

Data Viewer Integration Messaging Protocol

SR Research Ltd.

Toronto - Ottawa, Canada

Agenda

- Brief overview of Data Viewer
 - For more info check out Data Viewer Video Tutorials at www.sr-support.com
- Brief overview of EyeLink API, which allows experimental programming environments (e.g., Psychtoolbox for Matlab, Psychopy, E-Prime, NBS Presentation, Python, C/C++) to communicate with EyeLink systems
- Discussion of messaging protocol options and how to use them

Data Viewer

- Data Viewer is used for viewing, filtering, and processing gaze data recorded with EyeLink eye trackers.
- Runs on Windows, macOS, and Linux.

Inspector (Memory Usage 2%)

Trial View WB - WB: Trial: 1

WB: Trial: 1

- WB: Trial: 1: Fixation: 4333 ms
- WB: Trial: 1: Fixation: 4527 ms
- WB: Trial: 1: Fixation: 4735 ms
- WB: Trial: 1: Fixation: 6059 ms
- WB: Trial: 1: Fixation: 6258 ms
- WB: Trial: 1: Fixation: 7330 ms
- WB: Trial: 1: Fixation: 7693 ms
- WB: Trial: 1: Fixation: 7947 ms
- WB: Trial: 1: Fixation: 8533 ms
- WB: Trial: 1: Fixation: 9098 ms
- WB: Trial: 1: Fixation: 9390 ms
- WB: Trial: 1: Fixation: 9960 ms
- WB: Trial: 1: Fixation: 10309 ms
- WB: Trial: 1: Fixation: 10515 ms
- WB: Trial: 1: Fixation: 10703 ms
- WB: Trial: 1: Fixation: 12275 ms

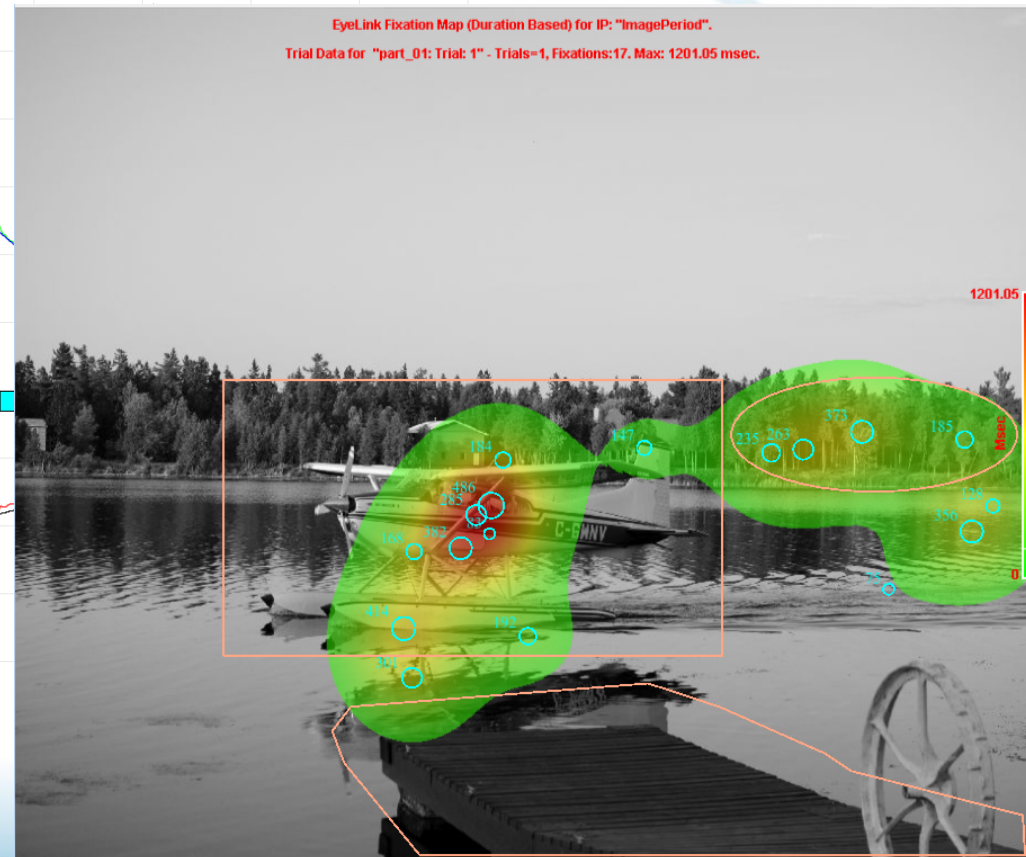
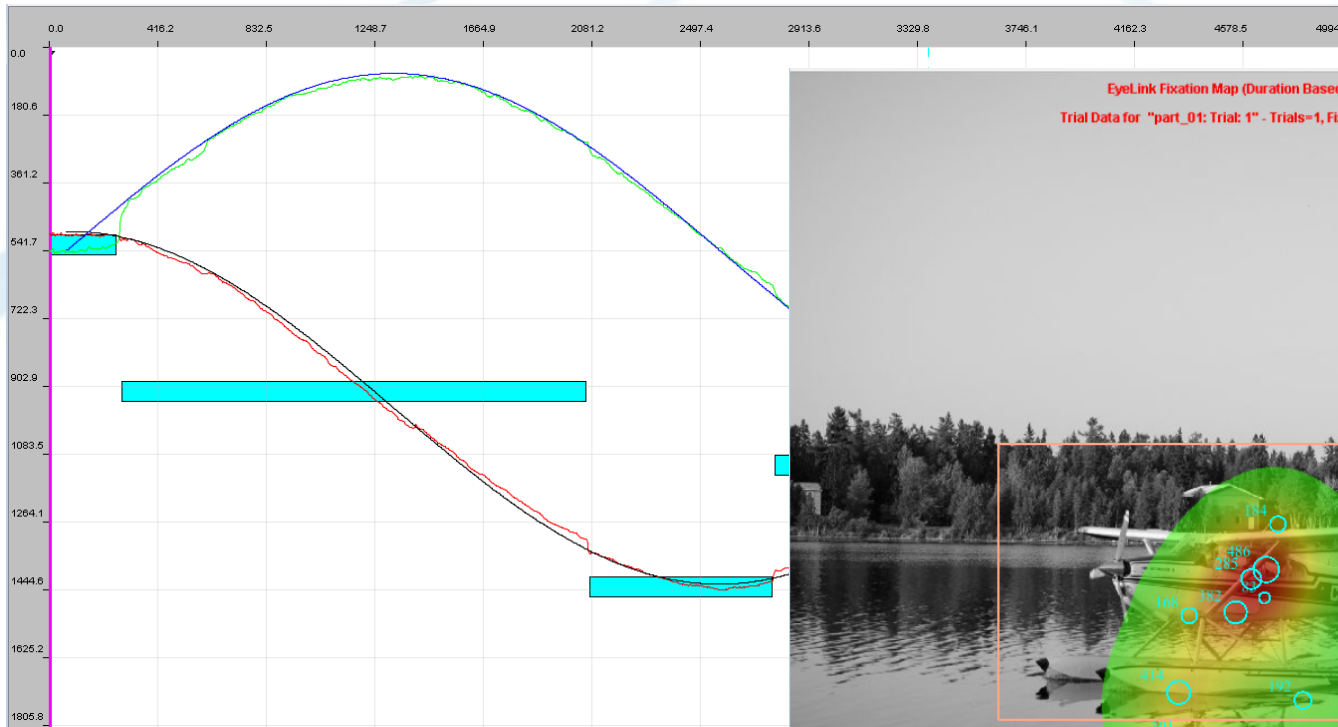
Field	Value
Label:	Trial: 1
Index:	1
Recording File:	WB.edf
Recording Start Time:	272597312 ms
Recording End Time:	272620092 ms
Recording Duration:	22780 ms
Sampling Rate:	1000 Hz
Interest Period Label:	Full Trial Interest Period
Interest Period Start:	0 ms
Interest Period End:	22780 ms
Interest Period Start Matched:	<input checked="" type="checkbox"/>
Interest Period End Matched:	<input checked="" type="checkbox"/>
Reaction Time:	22780 ms

View Trial Data Spatially with Image Overlay

1119.00,950.00

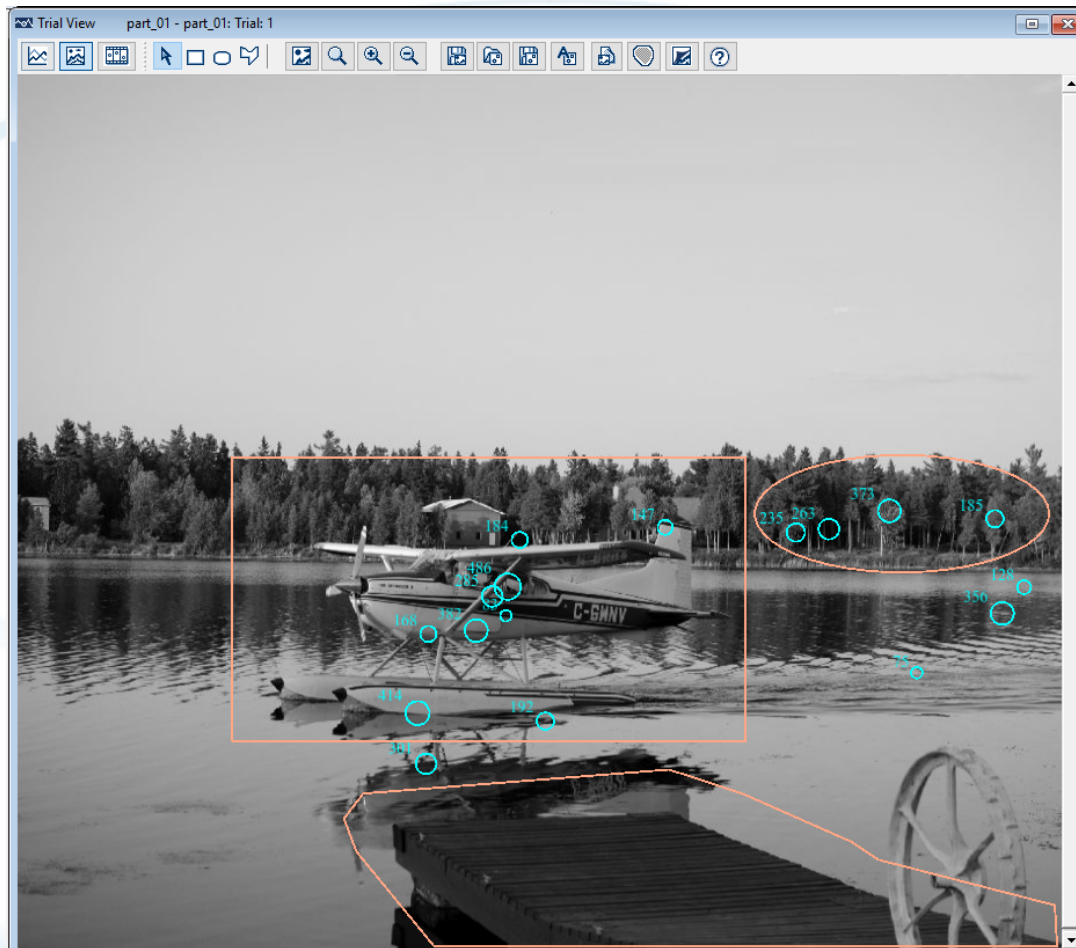
Data Viewer

- Various visualization options, including spatial overlay, temporal graph, playback, and fixation/heat maps



Data Viewer

- Allows matching of gaze data to interest areas



Data Viewer

- Output reports to summarize the data -- these can then be input to statistical packages

Fixation Output Report

Available Variables

- CURRENT_FIX_ADJUSTED
- CURRENT_FIX_BLINK_AROUND
- CURRENT_FIX_BUTTON_0_PRESS
- CURRENT_FIX_BUTTON_1_PRESS
- CURRENT_FIX_BUTTON_2_PRESS
- CURRENT_FIX_BUTTON_3_PRESS
- CURRENT_FIX_BUTTON_4_PRESS
- CURRENT_FIX_BUTTON_5_PRESS
- CURRENT_FIX_BUTTON_6_PRESS
- CURRENT_FIX_BUTTON_7_PRESS

>>

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Selected Variables

- RECORDING_SESSION_LABEL
- TRIAL_INDEX
- CURRENT_FIX_INDEX
- CURRENT_FIX_DURATION
- CURRENT_FIX_INTEREST_AREA_ID
- CURRENT_FIX_INTEREST_AREA_LABEL
- CURRENT_FIX_X
- CURRENT_FIX_Y

Variable Definition

Exclude Trial String :

Include Hidden Events in Relative (Previous / Next) Variables.

Treat Hidden Events as Missing Values in Relative (Previous / Next) Variables.

Place Quotes (") Around String / Text Variables

Create Output Report For All Custom Interest Periods

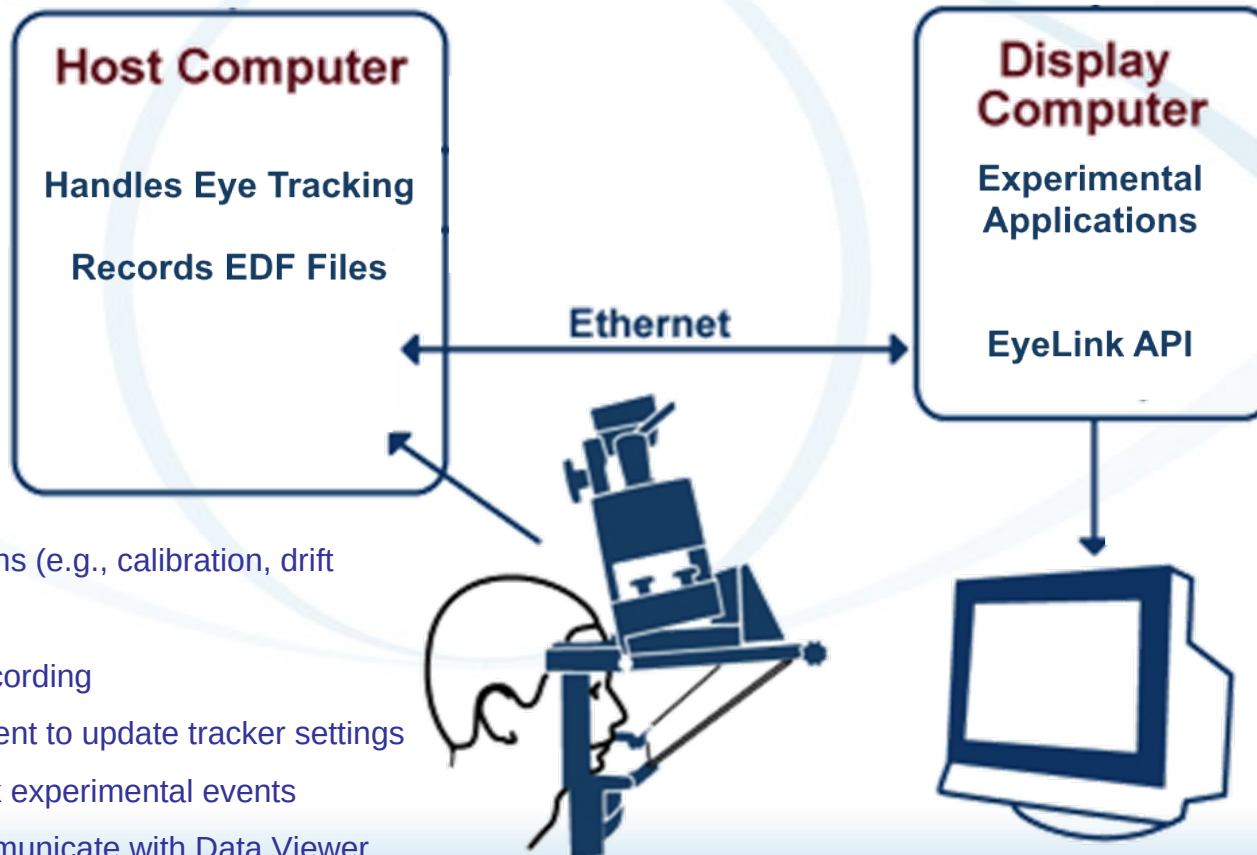
Report IP Data in One File. Report IP Data in Multiple Files.

Create one Report File per EDF File

RECORDING_SESSION_LABEL	TRIAL_INDEX	CURRENT_FIX_INDEX	CURRENT_FIX_DURATION	CURRENT_FIX_INTEREST_AREA_ID	CURRENT_FIX_INTEREST_AREA_LABEL
part_01	1	1	184	1	Plane
part_01	1	2	486	1	Plane
part_01	1	3	285	1	Plane
part_01	1	4	83	1	Plane
part_01	1	5	168	1	Plane
part_01	1	6	382	1	Plane
part_01	1	7	301	.	.
part_01	1	8	414	1	Plane
part_01	1	9	192	1	Plane
part_01	1	10	75	.	.
part_01	1	11	356	.	.
part_01	1	12	128	.	.
part_01	1	13	185	3	Trees
part_01	1	14	373	3	Trees
part_01	1	15	263	3	Trees
part_01	1	16	235	3	Trees
part_01	1	17	147	1	Plane

Overview of EyeLink API

Two computers in EyeLink Setup – Display PC applications use EyeLink API to communicate with Host PC



API:

- Allows eye tracker functions (e.g., calibration, drift check)
- Starts/stop eye tracker recording
- Allows commands to be sent to update tracker settings
- Allows messaging to mark experimental events
- Allows messaging to communicate with [Data Viewer](#)

Overview of EyeLink API

Presentation **INQUISIT**

Monkey Logic
MATLAB OpenSesame

Psychtoolbox LabVIEW

E-Prime **PsychoPy**



python™

Visual Basic

JAVA

C++

C#

C

Messaging Protocol

- When you send messages, it's often just to mark timing of experimental events, but you can send other special Data Viewer messages
- These allow you to create EDF files that are compatible with Data Viewer
 - Display Size Message
DISPLAY_COORDS 0 0 1919 1079
 - Trial Onset Messages
TRIALID 1 (TRIALID2, etc.)
 - Trial Event Messages
DISPLAY_IMAGE
DISPLAY_QUESTION
BUTTON_PRESS
DISPLAY_FEEDBACK
 - Image Load Messages
!V IMGLOAD CENTER ../images/plane.png 960 540
 - Video Frame Display Messages
!V VFRAME 27 0 0 ../videos/frisbee.mp4
 - Simple Drawing Messages
!V DRAWBOX 128 128 128 300 400 600 700
 - Target Position Messages (for moving targets)
!V TARGET_POS Targ1 (512, 384) 1 0
!V TARGET_POS Targ1 (512, 364) 1 0
 - Trial Variable Messages
!V TRIAL_VAR trial_condition condition_1
!V TRIAL_VAR reaction_time 2364
 - Interest Area Messages

Messaging Protocol

Display Size Message

```
DISPLAY_COORDS 0 0 1919 1079
```

- This should be sent at the beginning of the experiment, before any trials are run
- It provides Data Viewer with information about the screen resolution of the Display PC monitor, and makes it so that Data Viewer formats its Trial View Window appropriately. Should be 0 0 Width-1 Height -1

Messaging Protocol

Trial Onset Messages

TRIALID 1 (TRIALID2, etc.)

- This should be sent at the beginning of each trial
- It marks the onset of the trial and allows Data Viewer to break the single EDF file into its multiple trials
- A complementary Trial Offset Message (TRIAL_RESULT) should be sent at the end of each trial

Messaging Protocol

Trial Event Messages

DISPLAY_IMAGE

DISPLAY_QUESTION

BUTTON_PRESS

DISPLAY_FEEDBACK

- These are used to mark experimental events and can be used to set Interest Periods in Data Viewer
- They can be whatever you want, but you should be consistent across trials – if the message changes across trials then when you set an interest period it will only apply to the trials that have that messaging

Messaging Protocol

Image Load Messages

```
!V IMGLOAD CENTER ../images/plane.png 960 540
```

- These tell Data Viewer to load that image at the time of the message so that the stimulus can be seen as background over which gaze data is overlaid
- After IMGLOAD, should specify position type, path to image (relative to EDF location), position, and optional size
- There are three types of IMGLOAD messages
 - CENTER – the image is positioned such that its center is positioned at specified X,Y coordinate
 - TOP_LEFT – the image is positioned such that its top-left corner is positioned at the specified X,Y coordinate
 - FILL – the image is fit to the screen (it is stretched to fill screen if its size is less than resolution)

Messaging Protocol

Video Frame Display Messages

```
!V VFRAME 27 0 0 ../videos/frisbee.mp4
```

- These tell Data Viewer to play a particular frame of the video at the time of the message
- After the VFRAME, should give frame number, top-left X,Y coordinate of video, and path to video (relative to EDF location)

Messaging Protocol

Simple Drawing Messages

`!V DRAWBOX 128 128 128 300 400 600 700`

- These tell Data Viewer to draw a shape of certain color at a certain location
- Exact parameters depend on shape drawn (see DV manual for more info). Options include:
 - CLEAR – clears screen
 - DRAWLINE – draws a line
 - DRAWBOX – draws an unfilled box
 - FILLBOX – draws a filled box
 - FIXPOINT – draws a circle with a dot inside

Messaging Protocol

Draw List Message

!V DRAW_LIST draw_files\myDrawFile.vcl

- These tell Data Viewer to load image, video, and simple drawing commands from a text file
- The text file should have the drawing commands without the !V at the beginning. Each line should start with time of drawing relative to the time of the DRAW_LIST message (i.e., the DRAW_LIST message time is the 0 point for the drawing commands; times should be negative – they're offsets)

```
0 CLEAR 153 153 153
```

```
0 IMGLOAD CENTER ../../runtime/images/-4562545002357104754.png 512 384 1024 768
```

```
-5000 CLEAR 153 153 153
```

```
-5000 IMGLOAD CENTER ../../runtime/images/1853639206197164775.png 512 384
```

```
-6833 CLEAR 153 153 153
```

```
-6833 IMGLOAD CENTER ../../runtime/images/8781210645090787058.png 512 384
```

```
-8833 CLEAR 153 153 153
```

- Can be useful if there are a lot of drawing messages

Messaging Protocol

Target Position Messages (for moving targets)

```
!V TARGET_POS Targ1 (512, 384) 1 0
```

```
!V TARGET_POS Targ1 (512, 364) 1 0
```

- These provide the position of a target over time to Data Viewer
- Target position can be visualized in Temporal Graph View and can be output alongside gaze data in Sample Reports (as well as target velocity and acceleration)
- Specify the name of the target, the X,Y coordinate (at time of message, the visibility of the target (for cases where target disappears and reappears), and the step/interpolation status

Messaging Protocol

Interest Area Messages

!V IAREA RECTANGLE 1 242 336 692 585 Plane

!V IAREA FREEHAND 2 419,765 351,682 340,653 357,631 625,610 689,631 784,673 808,689 963,729 965,765 Dock

!V IAREA ELLIPSE 3 700 334 958 437 Trees

- These create Interest Areas in Data Viewer, which are used in analysis to determine how gaze data maps to different parts of screen
- Interest Areas can also be dynamic – if so, you can specify start and end time of each instance of interest area (see manual for more information on formatting)
- Can be rectangle, ellipse, and freehand
 - For rectangle and ellipse, specify ID, left, top, right, bottom, and label
 - For freehand, specify ID, list of X,Y points, and label
- Note, interest areas can also be created in Data Viewer

Messaging Protocol

Interest Area File Messages

!V IAREA FILE segments\example.ias

- These point to an Interest Area Text File. The text file in turn contains the interest area messages without the !V at the beginning

- For static interest areas, the time of the onset of the interest area relative to the time of the IAREA FILE message should be specified

-200 RECTANGLE 1 242 336 692 585 Monkey

-200 ELLIPSE 2 700 334 958 437 Giraffe

- For dynamic interest areas, the time of the onset and offset of each instance should be specified

-200 -400 RECTANGLE 1 242 336 692 585 Monkey

-200 -400 ELLIPSE 2 700 334 958 437 Giraffe

-401 -600 RECTANGLE 1 348 392 526 846 Monkey

-401 -600 ELLIPSE 2 319 412 954 576 Giraffe

Messaging Protocol

Trial Variable Messages

!V TRIAL_VAR trial_condition condition_1

!V TRIAL_VAR reaction_time 2364

- These create Trial Variables in Data Viewer. Data can be grouped by the values of the variables and the variables can be included in any of the output reports that are created by Data Viewer
- Typically these include independent/condition variables and dependent behavioral variables
- Typically sent at end of trial
- Should specify name of variable then value of variable

Messaging Protocol

Trial Offset Messages TRIAL_RESULT 0

- This marks the end of the trial for Data Viewer
- Is complement to the TRIALID message that marks the trial onset

Messaging Protocol

Message Offset values

- Sometimes it's not possible to send a message at the time of an event. In that case, you can send the message before or after the event, and precede the message with an offset value. Data Viewer will take the offset value into account by subtracting it from the time stamp of the message in the EDF. This effectively repositions the message forward or backward in time.
- Can be used for any of the messages discussed

650 DISPLAY_IMAGE

This will move the message backwards in time 650 msec

-650 DISPLAY_IMAGE

This will move the message forwards in time 650 msec

A large, stylized graphic of an eye, composed of several overlapping, light blue curved lines that form the shape of an eye, centered on the page.

Thank you!