Software Sampler Instrument Design - Review and Proposal

Sample Instrument Review

This review looks at and makes extensive reference to the drum sample-engine 'Superior Drummer 2' (2008) and the sample-instrument 'Joe Barresi Evil Drums SDX' (2010).

All audio examples can be found at https://soundcloud.com/c3020978/sets/ssid-review (or follow the **<< links >>** within the text)

(Fig.1 - Superior Drummer 2 main page)

Superior-Drummer recreates the sound of professionally recorded drums in a versatile software engine. The Evil-Drums sample library was recorded by Joe Barresi (Tool, Queens of the Stone Age, Bad Religion) with the same techniques and tools he would use when working on a professional project.

<< Demo Song - Default Settings >>

Channel Organisation

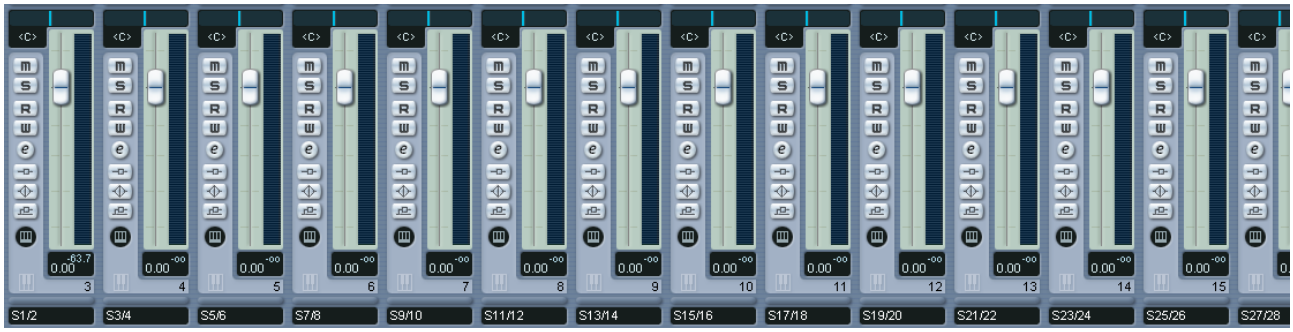
The drum instrument is organised by microphone channels which matches how a real drum kit is recorded; Kick, SnareDrumTop, SnareDrumBottom, RackTom1, RackTom2, FloorTom1, HiHat, Ride, Overhead Left&Right, AmbientClose Left&Right, AmbientMono. This means the drums produced can be mixed virtually the same as if they had been recorded.

The program is well organised giving the user direct access to the main features on the front page which will benefit the work-flow.

Mixer

(Fig.2 - Superior Drummer 2 mixer page)

The mixer is where the microphone channels are routed to their outputs. By default the outputs are grouped by stereo output channels which creates combined stereo channels in the sequencer (Fig.3). This in effect doubles the processor requirements for each channel which would not be desirable on a computer with limited resources.



(Fig.3 - Superior Drummer stereo outputs into mixer showing as combined stereo channels)

For mono outs, 'Mono-All-Channels' in the settings menu is used. The program needs closing and reopening to reconfigure the channels in the sequencer. Superior Drummer still outputs stereo pairs (Fig.4), but now they have separate left and right in the sequencer (Fig.5). This lowers the resources if mixing in the sequencer.

(Fig.4 - Superior Drummer stereo outputs. Pan hard to rout signal to mono side in sequencer)

(Fig.5 - Superior Drummer stereo outputs into mixer showing as individual left and right)

Changing outputs like this gives the user both options whilst not clogging up the sequencer's mixer with additional unused channels.

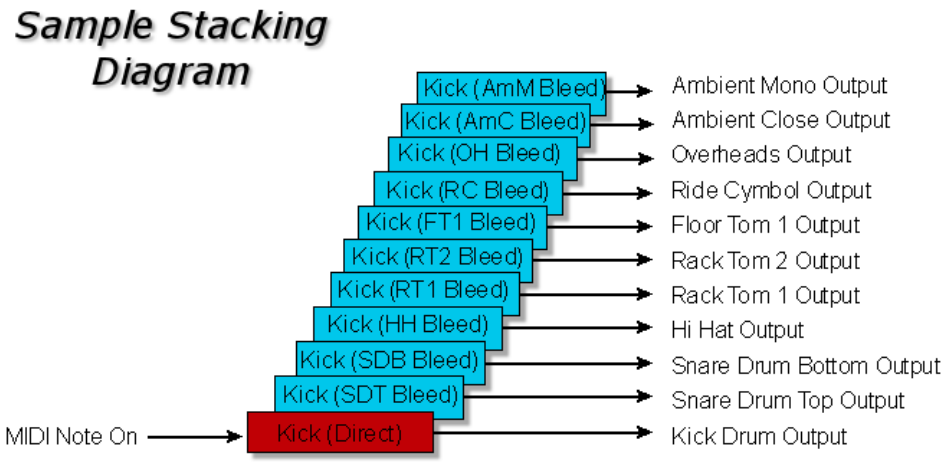
'Mono-All-Outputs' changes Superior Drummer in all past projects, rather than just the instance in the current project. This is a nuisance that could be corrected in a future update.

Full Bleed Control and Sample Stacking

Each direct drum sample is stacked with the bleed from every other microphone. This is the most powerful aspect of Superior-Drummer which gives a level of flexibility surpassing that which even the most prolific drum recordist could achieve.

(Fig.6 - Superior-Drummer Bleed Controls)

The edit button (Fig.6) allows the bleed to be switched on/off and adjusted in volume. The dial adjusts the overall level of all the bleed going into the microphone channel. The light indicates if the bleed is on and when off the samples are not loaded into RAM. This is a great way to balance sound and memory limitations.



(Fig.7 - Any single MIDI hit can trigger upto 11 samples)

When triggering a kick drum, the direct microphone sample will trigger and be output on the kick channel, at the same time a sample of the kick drum recorded with the snare microphone will be output from the snare channel.

Bleed Audio Examples

<< Demo Song - Just Snare Top - No Bleed >>

<< Demo Song - Just Snare Top - Full Bleed >>

<< Demo Song - Just Snare Top - No Bleed (Snr Channel) - Full Bleed (Other Channels) >>

Sample Velocities and Variations

Layer-limit restricts the number of roundrobin-variations available for a velocity-layer. The following SoundCloud example has restricted the number to 2 and turned off all but the random humanize feature.

<< Kick - Layer Limit 2 - Random On >>

Two distinct kick-drum samples are heard which shows the function of the layer-limit feature.

Information about the number of roundrobin-variations is not available. An email to ToonTrack and PlatinumSamples was not answered.

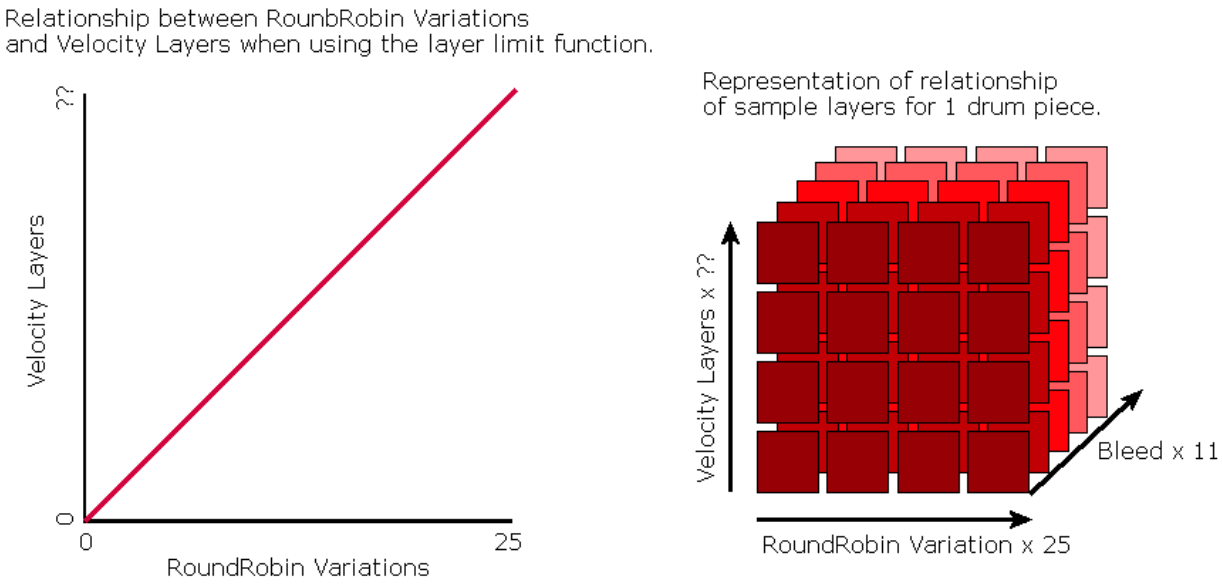
Loading one instrument then slowly increasing its layer-limit shows the amount of roundrobin-variations for that instrument. RAM usage stops increasing at around 25 layer-limits.

Superior-Drummer manual says "15 to 25 layers of gradient hits (many more in subsequent libraries)" and Platinum-Samples says about Evil-Drums, "recorded with as many as 256 velocity layers" (Joe Barresi Evil Drums, 2013).

<< Snare - Increasing Velocity - One Layer >>

<< Snare - Increasing Velocity - All Layers >>

The two audio-examples above show that minimising the layer-limit reduces both the variation and velocity layers together. Because of this there is no way to determine how many velocity-layers there are. It would be near impossible to differentiate between roundrobin and velocity layer in waveform analysis tests. A method to isolate one sample size, then calculate how many samples would fit into the known RAM usage would not work either because Superior-Drummer packs the samples in a proprietary compression format at up-to 70% compression (Marechal, 2011, pp.13).



(Fig.8 - Info-graphics depicting the relationships of samples within Superior-Drummer)

A better system would have a separate control for both. A user might want to limit the amount of variation but need all the velocities. There is no way to do this.

This system is a little confusing and not intuitive. The manual fails to explain the exact relationship between velocity-layers, roundrobin-variations and the limiting functions.

Humanize

These functions give the program instructions on how to select samples to break-up any "obvious repetition and patterns" (Marechal, 2011, pp.25). 'Random' chooses a sample at random from the roundrobin-layer. 'Alternative' chooses between samples played by the right-foot/hand or left-foot/hand. 'Semi-Sequence' picks samples randomly from the two adjacent velocity-layers. 'Vel-to-Vol' adjusts the volume of the same sample slightly between pre-determined values ensuring extra variation.

<< Snare - Max RoundRobin - Full Humanize >>

<< Snare - No RoundRobin - No Humanize >>

Drum Map and Articulations

Instrument	Articulations									
Kick	Right									
Snare	Center	Rim Shot	Side Stick	Flam	Ruff					
Hi Hat	Closed Edge	Closed Tip	Open 1	Open 2	Open 3	Open Tip 1	Open Tip 2	Open Tip 3	Open Tip 4	Closed Pedal
Tom1	Center									
Tom2	Center									
Tom3	Center									
Ride	Ride Tip	Bell Tip	Ride Shank	Bell Shank						
Crash 1	Crash									
Crash 2	Crash									

There are no cymbal-chokes (articulation) in this library. A workaround can be created by using the ADSR. In reality however, 'choking' causes resonances to decay after the cymbal has been stopped which is not possible using the ADSR. Superior-Drummer allows note-off messages and aftertouch which can be used for the chokes but this has the same problem. Cymbal-chokes should have been extra articulations.

The inclusion of stick against stick hits, as used for song count-ins, would have been a nice inclusion.

Extensive key-map comparing Evil-Drums to General MIDI and GM Extended.

GM Extended Core and X-Drums Generic	General MIDI Level 1 Percussion Key Map	MIDI		SDX Joe Barresi Evil Drums	Unique
		CC	16		
		CC	4	[Hats] hatsCtrl	
		CC	1	[Hats] hatsCtrl	
[X-Snare] Sidestick		G	127	[Snare] Sidestick	
[X-Snare] Rimshot		F#	126	[Snare] Rimshot	
[X-Snare] Head		F	125	[Snare] Center	
[X-Hats] Open		E	124	[Hats] Open 3	
[X-Hats] 1/2 Open		Eb	123	[Hats] Open 1	
[X-Hats] Closed		D	122	[Hats] Closed Edge	
		C#	121	[Hats] Open Tip 3	
		C	120	[Hats] Open Tip 1	
		B	119	[Hats] Closed Tip	
[X-Ride] Edge		Bb	118	[Cymbal 2] Crash	
[X-Ride] Bell		A	117	[Ride] Bell Tip	
[X-Ride] Bow		Ab	116	[Ride] Ride Shank	
		G	115	[Ride] Ride Tip	
		F#	114	[Ride] Bell Shank	
		F	113	[Ride] Ride Tip	
		E	112	[Ride] Bell Tip	
		Eb	111	[Ride] Ride Shank	

		D	110	[Ride] Ride Tip	
		C#	109	[Ride] Bell Shank	
		C	108	[Ride] Ride Tip	
		B	107	[Cymbal 2] Crash	
		Bb	106	[Cymbal 2] Crash	
		A	105	[Ride] Bell Tip	
		Ab	104	[Ride] Ride Shank	
		G	103	[Ride] Ride Tip	
		F#	102	[Ride] Bell Shank	
		F	101	[Ride] Ride Tip	
		E	100	[Ride] Bell Tip	
		Eb	99	[Ride] Ride Shank	
		D	98	[Ride] Ride Tip	
		C#	97	[Ride] Bell Shank	
		C	96	[Ride] Ride Tip	
		B	95	[Cymbal 1] Crash	
		Bb	94	[Cymbal 1] Crash	
		A	93	[Ride] Bell Tip	
		Ab	92	[Ride] Ride Shank	
		G	91	[Ride] Ride Tip	
		F#	90	[Ride] Bell Shank	
		F	89	[Ride] Ride Tip	
		E	88	[Ride] Bell Tip	
		Eb	87	[Ride] Ride Shank	
		D	86	[Ride] Ride Tip	
		C#	85	[Ride] Bell Shank	
		C	84	[Ride] Ride Tip	
		B	83	[Cymbal 1] Crash	
		Bb	82	[Racktom 1] Center	
	Open Triangle	A	81	[Racktom 1] Center	
	Mute Triangle	Ab	80	[Racktom 2] Center	
	Open Cuica	G	79	[Racktom 2] Center	
	Mute Cuica	F#	78	[Racktom 2] Center	
	Low Wood Block	F	77	[Racktom 2] Center	
	Hi Wood Block	E	76	[Ride] Ride Tip	
	Claves	Eb	75	[Floortom] Center	
	Long Guiro	D	74	[Floortom] Center	
	Short Guiro	C#	73	[Floortom] Center	
	Long Whistle	C	72	[Floortom] Center	
	Short Whistle	B	71	[Snare] Sidestick	
	Maracas	Bb	70	[Snare] Center	
	Cabasa	A	69	[Snare] Flams	/
	Low Agogo	Ab	68	[Snare] Center	
	High Agogo	G	67	[Snare] Sidestick	
	Low Timbale	F#	66	[Snare] Center	
	High Timbale	F	65	[Hats] Closed Edge	
	Low Conga	E	64	[Hats] Closed Edge	
	Open Hi Conga	Eb	63	[Hats] Closed Tip	

	Mute Hi Conga	D	62	[Hats] Closed Tip	
	Low Bongo	C#	61	[Hats] Closed Tip	
	Hi Bongo	C	60	[Hats] Open 3	
[Cymbals] Ride Edge	Ride Cymbal 2	B	59	[Ride] Ride Shank	/
[Cymbals] Crash B Mute	Vibraslap	Bb	58	[Cymbal 2] Crash	
[Cymbals] Crash B	Crash Cymbal 2	A	57	[Cymbal 2] Crash	
[X-Crash] Crash	Cowbell	Ab	56	[Ride] Bell Tip	/
	Splash Cymbal	G	55	[Cymbal 1] Crash	
[Cymbals] Crash A Mute	Tambourine	F#	54	[Cymbal 1] Crash	
[Cymbals] Ride Bell	Ride Bell	F	53	[Ride] Bell Shank	/
	Chinese Cymbal	E	52	[Cymbal 1] Crash	
[Cymbals] Ride Bow	Ride Cymbal 1	Eb	51	[Ride] Ride Tip	/
[X-Tom] Rack/Floor	High Tom	D	50	[Racktom 1] Center	
[Cymbals] Crash A	Crash Cymbal 1	C#	49	[Cymbal 1] Crash	
[Toms] Racktom 1	Hi-Mid Tom	C	48	[Racktom 1] Center	
[Toms] Racktom 2	Low-Mid Tom	B	47	[Racktom 2] Center	
	Open Hi-Hat	Bb	46	[Hats] Open 2	
[Toms] Racktom 3	Low Tom	A	45	[Racktom 2] Center	
	Pedal Hi-Hat	Ab	44	[Hats] Closed Pedal	
[Toms] Floortom 1	High Floor Tom	G	43	[Floortom] Center	
	Closed Hi-Hat	F#	42	[Hats] Closed Tip	
[Toms] Floortom 2	Low Floor Tom	F	41	[Floortom] Center	
[Snare] Rimshot	Electric Snare	E	40	[Snare] Rimshot	/
[Snare] Ruffs	Hand Clap	Eb	39	[Snare] Ruffs	/
[Snare] Head	Acoustic Snare	D	38	[Snare] Center	
[Snare] Sidestick	Side Stick	C#	37	[Snare] Sidestick	/
[Kick] Right	Bass Drum 1	C	36	[Kick] Right	
[X-Kick] Right	Acoustic Bass Drum	B	35	[Kick] Right	
		Bb	34	[Kick] Right	/
		A	33	[Snare] Center	
		Ab	32	[Cymbal 2] Crash	
		G	31	[Cymbal 2] Crash	
		F#	30	[Cymbal 2] Crash	/
		F	29	[Cymbal 1] Crash	
		E	28	[Cymbal 1] Crash	
		Eb	27	[Cymbal 1] Crash	/
[Hats] Open 1		D	26	[Hats] Open 3	/
[Hats] Open 2		C#	25	[Hats] Open 2	/
[Hats] Open 3		C	24	[Hats] Open 1	/
[Hats] Foot Splash		B	23	[Hats] Closed Pedal	
[Hats] Closed		Bb	22	[Hats] Closed Edge	/
[Hats] Pedal		A	21	[Hats] Closed Pedal	
		Ab	20	[Hats] HatsTipTrig	
		G	19	[Hats] HatsTipTrig	
		F#	18	[Hats] HatsTrig	
		F	17	[Hats] Open Tip 4	
		E	16	[Hats] Open Tip 4	/
		Eb	15	[Hats] Open Tip 3	

		D	14	[Hats] Open Tip 3	/
		C#	13	[Hats] Open Tip 2	/
		C	12	[Hats] Open Tip 1	/
		B	11	[Hats] Closed Tip	/
		Bb	10	[Hats] Closed Pedal	/
		A	9	[Hats] HatsTipTrig	
		Ab	8	[Hats] HatsTipTrig	
		G	7	[Hats] HatsTrig	
		F#	6	[Snare] Center	/
		F	5	[Floortom] Center	
		E	4	[Floortom] Center	/
		Eb	3	[Racktom 2] Center	
		D	2	[Racktom 2] Center	/
		C#	1	[Racktom 1] Center	/
		C	0		

(Key Map Table - https://docs.google.com/spreadsheet/ccc?key=0AsWMEXuWvqSIdFBaNnBhTFBBZXJZb1F0UThzVXhibmc&hl=en#gid=2)

Whilst there are far less kit pieces than keys, Toontrack have still transposed the samples across the entire key-range. This chart shows that the General-MIDI standard is outdated when it comes to modern drum-engines, hence the need for GM extended sets.

ADSR Envelope

The ADSR works an all samples belonging to a single piece of kit, e.g., SnareTop, SnareBottom, and Snare Bleeds regardless of microphone-channels. It works especially well on instruments with long sustain and allows them to be shortened which results in the overall kit-sound becoming more focused and less muddy.

<< Demo Song - Just Snare Top - Full Bleed - ADSR No Ring >>

<< Demo Song - Just Snare Top - Full Bleed - ADSR Extreme >>

Channel Fade

This acts like a gate and affects everything coming through the microphone-channel. This is a nice feature but for channels containing full-bleed it is a little less useful because it does not have a threshold setting like a gate would have. This can result in unnatural sounding bleed. Since you can switch off the bleed and change the release with the ADSR anyway, this has no real purpose.

Audio comparisons of fade use and external gate plug-in.

<< Demo Song - Just Snare Top - Full Bleed - Fade No Ring >>

<< Demo Song - Just Snare Top - Full Bleed - Fade Extreme >>

<< Demo Song - Just Snare Top - Full Bleed - Gate Plugin >>

Pitch

Has a two-octave range and changes the length of the sample relative to its pitch. It is a nice inclusion but for a realistic drum-engine doesn't seem much use. It can be used for extreme pitch changes or for subtle tuning of the kit but even then it is noticeable.

<< Demo Song - Snare Pitch Up Little >>
<< Demo Song - Snare Pitch Up Half >>
<< Demo Song - Snare Pitch Up Full >>
<< Demo Song - Snare Pitch Down Little >>
<< Demo Song - Snare Pitch Down Half >>
<< Demo Song - Snare Pitch Down Full >>
<< Demo Song - All Pitch Up Little >>
<< Demo Song - All Pitch Down Little >>

Multiple Hits Emulation (MHE)

MHE fades the attack depending on how close the triggered note is to a previous one. If the distance is great enough, the attack is again full. This adds realism to cymbal swells where the attack of the cymbal is not required on each hit.

<< Cymbals - Multiple Hits Emulation On >>

<< Cymbals - Multiple Hits Emulation Off >>

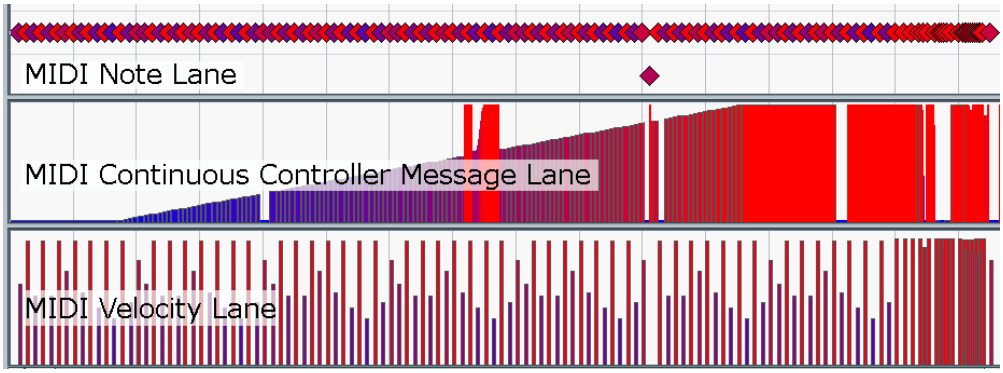
Transmuting

This defines the mute groups for the samples as-well-as how smoothly the transition occurs (Marechal 2011, pp.12). It happens behind the 'scenes' automatically. Some drums require a longer fade after the next sample starts. Muting samples instantly sounds unnatural. Superior-Drummer have set these so they sound very natural.

Continuous Controller Messages

Superior allows you to use MIDI Continuous-Controller messages to determine which Hi-Hat sample plays. By drawing into the controller-lane of a sequencer (Fig.8) you can create expressive Hi-Hat patterns. This function is primarily for E-Drum kits so the external Hi-Hat can control the samples in real-time.

<< Hi Hat - Complexity Example >>



(Fig.8 - Controller lane of Hi-Hat MIDI track for the above audio example)

Sound Quality

The drum-kit used was a Pork-Pie Tobacco-Satin recorded at Grandmaster-Recorders to analogue tape. Then converted to 44.1kHz/24bit for the library. Superior-Drummer offers a 16bit mode to save memory.

"Joe chose to record [...] using the exact same recording process he's used on numerous album projects. With expert use of the studios' Neve consoles, analog tape and his own (secret) esoteric collection of mic preamps, equalizers and compressors"

The sound quality of this library is exceptional. Joe Barresi is responsible for the drum sounds on Queens of the Stone Age and Bad Religion albums. When listening to this pack, those are the albums that come to mind as this pack is definitely his signature-sound.

Evil-Drums sounds big. Joe Barresi EQ'd and compressed the samples exactly as he would when recording. This gets us close to the real Joe Barresi sound which can then be mixed and further processed if needed. There are none of the nasal and muddy frequencies usually common on raw drum recordings.

Comparison of Evil-Drums to other sample packs

<< Demo Song - Default Settings >>

<< Demo Song - NY Avatar Sample Library >>

<< Demo Song - EZ Drummer >>

Together, Superior-Drummer and Evil-Drums are as close as you can get to the sound of a real-drummer. The features Humanize, MHE and Transmuting, along with velocity-layers and roundrobin-variations give Superior-Drummer a complex and realistic sound, and with careful programming can be indistinguishable from a real drummer.

Presentation Material - Manual and Videos

There are an extensive collection of videos on the Toontrack website about every feature of Superior-Drummer, which are professionally done. The manual covers almost everything but can be a little confusing at times as it uses language to explain things that has not been defined. Such as gradient-hits and sample-pool when talking about the humanization functions on page 25. Some aspects of the engine and library remain a mystery after reading the manual such as how the layer-limit functions work. The humanize functions could be explained better. It does cover most everything else in detail.

The continuous-controller section fails by assuming the reader understands what the Hi-Hat articulations HatsCtrl, HatsTrig and HatsTipTrig mean even though there are no explanations in the manual. They sound the same as other samples. Maybe they are to do with E-Drums users who already understand certain terminology.

The manual comes in PDF but the PDF does not have a list menu, only thumbnails which makes jumping to the desired heading a manual task.

Evil-Drums manual by comparison is poor. The PDF manual just lists the drums recorded and there is only one official demonstration video.

Sample Instrument Proposal

Evil-Drums is an extensive library. This project does not seek to emulate Evil-Drums. Time and technology could make that difficult. A simple real-drum sample-engine will be devised that takes its inspiration from Superior and Evil-Drums.

Drum-Map and Articulations

This sample instrument layout will follow Evil-Drums but omitting many of the articulations. The keyboard layout will follow GM extended.

Instrument	Articulations									
Kick	Right									
Snare	Center	Rim Shot	Side Stick	~~Flam~~	~~Ruff~~					
Hi Hat	Closed Edge	Closed Tip	Open 1	Open 2	Open 3	~~Open Tip 1~~	~~Open Tip 2~~	~~Open Tip 3~~	~~Open Tip 4~~	Closed Pedal
Tom1	Center									
Tom2	Center									
Tom3	Center									
Ride	Ride Tip	Bell Tip	Ride Shank	~~Bell Shank~~						
Crash 1	Crash									
Crash 2	Crash									

Removing some of the extra articulations is a good way to reduce the work-load to fit the time-frame. The snare articulations can be recreated in MIDI and the Hi-Hat are alternative stick-hits only included in very extensive libraries.

Drum Recording in the University Studios

To be recorded over one 8hour night session in week-5. The drums will not be processed before hand like Evil-Drums are. This will give the user a natural starting point for a drum-mix.

Mic	Instrument	Articulations					
AKG-D112	**Kick**	Right					
Shure-SM57 (Top and Bottom)	**Snare**	Center	Rim Shot	Side Stick			
Unknown LDC	**Hi Hat**	Closed Edge	Closed Tip	Open 1	Open 2	Open 3	Closed Pedal
Unknown Dynamic	**Tom1**	Center					
Unknown Dynamic	**Tom2**	Center					
Unknown Dynamic	**Tom3**	Center					
AKG-451	**Ride**	Ride Tip	Bell Tip	Ride Shank			
AKG-414 Stereo Pair as overheads	**Crash 1**	Crash					
	Crash 2	Crash					
Unknown Stereo Condenser Pair (Ambience Close)	**All**						
Unknown LDC (Ambient Mono)	**All**						

Velocity-Layers and RoundRobin-Variations

Time will be a big factor in determining how many of these are recorded. But there is other software that can give an indication of a good compromise. Platinum Samples offer low-resource programs and libraries such as Session-Drummer 3 and a stripped down Joe Barresi recorded pack.

"High resolution Drum kit for Session Drummer 3 with up to 16 velocity-levels and 4 round-robin variations." (Evil Kit 1 for Session Drummer 3, 2013)

Using those numbers: 21 microphones x 4rrv x 16vl = 1344 individual samples. 16 velocity layers will be difficult to achieve within the scope of the project. Limiting this number will allow the project to go more smoothly.

A compromise of 4 roundrobin-variations and 6 velocity-layers should give enough variation for a small-scale drum-engine which comes in at 504 samples.

Bleed-Control

Full bleed will be recorded and organised as samples. The capabilities of Kontakt to allow individual control like in Superior-Drummer will need to be determined. It will involve a lot of groups. A foreseeable problem might come when trying to get the program to select the same random roundrobin-variation from multiple sets of groups (direct + variations, bleed1 + variations, bleed2 + variations) which all must be in sync.

There might need to be a compromise in what bleed is included and these could potentially be locked like in Toontrack's EZ-Drummer (2006) software (Fig.9), a stripped down version of Superior-Drummer.

It has on/off bleed state for the snare-bottom and overhead channels. The other channels do not include bleed.

(Fig.9 - Toontrack's EZ Drummer with 'locked down' bleed and controls)

Outputs

There will be an output for each instrument, and a way to adjust the volume and panning. If possible selectable outputs will be implemented, multiple single mono-outs or a combined stereo master out.

Effects and Humanisation Features

A simple ADSR and pitch-shift control will be added to each instrument like in Superior-Drummer.

Roundrobin-variations will be selected at random, but to give more variation there will be the option to randomly modulate volume slightly.

User Interface

If the least that can be implemented is a photo of a drum-kit, that would be great. The most would be something that resembles a simplified version of Superior-Drummer's mixer. Work is cut-out for this project as it currently stands. The user-interface will probably be a product of pure function.

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