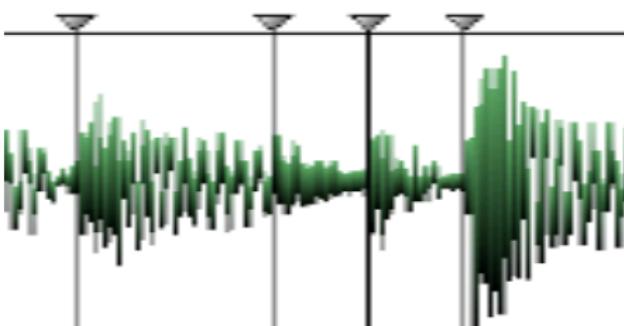
Using Recycle: Further Slice Processing (2)

- **Tempo Adjustment:** By adjusting the Preview Tempo knob or typing in a new tempo directly in the Preview Tempo field, you can change the tempo of the loop.
- By adjusting the Pitch knob you can change the *pitch* of the loop.
- In addition there are a gate and three effect processors; Envelope, EQ and Transient Shaper, that allow you to further tweak the sound of the loop before exporting/saving it as a file.
- **Saving slices:** You could at this point simply save the sliced-up loop as a REX2 file and import this file into a compatible program.

Using Recycle — Slice Editing

By adjusting *sensitivity*, you control how many slices are available.

However, apart from very simple audio, it is **difficult** to select the desired slices with sensitivity control **alone**, you need to edit the slices:



Recycle Toolbox

The Toolbox is located in the upper left corner of the toolbar:



Arrow : Used for selecting Slice markers by clicking on their handles.

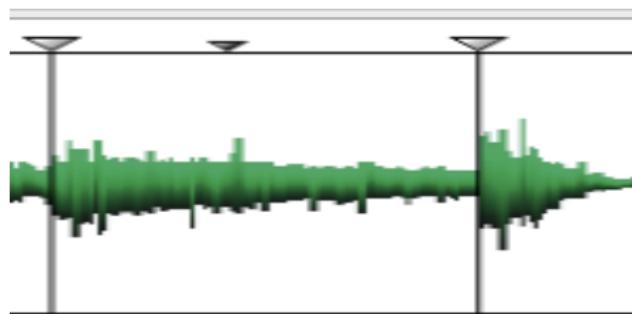
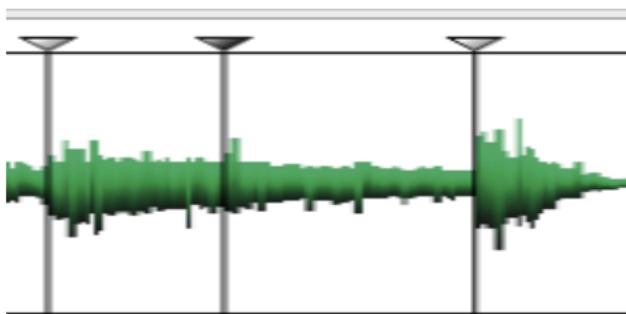
Mute (X) : Used for muting slices by clicking on their handles.

Lock : Used for locking slices, by clicking on their handles.

Pencil : This is used for adding slices manually.

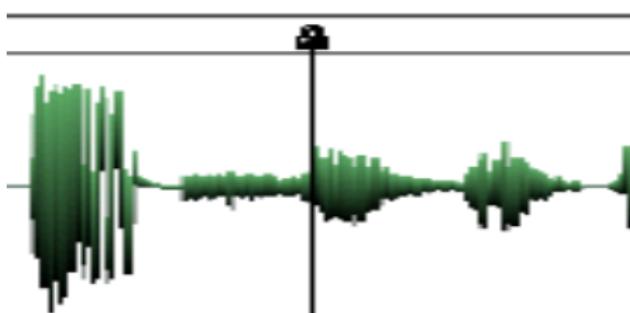
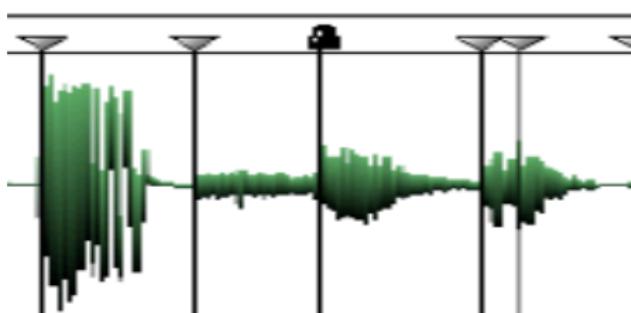
Using Recycle — Muting Slice Markers

Muting : Select **mute tool (X)**, Click on marker that divides the two slices you wish to *join*



Clicking on a muted mark (whilst in mute tool) **unmutes** it.

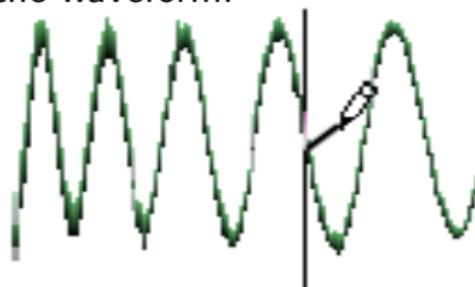
Locking : Lock tool is essentially the opposite of the Mute tool — If you lock a slice, by clicking on its marker with the Lock tool, it will stay even if you drag the Sensitivity slider all the way to zero or try to mute it.



Using Recycle — Manual Slice Markers

In **extreme** cases you may need to resort to manual slice selection:

- Identify the area where you need a slice, zoom in if necessary
- Select the *Pencil Tool*.
- Move the pointer over the waveform display — A vertical line moves across the waveform.



- The line snaps to zero crossings in the waveform (positions where the amplitude is close to zero) — so added slices won't introduce any clicks or pops.
- When you have found the correct position, click with the Pencil tool. The slice appears.
(Manually added slices are initially locked)

Beat Slicing — Simple Application

Recap: Create a MIDI performance of a chromatic scale, whose note timing trigger each sample at the perfect time to recreate the original audio.

Recycle Slicing:

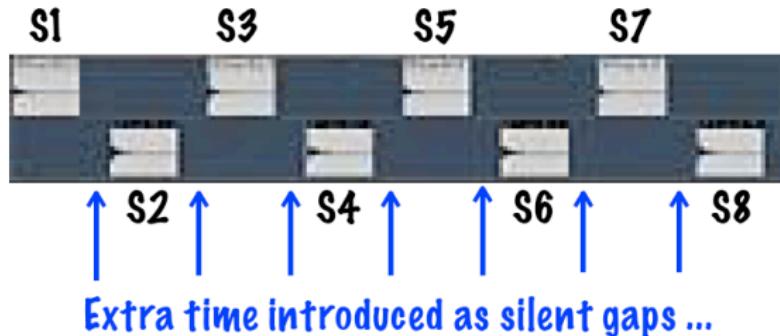


Midi Mapping/Triggering of Slices:

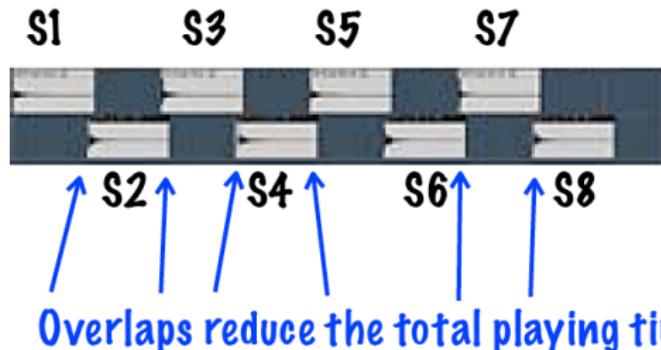


Beat Slicing — Tempo Change Problems

Replay after tempo is made slower:



Replay after tempo is made faster:



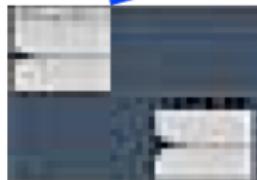
Beat Slicing - Artefacts, Solving the Tempo Problem

For drum loops etc. — **attacks** are artefact free.

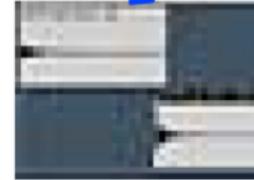
- The most important part of a percussion sound.

Two artefacts (from previous slide):

Artifact: Silent gap.



Artifact: Tail overlap.



Beat Slicing Solution

Solutions

- Apply envelope to each slice to fade it to silence before gap or overlap.
- **For gaps:** loop the end of the tail to extend it through the gap.

Beat Slicing Algorithms Background: Hints for Coursework

Silence Points : Find silence points (**zero (amplitude) crossings**) in sample.

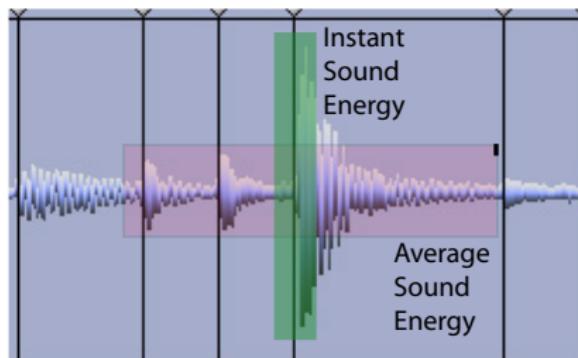
Snapping to silence points means that no nasty clicks in audio when joining audio together.

Beat Perception : *The human listening system determines the rhythm of music by detecting a pseudo-periodical succession of beats*

- The more energy the sound transports, the louder the sound will seem.
- But a sound will be heard as a beat only if his energy is largely superior to the sound's energy history, that is to say if the brain detects a large variation in sound energy.
- Therefore if the ear intercepts a monotonous sound with sometimes big energy peaks it will detect beats.

Beat Slicing Algorithms Ideas (1):Hints for Coursework

Simple sound energy :



- Computing the **average** sound energy of the signal over a relatively large sample (around 1 second)
- Compute **instant** sound energy (around 5/100 second).
- Comparing average to the instant sound energy.
- We detect a beat only when the instant energy is larger than the local energy average.

Beat Slicing Algorithms Ideas (2): Hints for Coursework

Frequency selected sound energy : More elaborate model:

Try to detect big sound energy variations in particular frequency subbands

- Apply Fourier Transform — separate beats according to their frequency sub-band.
- Apply energy analysis but in frequency space:
 - Compute Fourier Transform over 1024 samples.
 - Divide into around 32 sub-bands.
 - Compute the sound energy contained in each of the sub-bands
 - Compare it to the recent energy average corresponding to this sub-band.
 - If one or more sub-bands have an energy superior to their average we have detected a beat.
- For more details search web or see references at end of slides.

Beat Slicing in Cubase

Cubase takes a simpler more user interactive approach to beat slicing.

In the Sample Editor

- Select **Hitpoints** Editing Option.
 - Either adjust **Threshold** or visual **horizontal lines** to select the appropriate level of hit points, as displayed.



Beat Slicing in Cubase (Cont.)



- When happy hit the **Create Slices** button.
- Hitpoints can then be edited in a similar fashion to Recycle

Cubase Drum Sampler

Cubase has a built in Drum Sampler: **Groove Agent One**.



To map sliced beats (hit points) to Groove Agent One:

- Simply drag the sliced audio file onto one of the **Drum Pads**.
 - Subsequent slices are mapped to consecutive pads.

Intakt: Beat Slicing and Granular Synthesis



Intakt¹ is a basic sample manipulator — it can slice up beats and do much more.

- Modulation and effects sections also provided

¹Intakt is now no longer available but its functionality is bundled into Kontakt

Intakt — Modes of Operation

They are the 3 basic modes of operation:

Sampler

Beat Machine

Time Machine



Intakt — Sampler Mode



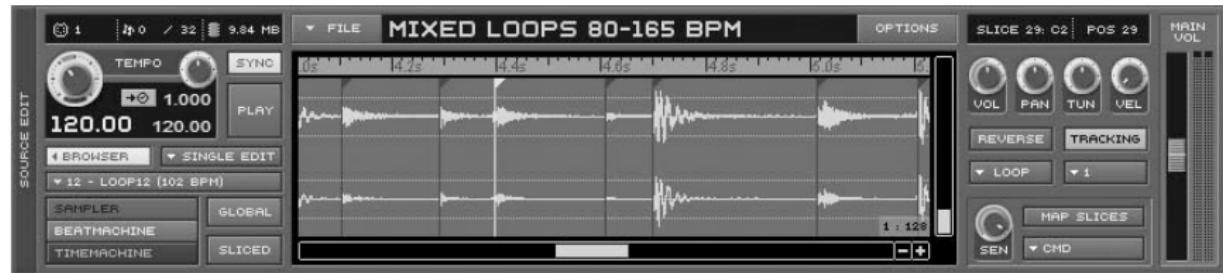
A “standard” representation of a digital sampler:

- Sample playback and pitch changes by resampling the audio data — see tracking option.
- Loops samples.
- Key Features:

Tracking : When enabled, a Zone’s pitch changes as you play different keys on the keyboard — pitched sounds. Disabled: play at its original pitch, without transposition — drum sound mapped over several keys

Reverse : Reverses playback for all samples contained in the selected Sample.

Intakt — Beat Machine Mode



Beat Machine is a Has similar features to Recycle, Key Features:

Tracking : When enabled, a Zone's pitch changes as you play different keys on the keyboard — pitched sounds.

Disabled: play at its original pitch, without transposition — drum sound mapped over several keys

Reverse : Reverses playback for the selected Zone or Slice.

Sen : Adjusting the Slice sensitivity

Loop : Loops the selection.

Beat Machine — Global Edit Mode

- Effects and Modulation are applied to the entire Sample or Loop.
- This is similar to Sampler Mode, with a few particular differences.
 - Changing the Tempo stretches the beat without transposing the sound.
 - There is a Sync button that enables Beat Machine to lock to Intakt's Global Tempo or that of an external clock.

Beat Machine — Sliced Edit Mode

Key Features:

- Mapping Base Key: Use this to decide where to map the Slices.
 - Number of Slices: Choose how many of the Slices from your Sample you want mapped.
 - Mapping End Key: The end key for your Slice map.
 - Create Volume Envelope: Use this to give attack or release to each slice.
 - Save Midi Timing Template — export similar to Recycle
 - Bars+Beats/Measure: Input the samples length and the beat's measure here
 - Resulting Tempo: This display shows the Loop's Tempo
 - Artificial Slice Stretch: Smoothes the transition between slices at slower tempos. Use this if you find that slowing the Sample down causes the Slices to be slightly clipped.

Time Machine



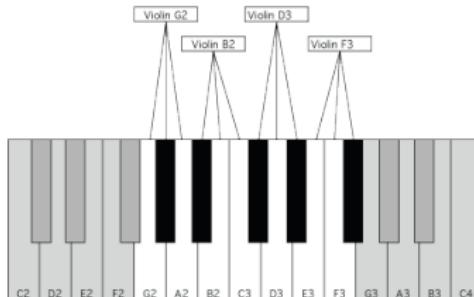
A **granular synthesizer**: Designed to alter sample speed while preserving the original pitch information.

Key Features

- Tune: Changes the selected Sample's pitch while preserving the length and speed of the Sample.
 - Speed: Changes the playback rate independently of pitch.
 - Legato: This feature preserves the sample playback position when switching between samples. If you hold a key while pressing another key with the Legato option enabled, the new sample will not be triggered from the beginning, but will proceed from the current sample position associated with the first key.
 - TRC/TRS: Controls Transients between samples/grains.

RECAP Sample-based Synthesis: Multisampling

- Non-pitched simple example: the concept of drum mapping
 - **see also general MIDI section later**
- Need to preserve relationships between key notes**
- Multisampling Basic Idea:**
 - Sample instrument at regular intervals to cover regions of several adjacent notes (**splits**) or for every note.
 - Advantage:** provides a more natural progression from the lower to the higher registers



Sample-based Synthesis: Example Kontakt Sampler Multisample Keymap



Sample-based Synthesis: Velocity Layers

- When pluck a string or hit a drum or press a piano key, sound produced **depends** on how hard the action was.
- In software, this is measured by the velocity of a key press etc.
- Multisampling lays out samples vertically in keymap.
- Velocity layers** layed out **horizontally**



Sample-based Synthesis: Key Map and Velocity Layers



Most instruments are a combination of multisample key mapped and velocity layers

Sample-based synthesis Basics: Sample Keyswitching

- Instruments can make vastly different sounds depending how they are played
- Example: Trumpets (muted/not muted), violin (plucked, slow/fast up/down bow)
- For expressive performance samples can be **keyswitched**: Use keys (usually lower keys outside of instrument range) to select appropriate sounds
 - Essentially banks of *keymapped* velocity layered samples

JAZZ & BIG BAND

TPT 1 KS

CPU USAGE: 0% KEY RANGE: C-2 - G9

OPTIMISE: 0% 93.78 MB 48 / 2

POR TA LENGTH PAN VOLUME

TUNE PAN VOLUME

VOLUME

F# OCT F

G = Bucket mute
F = Harmon mute
E = Cup mute
D = Straight mute
C = Open (no mute)

Example: If you press the "F" key the instrument will switch to a Harmon mute.

Harmon mute key switch

References

- www.cs.berkeley.edu/~lazzaro/class/music209 — Good overview of Beat slicing. (I borrowed a few figures from here)
- www.soundonsound.com/sos/jun04/articles/beatslicing.htm — Sound on Sound Magazine Beat Slicing Masterclass
- emusician.com/mag/square_one/emusic_slice/index.html — Electronic Musician Magazine Article on Beat Slicing