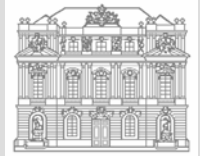


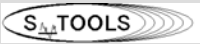
# S\_TOOLS - STx

Supplement #02

## Sequencer & Sound Synthesis



## STx – Sequencer - 1



Purpose:

- Sequencing of arbitrary sound segments located in soundfiles available to STx for:
  - concatenation of sound segments
  - queued reproduction (A/B-X auditive comparison)
  - spectral analysis (all that apply for soundfiles)
  - export sequence signals into existing soundfile(s)
  - re-import segments from soundfile(s) into sequence(s)
- Generation and processing of sounds by means of
  - additive synthesis
  - amplitude and/or frequency modulation
  - filtering (subtractive synthesis)
- Multi-channel sequencing and mixing of stored sound segments and real-time synthesized sounds.

*Note 1:* signals created or provided by the Sequencer are accessible to all STx functions with a few exceptions.

*Note 2:* signals to be processed in a specific sequence should have the same sampling rate and uniform binary coding.

# STx – Sequencer - 2

## How to create a new sequence?

1. Start STx
  2. Click right mouse button on current DataSet
  3. Select "Add" -> "Sequence"
  4. Specify an ID, sampling frequency, number of channels.
  5. Specify optional annotations in the edit box in the format "Text1 = any annotation;"
  6. Click "OK"
  7. The new sequence appears in the DataSet Detail View.
- *Note:* the sequence ID must begin with a letter and be alphanumeric. No special characters are allowed at all.

The new sequence appears in the DataSet Detail View

Tag	ID	File Ref	SR Ch
AFile	ASR03#orig.WAV	D:\A_Sig\ASR03#orig.WAV	16.
AFile	ASR03.WAV	D:\A_Sig\ASR03.WAV	16.
AFile	ASR03#orig.WAV.1	D:\A_Sig\FI\Grafall\70\ASR03#orig.WAV	16.
ASequence	am1		44.
ASequence	addsynth01		44.100 1

# STx – Sequencer - 3

## Opening the "Edit Sequence Signal" dialog

1. Double click on "ASequence" .....
2. Opens an empty sequence list window,
3. select the "Signal" Detail View
4. Select "Add Signal" from the context menu (Hotkey "Ins")
5. The "Edit Sequence" dialog is ready now to accept signal synthesis parameters.

The screenshot shows the STx Sequencer software interface. The main workspace displays a table of children of root:

Tag	ID	File Ref	SR[kHz]	Ch.
AFile	ASR03#orig.WAV	D:\A_Sig\ASR03#orig.WAV	16.000	1
AFile	ASR03.WAV	D:\A_Sig\ASR03.WAV	16.000	1
AFile	ASR03#orig.WAV.1	D:\A_Sig\F\Gratall\70\ASR03#orig.WAV	16.000	1
AFile	AMF001	D:\AMF001.wav	44.100	1
ASequence	addsynth01		44.100	1

The context menu for the 'ASequence' entry is open, showing options like Play, Run, Setup, Add Signal, Edit, Delete, Copy, Cut, Paste, Enable, Disable, Set .., Select, Show, and Move Signal. The 'Add Signal' option is highlighted.

The 'Signals of Sequence "addsynth01"' window is open, showing a table with columns: Mode, Base, Time, Ch, Signal, Dur., Amp., Params. The 'Signal' tab is selected.

The 'Edit Sequence Signal (1 of 1)' dialog is open, showing parameters for the signal. The 'Mode' is set to 'ON', 'Time' is 'Absolute', and 'Channel' is 'All'. The 'Signal' dropdown is set to 'Pause', 'Amp.' is '1', and 'Dur[s]' is '1'. The 'Params' field is empty.

# STx – Sequencer - 4

## How to input signal parameters for additive synthesis?

**Note 1:** each of the options can be specified in any combination. The user is responsible for the plausibility of the synthesized signal.

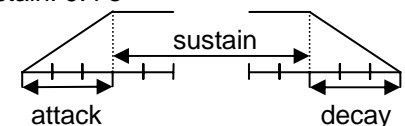
**Note 2:** in the example given above, no filter function has been used. For applications requiring real-time filtering, see the following pages.

**Note 3:** in order to analyze the signal in real time, the STx Real-Time Analyser (RTA) must be running prior to sequence reproduction.

1. select Mode: ON/OFF .....
- (OFF = exclude from processing)
2. specify starting time setting
3. specify channel for signal output
4. select type of signal and specify signal parameters
5. select type of waveform envelope and specify time and amplitude values to be connected to create the envelope
6. select type of amplitude modulation and specify parameters
7. select type of frequency modulation and specify parameters

The parameter settings on the left create the following signal:

- Tone: single sinusoid, frequency: 1000 Hz, starting phase: 0; amplitude: 0.5 (i.e. -6 dB re full scale); duration: 10s, starting time: 0s
- Signal- (waveform-) Envelope: onset time 0.3 s, decay 0.3 s, sustain: 9.4 s



- Amplitude Modulation (sinusoidal): the carrier frequency of 1000 Hz is modulated 100%, modulation rate 5 Hz, 0 phase.
- Frequency Modulation (sinusoidal): additional frequency modulation is introduced with a width of +/- 25 Hz, modulation rate: 7Hz, 0 phase.
- The signal will be included in sequence generation (MODE=ON)



The signal output is generated in real time for both channels when "play" is started (mono signal)

# STx – Sequencer - 5

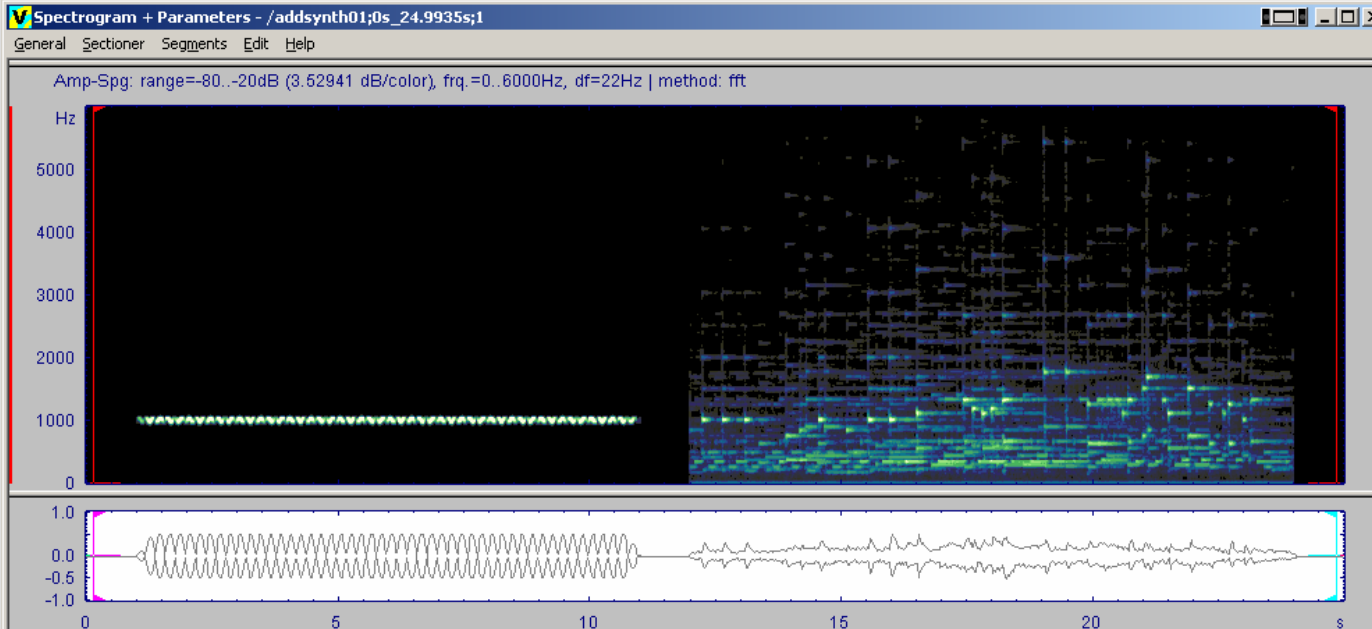
## How to concatenate synthesized signals with sound segments from soundfiles?

After specifying the synthesized signal parameters, the Signal View shows the signal definitions stored in the current DataSet:

Signals of Sequence "addsynth01"															
M...	Base	T...	C...	Signal	Dur.	A...	Params	Env	Points	Filter	I...	AM	Pa...	FM	Par...
ON	Absolute	0	All	Pause	1	1		none		none	none	none			
ON	End	0	All	Tone	10	0.5	1000 0 1	Linear	0.3 1 9.7 1 10 0	none	none	Sine	1 5 0	Sine	50 7 0
ON	End	0	All	Pause	1	1		Linear		none	no	none			
ON	End	0	1	Segment	11.9935	1	/Schubert...	none		none	no	none			
ON	End	0	All	Pause	1	1		Linear		none	none	none			

The composed sequence "addsynth01" now contains: 1s pause, followed by the sinusoid (1000 Hz, AM+FM+envelope), 1s pause, a short part of music (piano) and the final pause with a duration of 1s (see spectrogram below).

1. Prepare a Playlist offline in order to schedule sound events properly.
2. Specify "cue in" and "cue out" points (time "Base") of individual sound segments:
  - a. "Absolute" addresses (in s.xxx)
  - b. Relative to "Begin" and "End" or "Begin" and "Duration" of preceding segments
  - c. Specify overlaps (mixing) with adequate amplitude matching (in total < 1.0 to avoid overload).
3. Specify signal parameters as shown before.
4. Start playing.
5. Optionally a spectrogram could be performed in advance



*Note 1:* in order to overlay (mix) the piano segment with the sinusoid at 5s, the "Base" setting has to be changed to "Absolute" and "Time 5s".

*Note 2:* Edit signal parameters by double clicking the entry in the Signal Detail View

*Note 3:* The shortcuts Ctrl+X and Ctrl+V can be used to 'copy' soundfile segments into a sequence. Since only a reference is copied (no physical transfer), the corresponding soundfile must be present in the current DataSet.

# STx – Sequencer - 6

## How to apply filters in STx sequences?

Elliptic, Butterworth and Chebychev filter can be applied to sequence segments in combination with all other sequencer functions.

1. Define the source signal, type of signal, envelope etc.
2. Specify the filter type and filter parameters.

**Edit Sequence Signal (1 of 1)**

Mode: **ON** Time: **Absolute** [0] s Channel: **All**

Signal: **Noise** Amp: **0.8** Dur[s]: **5**

no parameters

Params: [ ]

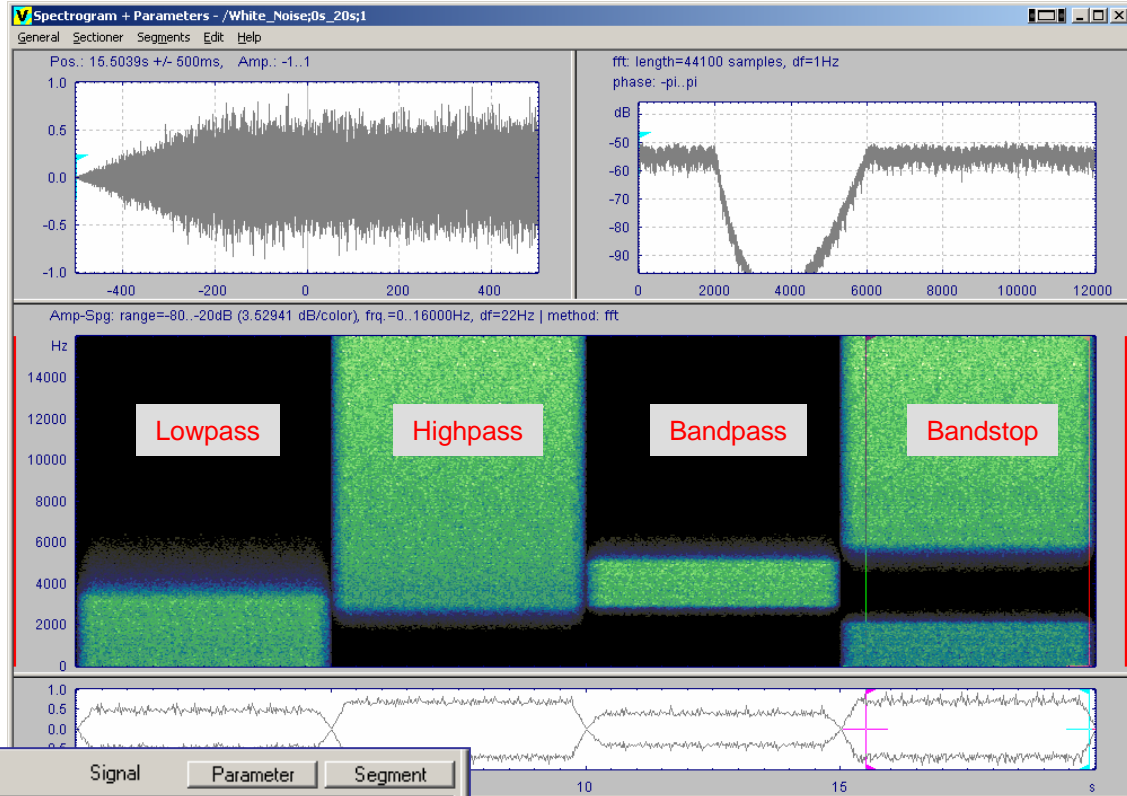
Envelope: **Linear** Points (t1 a1 ..): **0 0.3 1 4.7 1 5 0**

Filter: **Elliptic** Invert: **off** fmin fmax order ripple damping: **300 3200 5**

none  
Elliptic  
Butterworth  
Chebychev

FM: **none** depth rate dutycycle: [ ]

Prev Append  
Next Delete Close



Signals of Sequence "White\_Noise"

Signal	Parameter	Segment											
M...	Base	T...	C...	Sig...	D...	A...	Env	Points	Filter	I...	Params	AM	FM
ON	Absolute	0	All	Noise	5	0.8	Linear	0 0.3 1 4.7 1 5 0	Elliptic	off	0 3200 5	none	none
ON	End	0	All	Noise	5	0.5	Linear	0 0.3 1 4.7 1 5 0	Elliptic	off	3000 22000 5	none	none
ON	End	0	All	Noise	5	0.8	Linear	0 0.3 1 4.7 1 5 0	Elliptic	off	3000 5000 5	none	none
ON	Absolute	15	All	Noise	5	0.5	Linear	0 0.3 1 4.7 1 5 0	Elliptic	off	0 2000 7	none	none
ON	Absolute	15	All	Noise	5	0.5	Linear	0 0.3 1 4.7 1 5 0	Elliptic	off	6000 20000 7	none	none

The example spectrogram shows from left to right the filtering of white noise: Lowpass, Highpass, Bandpass and Bandstop. Left: The sequencer parameter definition to obtain the sounds described.

## STx – Sequencer - 7

### How to copy the content of a sequence into an existing soundfile?

Assume a sequence has been created as described above and the user wants to copy the content of the sequence into a soundfile:

Signals of Sequence "addsynth01"												
	Mode	Base	Ti...	Ch	Signal	Dur.	Amp.	Params	Env	Points	Filter	Invert
!	off	Absolute	0	All	Pause	1	1		none		none	
!	ON	End	0	1	Segment	11.9935	1	/Schubert..	none		none	no
▶	ON	End	0	All	Pause	1	1		Linear		none	
Edit	ON	End	0	All	Tone	10	0.5	1000 0 1	Linear	0.3 1 9.7 1 10 0	none	
!	off	End	0	All	Pause	1	1		Linear		none	

Segments of Sequence "addsynth01"					
	ID	Begin	Length	Chn.	Chn.
!	addsynth1	0.0000	22.9935	0	

- Sequencer sound segments can be arranged in consecutive order, with or without pauses, overlapping or synchronized on all available channels.
- The number of channels available depends on the sound subsystem configuration installed (currently limited to 128 channels).
- The signal modifications, such as filtering, AM, envelope can be applied to individual channels at their own timing or to all channels simultaneously. FM can only be applied to real time generated signals.
- Signals specified in sequences can also be processed by all STx functions with a few exceptions.
- Sound segments from arbitrary sound files with compatible sampling rates and binary coding can be processed in a single or multiple sequences.

1. Check the integrity of your sequence (play or analyze)
2. Rearrange the sequence list (Ctrl+Up or Ctrl+Down) if the current order should be changed.
3. Switch "Mode-OFF" if list items should be skipped.
4. Update "Segment" and save new list configuration.
5. Rename the default segment name "Signal.All" to the segment name you want to obtain in the segment list of the destination soundfile.
6. "Copy" and "Paste" the segment from the sequence into the segment list of the destination soundfile. The segment will be appended to the existing signal(s).
7. Reimporting soundfile segments into sequences is performed by "Copying" and "Pasting" in reverse order.

#### Note 1:

if a new soundfile has to be created use the same procedure as for "Add a Sequence" by selecting "Add a Soundfile" to the current DataSet (see page 2).