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APPLICATION NOTE

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## Application Note 270 Synchronizing Physiology Data Recording with Associated Video Using Acq*Knowledge* and MP150

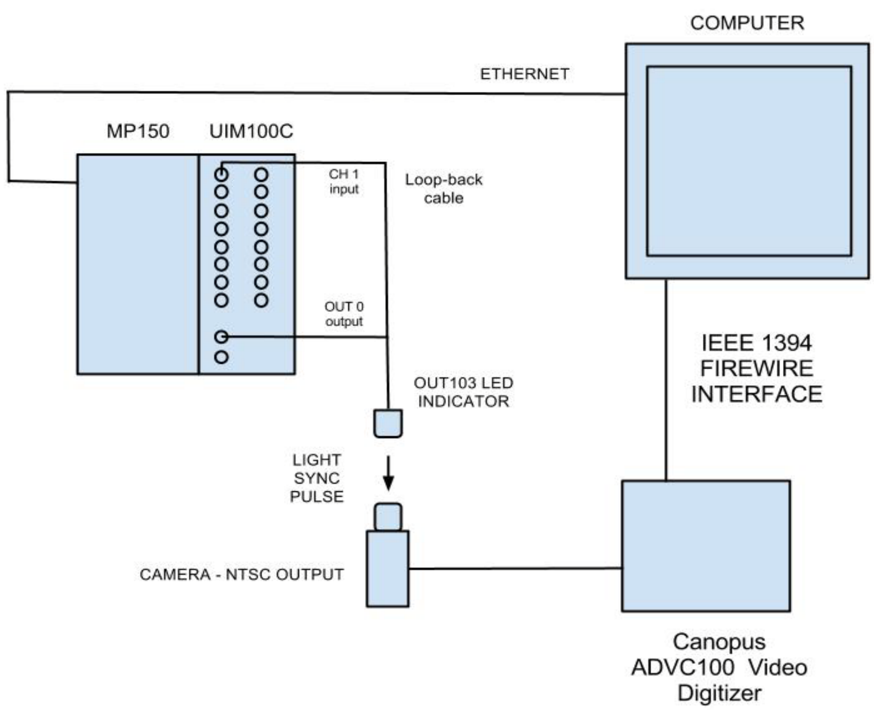
Synchronized video coupled to simultaneously recorded physiological variables can increase understanding of test results. Acq*Knowledge* software, running under Windows, provides the ability to record a video signal which can be simultaneously collected with other types of time-series data, such as biopotential data (ECG, EEG, EMG, or EOG) or transducer data (electrodermal activity, force, temperature, pressure, goniometer, accelerometer, strain, etc.).

The key issue when performing simultaneous recording of physiological data and video data is synchronization. Because the video camera and associated digitizer are separate devices from the MP unit, the data from the video digitizer is only combined with data from the MP unit as they arrive to the Acq*Knowledge* application running on the computer.

The setup illustrated in this application note can be used to determine the differences in clock rates between the video digitizer and the MP unit. This difference number, expressed in ppm, can be used to estimate the maximum error expected when physiological data acquired by the MP unit is compared to simultaneously acquired video data into Acq*Knowledge*.

The setup in this application note indicates the recommended method by BIOPAC to perform tightly synchronized capture between measured physiological data and associated video data. With this setup, it's typically possible to obtain synchronization between physiological data and video data to within ±1 video frame (33.3 ms) over a one-hour period. When employing this setup, users should perform the following test procedure to determine the applicable fixed delay (usually ±100 ms or less) to initially tightly synchronize the physiological recording with the video recording.

To time-synchronize these two data streams (from the video digitizer and the MP unit), a visual sync pulse should be generated by Acq*Knowledge* and output by the MP unit so it can be visually acquired by the video camera and associated digitizer. In this manner, the visual sync pulse can be observed on the video playback window in Acq*Knowledge*. During playback, the stimulus signal is also present as a square-wave pulse in a loop-back channel (CH 1) in Acq*Knowledge*. This square-wave pulse indicates the synchronization marker. When the Acq*Knowledge* measurement cursor is placed at the onset of the synchronization marker on CH 1, then the visual sync pulse should be initially evident on the video playback.



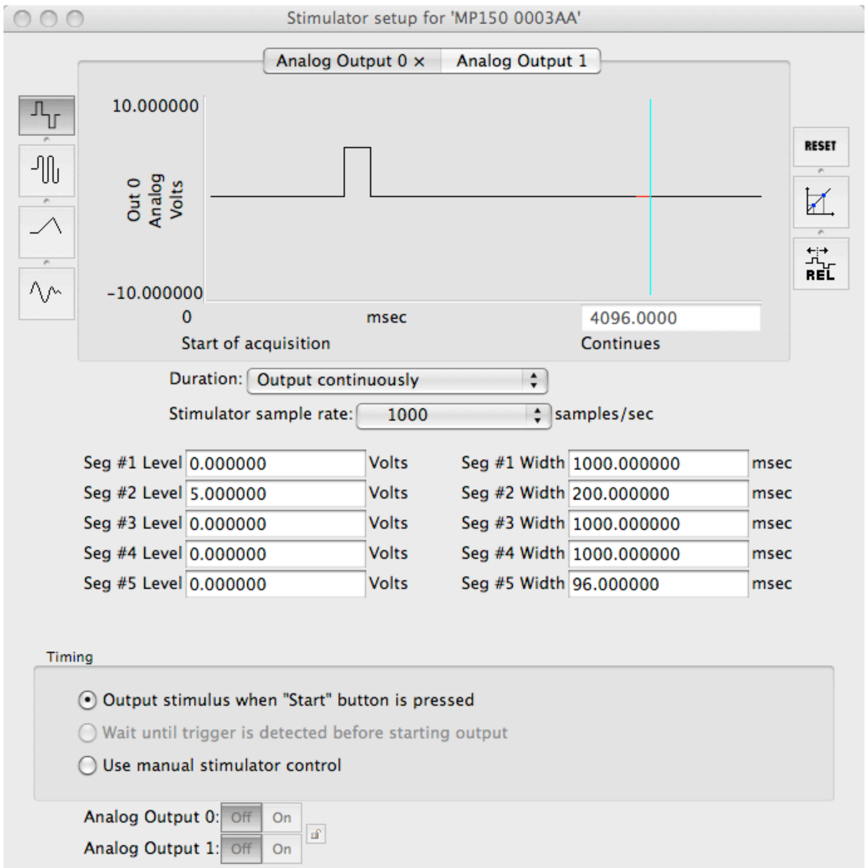

**MP System Setup for Video Synchronization**

To tightly and initially synchronize the recordings, the user is permitted to introduce a fixed delay (positive or negative time delta) to exactly time-align the recorded loop-back data with the recorded video data. Typically, this fixed delay is on the order of ±100 ms or less and is entered under the Media/Media Setup/Linked Media window in Acq*Knowledge*.

This fixed delay is present because the various software processes operating within Acq*Knowledge*, the video digitizer and the MP unit are subject to time execution changes depending on computer type and Ethernet traffic. This fixed delay does not vary, once determined for a specific computer setup. For applications requiring ±1 second synchronization accuracy or less, establishing this fixed delay is not necessary and it can be left at its default value of 0 ms.

Three synchronization tests were performed: the first test was for 1,500 seconds, the second test was for 1 hour (3,600 seconds), and the final test was for 24 hours (86,400 seconds).

All tests employed the OUT103 LED indicator, driven from Analog Output 0, with a stimulus loop-back cable connected to CH 1. A periodic pulse train was generated in the Acq*Knowledge* Stimulus Setup window and output via OUT 0 port on UIM100C. The OUT 0 port was connected to a 3.5 mm mono splitter. One output of the splitter was set to drive the OUT103, the other output of the splitter was directed through the loop-back cable to the CH 1 Analog input. CH 1 was sampled at 1000 Hz, during simultaneous output of the stimulator signal driving both OUT103 and CH 1.




**Stimulator Setup Output to Analog Output 0**

The ADVC100 (Canopus Technology) – from Grass Valley – video digitizer was used to collect NTSC analog video data direct to the computer running Acq*Knowledge* under Windows. The ADVC100 interface was via IEEE1394 (Firewire). The video data was saved in Acq*Knowledge* with Windows Media Video (*.wmv) format.

- WMV formatted files include time-code information and are better suited for holding tight synchronization of video data over long periods of time.
- Video data recorded in Acq*Knowledge* in Audio Video Interleave (*.avi) format is best suited for synchronization of video data only when audio data is also recorded.

**TEST 1 Results—1,500 second acquisition**

Camera-sourced video data was observed to be synchronized to the waveform data (stimulus loop-back display on CH 1) within a maximum delta of 2 frames (±1 frame) from beginning to end of recording. The fixed delay used in Media/Media Setup/Linked Media was -100 ms.

The fixed delay was adjusted so an equal number of frames were indicated as both slightly ahead and slightly behind the defined light trigger point, and these time deltas were always less than the time period of one frame (33.3 ms).

**TEST 2 Results—3,600 second acquisition**

Camera-sourced video data was observed to be synchronized to the waveform data (stimulus loop-back display on CH 1) within a maximum delta of 2 frames (±1 frame) from beginning to end of recording. The fixed delay used in Media/Media Setup/Linked Media was -100 ms.

The fixed delay was adjusted so an equal number of frames were indicated as both slightly ahead and slightly behind the defined light trigger point, and these time deltas were always less than the time period of one frame (33.3 ms).

**TEST 3 Results—86,400 second acquisition**

Camera-sourced video data was synchronized to the waveform data (stimulus loop-back display) within a maximum delta of 54 frames (±27 frames) from beginning to end of recording. The fixed delay used in Media/Media Setup/Linked Media was -100 ms.

The fixed delay was adjusted so an equal number of frames were indicated as both slightly ahead and slightly behind the defined light trigger point, within the first 3,600 seconds of the recording. These time deltas were always less than the time period of one frame (33.3 ms), within the first 3,600 seconds of the recording.

After 3,600 seconds had elapsed, it became more evident that there was a very slight difference in the clocking speed between the MP150 unit and the video digitizer. The following table shows the linear drift in time offset (due to video digitizer and MP unit clock speed differences) between the video signal and the synchronization marker.

| Time (seconds) | Offset (ms) | Video Frame Offset |
|---|---|---|
| 0 | -30 | 1 |
| 1,350 | 0 | 0 |
| 2,700 | +30 | 1 |
| 5,400 | +68 | 2 |
| 10,800 | +175 | 5 |
| 21,600 | +434 | 13 |
| 43,200 | +868 | 26 |
| 86,400 | +1793 | 54 |

The table shows that there is a reasonably linear drift between the video digitizer clock and the MP clock on the order of 1.793 seconds over a 24 hour (86,400 second) period. This translates to a clock speed difference of (1.793/86,400) or 21 ppm. This means that the MP clock and the video digitizer clock are equivalent to each other within 21 ppm, or stated differently, the ratio between the clock speeds is 1.000021.

These results will be typical for the configuration specified in this application note. The ADVC100 video digitizer adheres to the IEEE 1394 interface standard and will provide considerably more accurate timing than a typical USB (web) camera. Furthermore, the IEEE 1394 interface will provide higher reliability for data transfer to the host computer, with far less propensity to drop frames, as compared to the USB interface.