S_TOOLS - STx

Supplement #02

Sequencer & Sound Synthesis
Purpose:

- Sequencing of arbitrary sound segments located in soundfiles available to STx for:
  - concatenation of sound segments
  - queued reproduction (A/B-X auditory 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.
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.
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.
How to input signal parameters for additive synthesis?

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).

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.
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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:

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

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).

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.
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.

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.
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:

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.

- 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.

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).