# Synchronizing the UltraSoundGate with other (video or physiological data) recording equipment

There are various approaches for synchronizing the ultrasound recordings made with the UltraSoundGate system.

Simultaneously triggering both the UltraSoundGate and the third-party system by using an external TTL pulse fed into the DIN input

To guarantee a (sample) precise start of the wav files in the Avisoft-RECORDER USGH software, the DI input (*Trigger* option "*UltraSoundGate DI*") should be used:
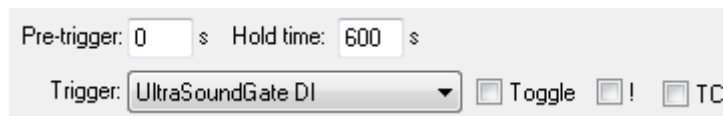

The external TTL pulse can be created either by a custom-made external trigger button or even by the internal UltraSoundGate TRG button. Because the internal TRG button of the USG is tied to the TRG input, it is necessary to use a Y cable that connects the 2.5 mm DIN and the TRG input jacks. There are internal pull-up resistors that create a logic high level at the DIN and TRG inputs as long as the button is not pressed. A suited Y adapter cable with blank cable ends is available through the order number #52003. When the button is pressed, the voltage level at the cable end of the adapter cable will change from 4.5 V to 0.0 V (active low).

Alternatively, the TRG input or the TRG button on the UltraSoundGate alone could be used, but this would introduce a variable delay between the occurrence of the TRG pulse and the start of the .wav file of several 10 ms, depending on the selected *Buffer* size settings.

Note that it is in any case necessary to first start the monitoring mode by clicking at the red recording button (, *Monitoring > Start*) to arm these alternative start triggers. Otherwise, the recordings will not be triggered.

Another option would be to configure the TRG socket of the UltraSoundGate as a digital output. The TRG socket will then represent either the internal *trigger state* or the *file saving state* according to the selection made on the *Control Output Settings* dialog box:
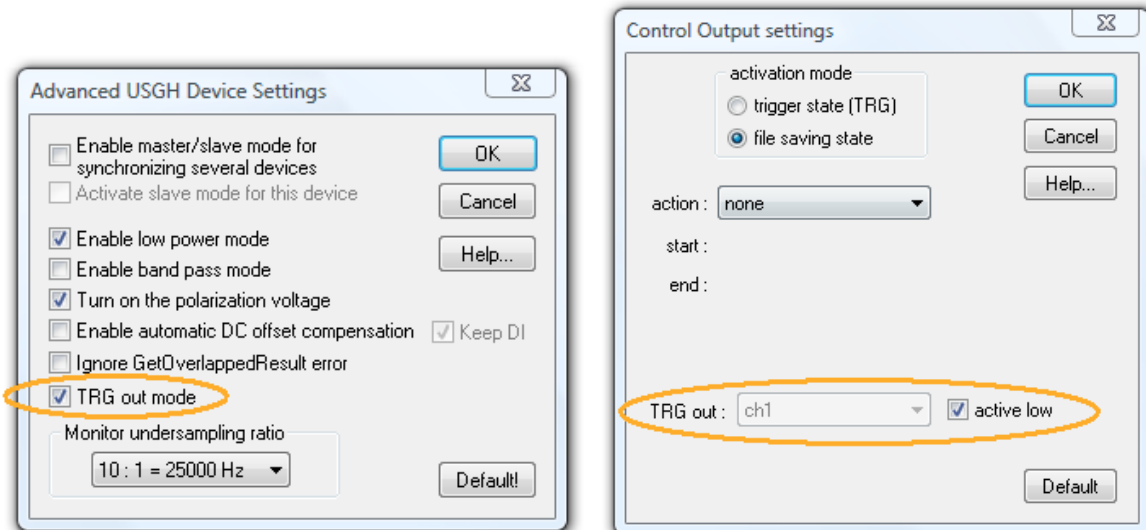
If the *file saving state* has been selected, the TRG output will be active as long as a .wav file is being saved onto disk (excluding the pre-trigger interval). Note that there will be a jitter of several 10 ms, depending on the selected *Buffer* size settings.

For connecting the TTL I/O signals we recommend to use original 2.46mm ID (0.097") Phone Plug Mono Connectors by Switchcraft Inc. (850X Switchcraft Inc. | Connectors, Interconnects | DigiKey). Other brands may not provide a reliable electrical connection.

It is also possible to send TTL pulses through externally attached National Instruments DAQ devices (e.g. NI USB 6501, 24 line Digital I/O) that would allow to synchronize UltraSoundGate models that have no digital inputs and outputs (e.g. USG 116Hb and 416Hb). After installing the NI DAQmx device driver, the *RECORDER USGH NI-DAQmx* software (rec_usgh_nidaqdi.exe) rather than the standard *RECORDER USGH* software (rec_usgh.exe) must be launched.
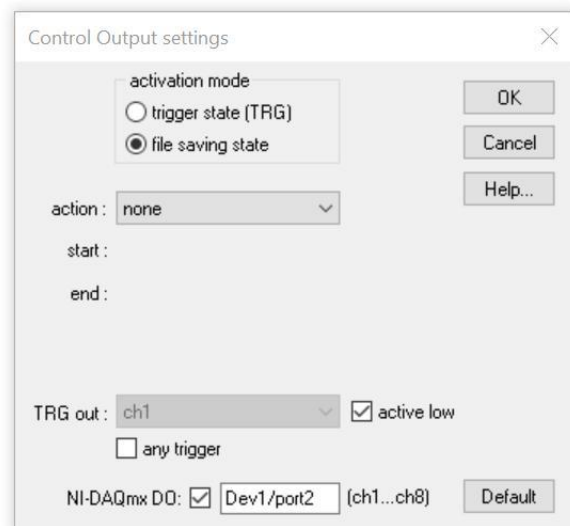
Then navigate to *Options > Control output settings…*, activate the *NI-DAQmx DO* option and select the NI device (*Dev1*) and port (*port0…3*) that should be used for sending the TTL pulse. The least significant line (PX.0) of the selected port will be linked to first channel in the RECORDER USGH NI-DAQmx software (PX.1 will be linked to the second channel and so on).

All the above synchronization methods assume that the sample clocks of the two recording systems are synchronous. The precision of common crystal-controlled clock generators is usually better than +-50ppm. So, under worst-case conditions (100ppm difference), these deviations can accumulate to a time lag of 300 ms after a time period of 10 minutes.

If these deviations were not acceptable, a continuous reference clock should be used instead. This could be for instance a simple 1 Hz or 1 kHz TTL clock signal that is being recorded by both recording systems as a reference. The problem is here that the pulses must always be counted from the start of the acquisition process (Avisoft-SASLab Pro does this when the option **clock reference pulses on USD DI (LSB)** has been selected from the command **Analyze/Time axis format…**)

The internal sample clock of the UltraSoundGate unit is available at the SYNC socket (3.5 mm TRS) on the tip contact. The frequency of that clock signal corresponds to fs*16 or fs*32, depending on the selected sample rate and the Advanced USGH Device Settings.

Using SMPTE / LANC time code as a clock reference

A better solution would be to use a reference clock signal that inherently encodes the absolute time, such as provided by SMPTE (en.wikipedia.org/wiki/SMPTE_time_code) or SONY LANC (Control-L) linear time code generators that are commonly being used in Video productions.

SMPTE time code can certainly be useful for synchronizing sound and video recordings because suited time code generator / window inserter products are commercially available (HORITA PG-2100 or TG-50/TG-50P, www.horita.com, available from www.bhphotovideo.com):

The linear time code information would then be recorded both onto the video and the UltraSoundGate recording systems, which allows assigning the individual video frames precisely to certain points in time on the recorded .wav file.

In case you are using a consumer-grade (DV) video camera that does not provide LANC time code and does not have SMPTE capabilities (or that does not provide access to the analog video signal), then it would still be possible to use the SMPTE time code mechanism by placing a SMPTE time code display / reader / generator (for instance a HORITA VLR-100 LTC Reader/Generator or a Time Code Slate) into the image area:

Yet another option would be to record the SMPTE time code signal onto the audio track of the video recording system. There is video editing software available that can subsequently extract that time code (AVID or the stand-alone application FCP-AUX TC reader http://www.videotoolshed.com/?page=products&pID=26 for processing QickTime (.mov) files), which would however require additional (sometimes very time-consuming) conversion and processing steps.

See also www.avisoft.com/LANC_SMPTE.pdf

Mixing the Avisoft-RECORDER real-time spectrogram image with the video camera signal

Another simple method for synchronizing video and ultrasound recordings would be to mix the video output signal of the PC graphics adapter (showing the Avisoft-RECORDER real-time spectrogram) and the video camera output signal by using a video mixer, such an Edirol / Roland V-4 Four Channel Video Mixer (Vertically divided multiscreen or Picture in picture mode). Such a setup would of course require a special graphics adapter card with an S-Video TV output.

http://lib.roland.co.jp/support/en/manuals/res/1811436/V-4_e07.pdf

Alternatively, a screen video capture application could be used to record the PC screen with the real-time video display and the RECORDER real-time spectrogram display running simultaneously.

Using the acoustic monitoring output of the UltraSoundGate hardware as a reference

A number of single-channel UltraSoundGate units have an in-built acoustic monitor output that performs a simple under-sampling procedure in order to make the ultrasonic vocalizations audible to the human ear and compatible to common audio recording equipment. This signal could be recorded for instance onto the audio track of a video recording system that would afterwards allow to identify the occurrences of the individual ultrasonic vocalizations on the audio track relative to the video image.

Simultaneously sampling both the ultrasound signal and the physiological data

A more direct method to synchronize the different data was to use the same multichannel recording hardware for sampling both the ultrasound signal and the related data. One option would be to use National Instruments DAQ device in conjunction with a special version of the Avisoft Bioacoustics ultrasound microphone, the model CM16/CMPA40-5V (part#40014):
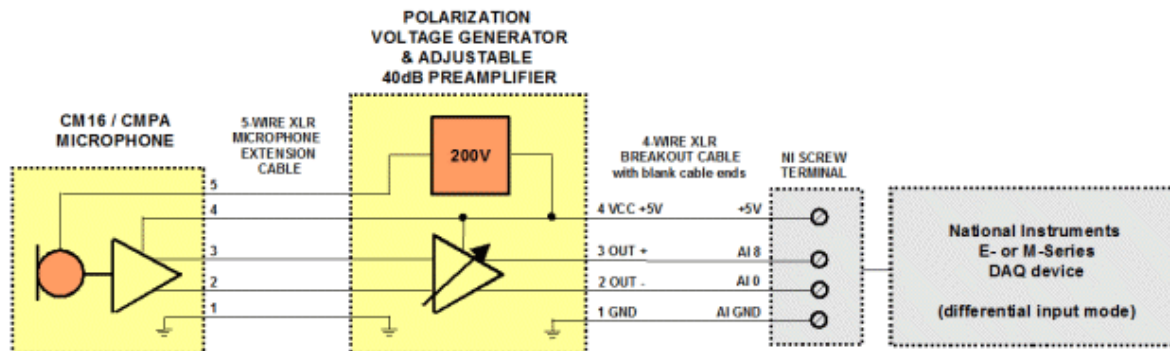
Remote-controlling the RECORDER software from other software

In case the video recording is done PC-based through a video acquisition software (including something like MatLab, EthoVision or other custom software), it would also be possible to remote-control the RECORDER software via Dynamic Data Exchange (DDE) or via a command line program (CMCDDE.EXE). See the RECORDER online help (http://www.avisoft.com/Help/RECORDER/dde_command_interface.htm) or the manual, chapter *DDE Command Interface* (http://www.avisoft.com/RECORDER.pdf) for further details on this option.