VES-9000 Video ODS™

April 2, 2025

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VES-9000 Video Processing

If the **VES-9000 Video Processing** option is authorized by your MEscope license, the following commands are enabled in the MEscope window, the Data Block (**BLK**) and Shape Table (**SHP**) windows. Open **Help | License Manager** to verify authorization of this option.

Additional MEscope Commands

- **Videos | Video Wizard**
- **Videos | Reprocess Video**

Additional Structure Window (STR) Commands

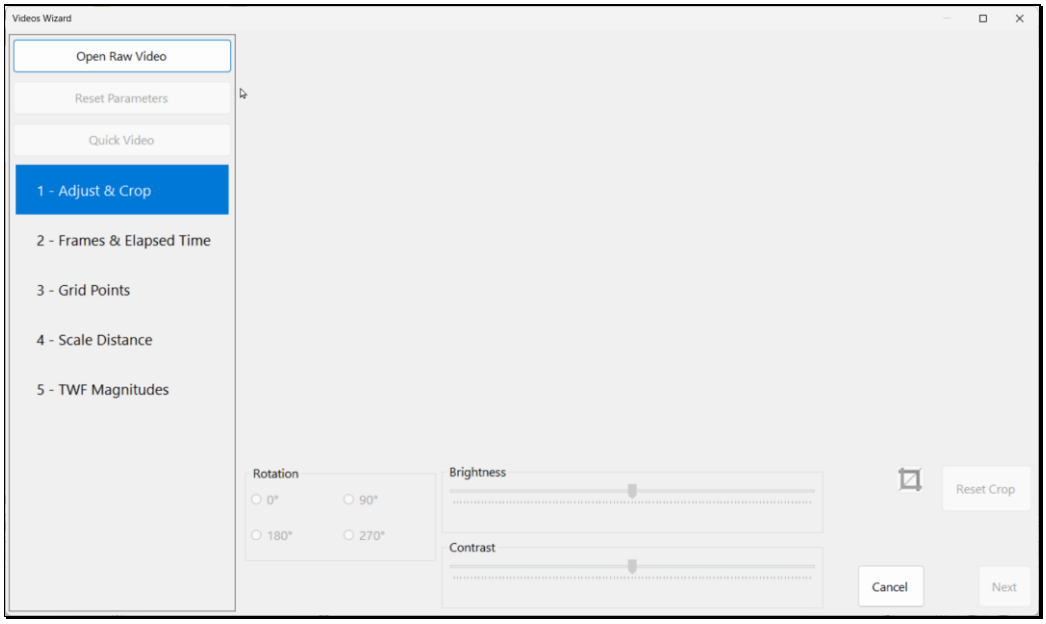
- **Deflection | Remove Background Motion**
- **Deflection | Use First Video Frame**

MEscope Videos Menu

Videos | Video Wizard

An MEscope project (**VTmax**) must be open to enable this command.

Opens the Video Wizard window shown below.



Opening Video Wizard Window

The **Video Wizard** has ***five numbered steps***, listed on the ***left side*** of the window. These steps are used to process a raw video and extract vibration **Time Waveforms (TWFs)** from it.

A raw video can be recorded with any cell phone or any high-speed digital video camera. Any video in the following formats, **(.mov, .wmv, .avi, .mpg, .mpeg, and .mp4**), can be processed using the Video Wizard.

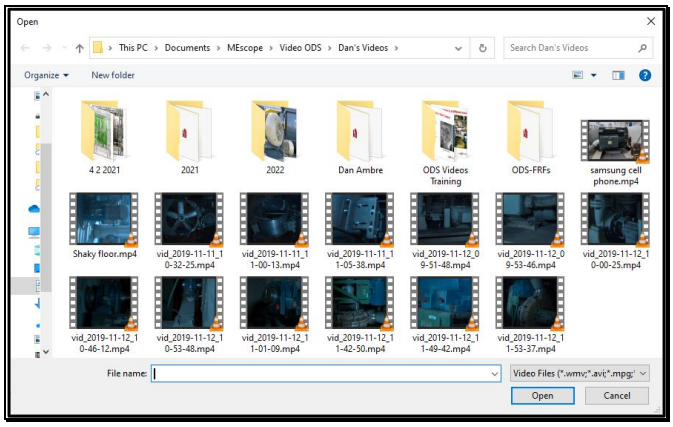
- The Video Wizard extracts **Time Waveforms (TWFs)** for a video by calculating the movement of each pixel between successive frames of the video
- The extracted **TWFs** are stored in an MEscope **Data Block (BLK)** file
- The **TWFs** are also transformed to their equivalent **Discrete Fourier Transforms (DFTs)**, and the **DFTs** are stored in a separate **Data Block (BLK)** file

Opening a Raw Video

- ***Press*** the **Open Raw Video** button on the **upper left side** of the **Video Wizard** window

A windows file dialog box will open, from which you can navigate to a video stored on your computer.

- ***Double-click*** on a video file to open it in the **Wizard**



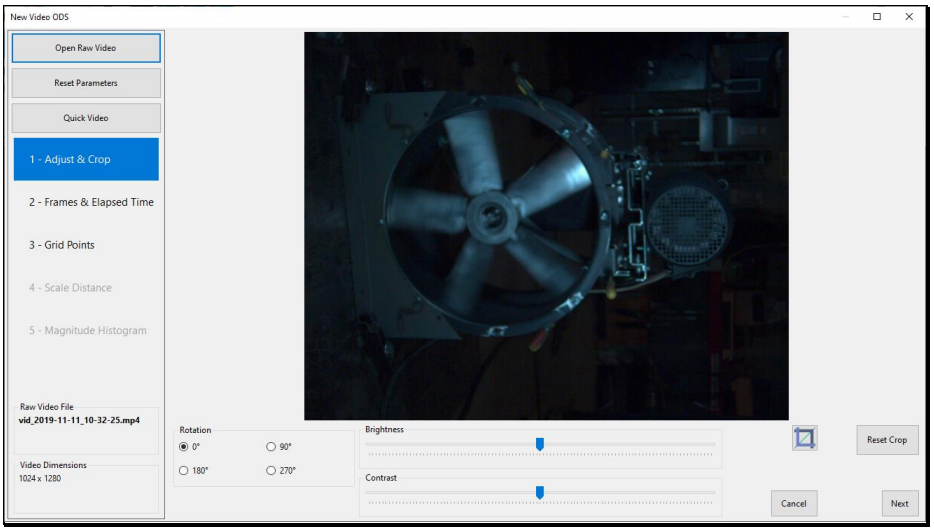
Open File Dialog Showing Video Files

Video Wizard Step 1 - Adjust & Crop

After a raw video has been opened in the **Wizard**, it will proceed to step **1 – Adjust & Crop**. Several functions can be carried out in this step.

Rotating The Video

The video may have been recorded with the camera rotated so that the test article is not in a vertical position. In the example shown below, the machine is in the horizontal position.



Raw Video Rotated 270 Degrees from Vertical.

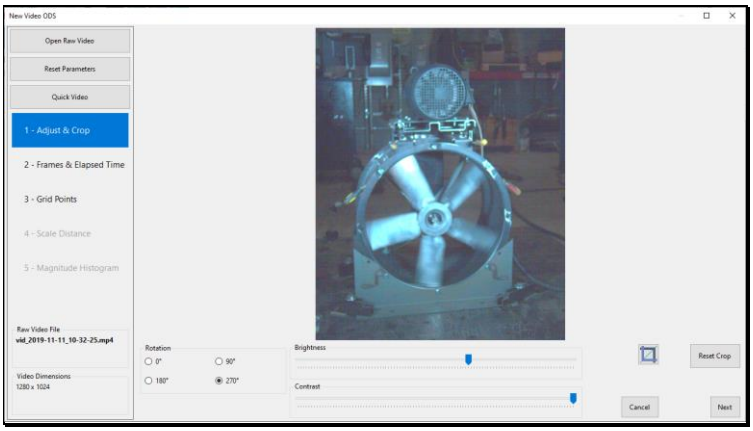
To rotate the video above so that the machine is vertical,

- **Click on 270°** to rotate the machine to the vertical position

Brightness & Contrast

If the video recording is too dark, its **brightness & contrast** can be improved by using the sliders below the video in the **Video Wizard** window

- ***Slide*** the **Brightness & Contrast** controls ***horizontally*** to improve the brightness & contrast of the video, as shown below



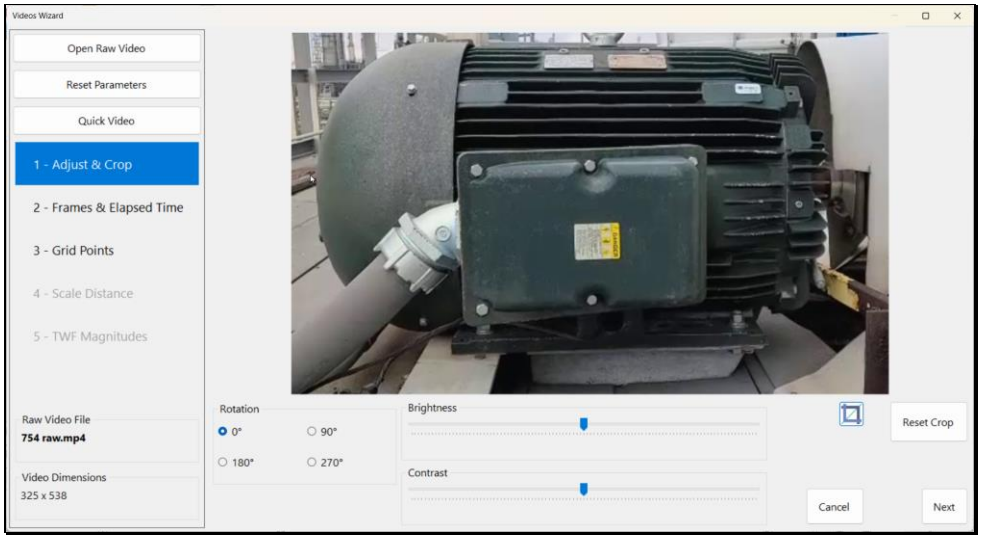
Video With Brightness & Contrast Improved

Cropping The Video

Many videos will capture a lot of the background area which is not of interest.

The background and surroundings of the test article should be removed by cropping as much of the video as possible.

- To initiate cropping, ***press*** **the crop button** on the ***lower right*** of the video
- ***Draw*** a **cropping box** around the **area to be retained** in the video
- ***Press*** the **Reset Crop button** on the ***lower right*** to return to the **un-cropped video**



Cropped Video with Most of the Background Removed

Video Wizard Step 2 - Frames & Elapsed Time

To move from Step 1 to Step 2,

- Either ***press*** the **Next** button in Step 1, or ***double click*** on 2 - **Frames & Elapsed Time**

In this step, video frames can be removed from the beginning and the end of the video, and the recording speed of the video, (in **frames per sec,** or **fps**), is entered. When the number of frames and the **fps** are determined, the elapsed time of the video frames is calculated with the formula,

Elapsed Time = fps x (End Frame – Start Frame +1)

The **fps** of the video is the same as the **sampling frequency** in **Hertz** of a digital acquisition system or spectrum analyzer. The **fps** of the video, together with number of frames of the video, determines the **frequency range** of the **DFTs** calculated from the **TWFs** extracted from the video.

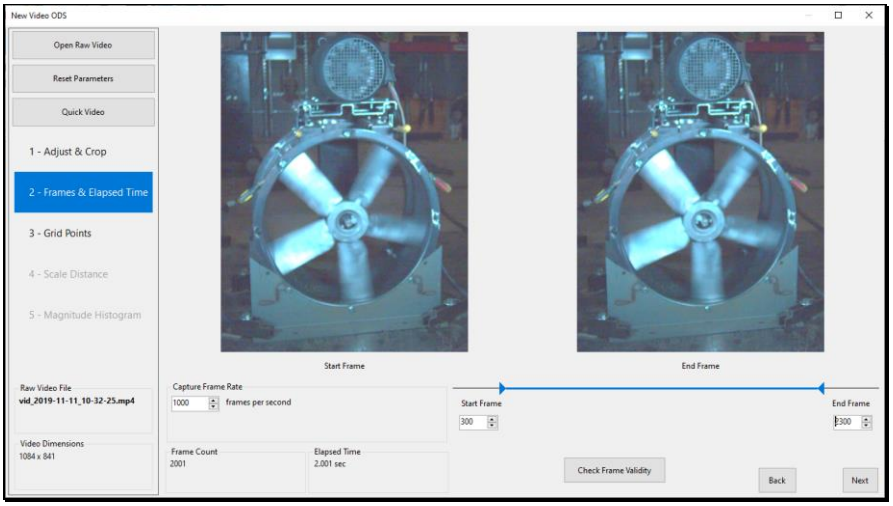
The formula for the maximum frequency (**Fmax**) of the **DFTs** is,

Fmax = fps/2

Removing Video Frames

With some cell phones, the first few and the last few frames of a video are acquired ***using a different*** **fps** than the **fps** chosen for recording the video. For example, if **fps = 240 Hz** is chosen, the first few and the last few frames of the video might be recorded at ***a lower fps***. These frames should be removed from the video in this step to obtain frames with the ***same*** **fps**.

- ***Press*** **2 - Frames & Elapsed Time**
- ***Slide*** the **left end** of **horizontal slider** to select a **Start Frame**
- ***Slide*** the **right end** of **horizontal slider** to select an **End Frame**
- Enter the **Capture Frame Rate** into the **frames per second** box



fps = 1000, Frame Count = 2001 ➔ Elapsed time = **2.001 seconds**

Obtaining Better Frequency Resolution

The recording time of the video determines **frequency resolution of the DFTs** extracted from it. To achieve better frequency resolution (**Δf**) between samples of the **DFTs**, the video must be recorded over a longer time length.

A rule of the FFT is;

Δf = 1/ T, where **T = the time length of the video, not its fps**.

Video Wizard Step 3 - Grid Points

To move from Step 2 to Step 3,

- Either ***press*** the **Next button** in Step 2, or ***double click*** on **3 - Grid Points**

Rectangular Point Grid

In this step, a grid of points is displayed and used to **reduce the number of TWFs** extracted from frames of the video.

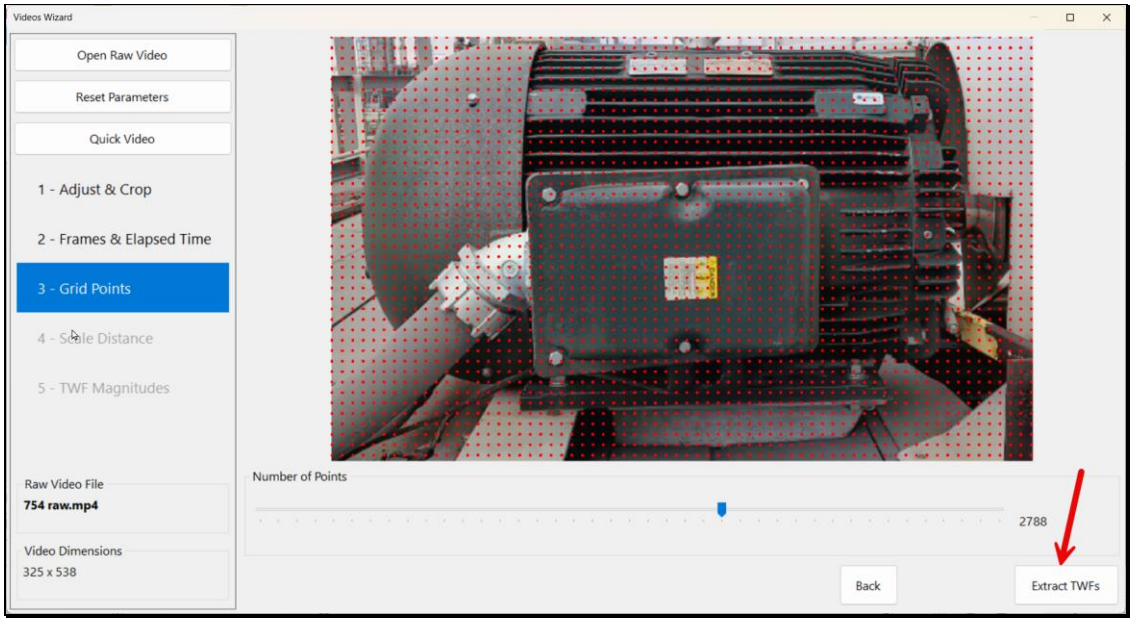
- The **TWF** of each pixel in each video frame is extracted from its motion in successive frames
- The **TWF** of each point in the **point grid** is calculated from the **TWFs** of the pixels surrounding it in each frame
- During ODS animation, each frame of the video is attached to the **point grid** and is deflected using the **TWFs** or **DFTs** of each point in the **point grid**

The deflection of the **grid points** during sweep or dwell animation is defined as a **Video ODS**.

Number of Grid Points

- ***Drag*** the horizontal slider ***to the right*** **to increase** the number of points in the **point grid**
- ***Drag*** the horizontal slider ***to the left*** **to decrease** the number points in the **point grid**

The points in the **point grid** are displayed at **red dots**, as shown below.



Rectangular Grid Showing 2610 Points.

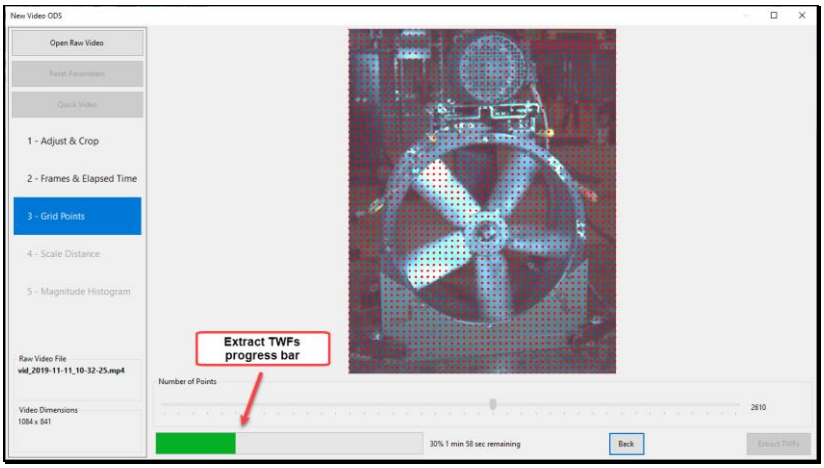
Extract TWFs Button

When this button in the ***lower right corner*** of the window is ***pressed***, **two TWFs** are extracted for each point in the **point grid**. One **TWF** for the **horizontal displacement** and one **TWF** for the **vertical displacement** of each grid point is extracted for each frame of the video.

Each sample of a **TWF** corresponds to the displacement of the pixels in a frame of the video

For example, if there are **2000 grid points**, then **4000 TWFs** are extracted from the video. If there are **1000 frames** in the video, then each **TWF** will have **1000 samples** of data in it.

The **Extract TWFs** command **can take several minutes** to process a video. The processing time is strongly dependent on the **number of frames chosen in Step 3** of the Video Wizard.



*Step 3 When **Extract TWFs** Has Been Pressed*

When the **Extract TWFs** command has completed, Step 4 will be selected.

Video Wizard Step 4 - Scale Distance

This step is **automatically chosen** after the **Extract TWFs** command has been executed in Step 3.

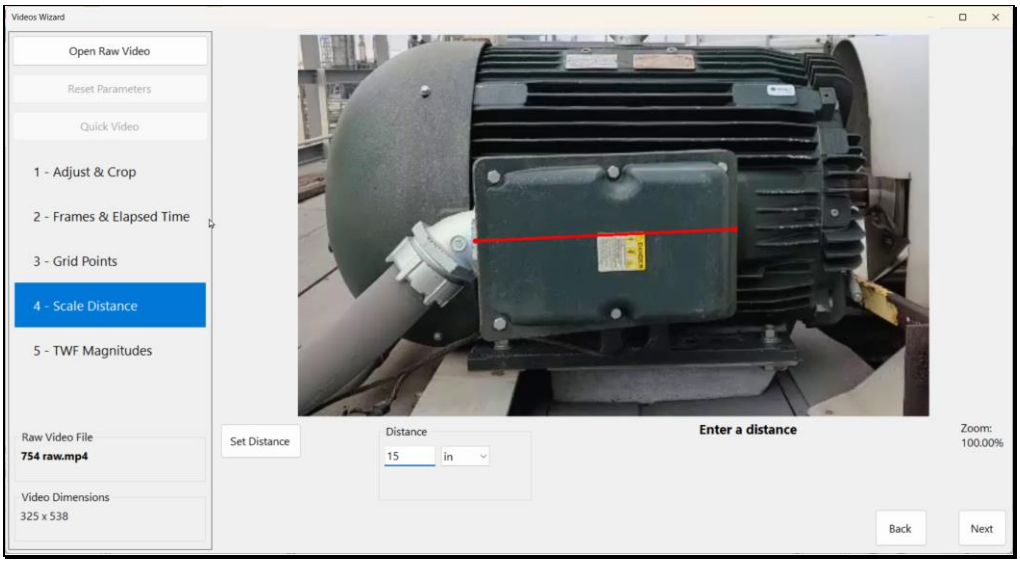
In this step, the **TWFs** extracted in Step 3 are scaled so they accurately reflect the displacements of the test article captured by the video.

In this step, any two points in a frame of the video are selected and the distance between those two points is entered in English or Metric distance units

- **Press** the **Set Distance** button
- ***Click*** on the **beginning & end points** of a **known distance** in the displayed video frame

A **red line** will be displayed between the two points

- Enter the distance between the two points in length units



Red Line Showing 36 Inches of Distance Between Two Points in the Video.

A distance line should be chosen **as close as possible** to the recording plane of the video, but it can be ***at any angle*** between two points captured by the video. To provide an accurate distance measurement, a measuring stick of known length, (like a yard stick), could be laid in front of the test article.

Zooming the Display

- Zoom and pan the display to pick the two endpoints of the distance more accurately
- To **zoom the display** in or out, place the mouse pointer on the video and ***spin the mouse wheel***
- To **pan the display**, ***hold down*** the **Ctrl key** on the keyboard and ***drag*** the mouse pointer

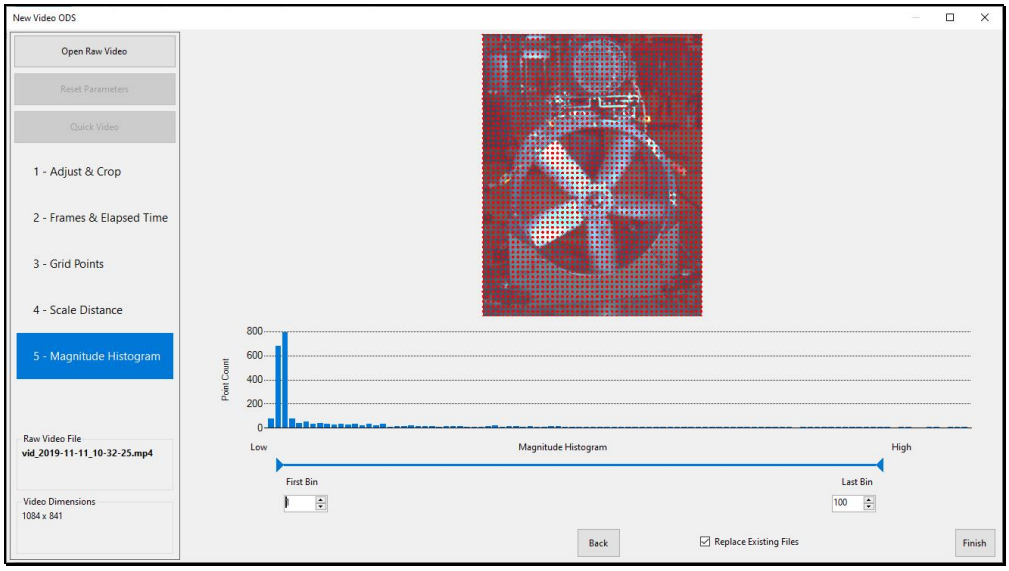
Video Wizard Step 5 – TWF Magnitudes

To move from Step 4 to Step 5,

- Either ***press*** the **Next** button in Step 4, or ***double click*** on **5 – TWF Magnitudes**

In this step, the **TWFs** for each grid point are divided into **100 bins** based on their magnitude. Then the count of **TWFs** in each bin is displayed in a histogram of magnitude counts from smallest to largest.

- **100 bins** are used for counting **TWF magnitudes**, from the smallest to the largest



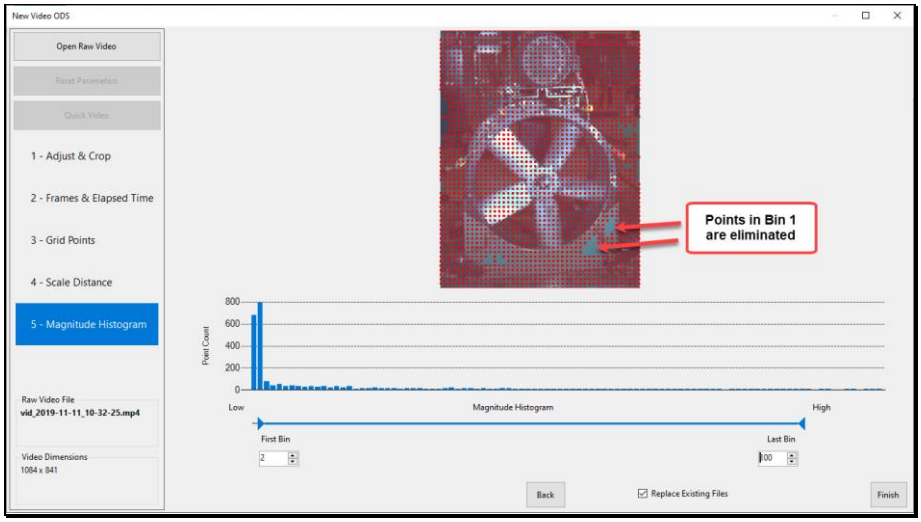
TWF Magnitudes Histogram Showing 100 Magnitude Bins

In this step, points with **small magnitudes** and points with **large magnitudes** can be eliminated for further analysis.

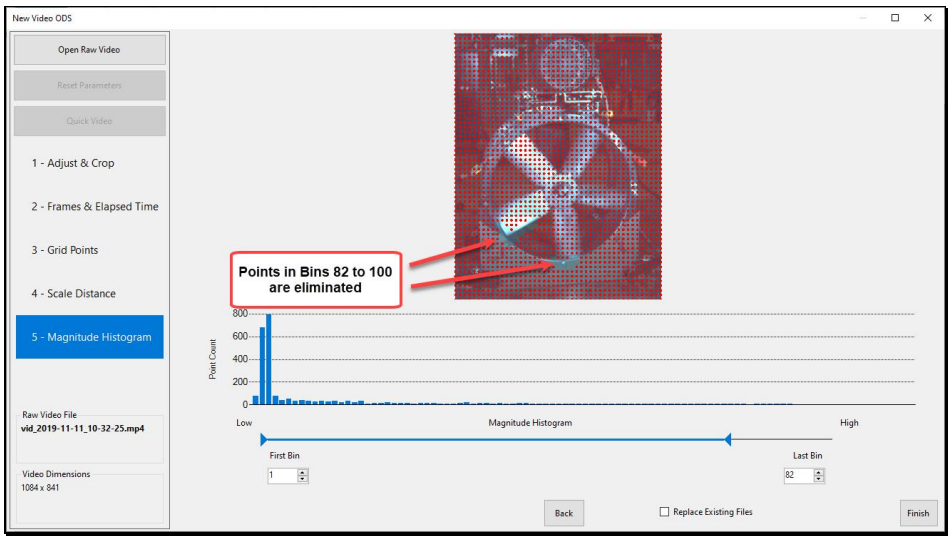
- To delete **TWFs** with **small magnitudes**, ***drag*** the **left end** of the slider bar **to the right**
- To delete **TWFs** with **large magnitudes**, ***drag*** the **right end** of the slider **to the left**

A bin number can also be entering to the **First Bin** and **Last Bin** boxes below the slider bar

- When the **First Bin** is ***increased*** **above 1**, the grid points with **low magnitude TWFs** are not displayed on the grid and their **TWFs** are removed from the Data Block of **TWFs**
- When the **Last Bin** is ***decreased*** **below 100**, the grid points with **high magnitude TWFs** are not displayed on the grid and their **TWFs** are removed from the Data Block of **TWFs**
- Also, a **DFT** is calculated for each remaining **TWF** and saved in the Data Block of **DFTs**



Points With Low Magnitude TWFs Removed From the Grid



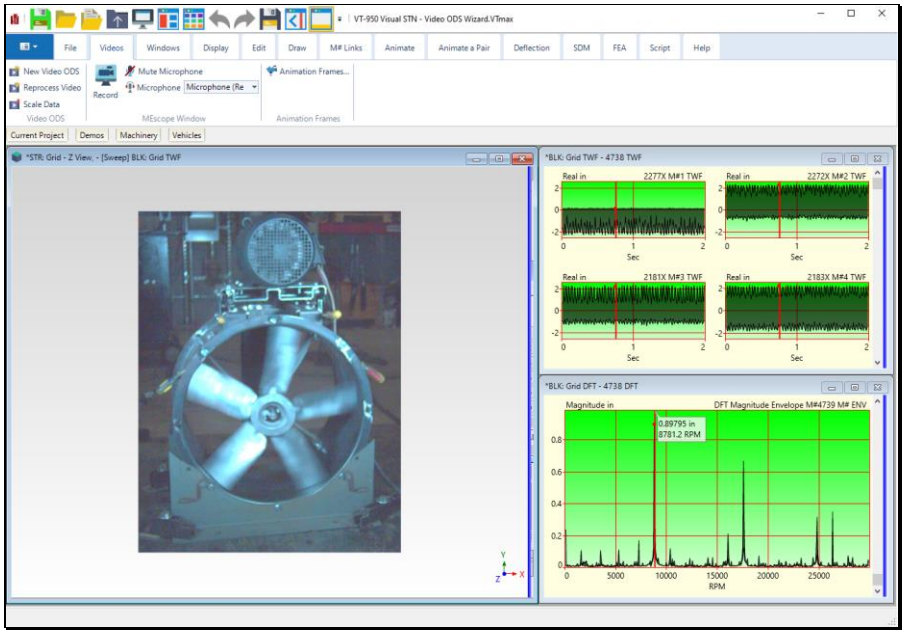
Points With High Magnitude TWFs Removed from the Grid

Finish Button

To close the **Video Wizard** and begin **Video ODS** sweep animation through the Data Block of **TWFs**,

- ***Press*** the **Finish button** in Step 5

When the **Finish button** is pressed time-based **ODS sweep animation** will begin from the **Line** cursor position in the Data Block of **TWFs**.

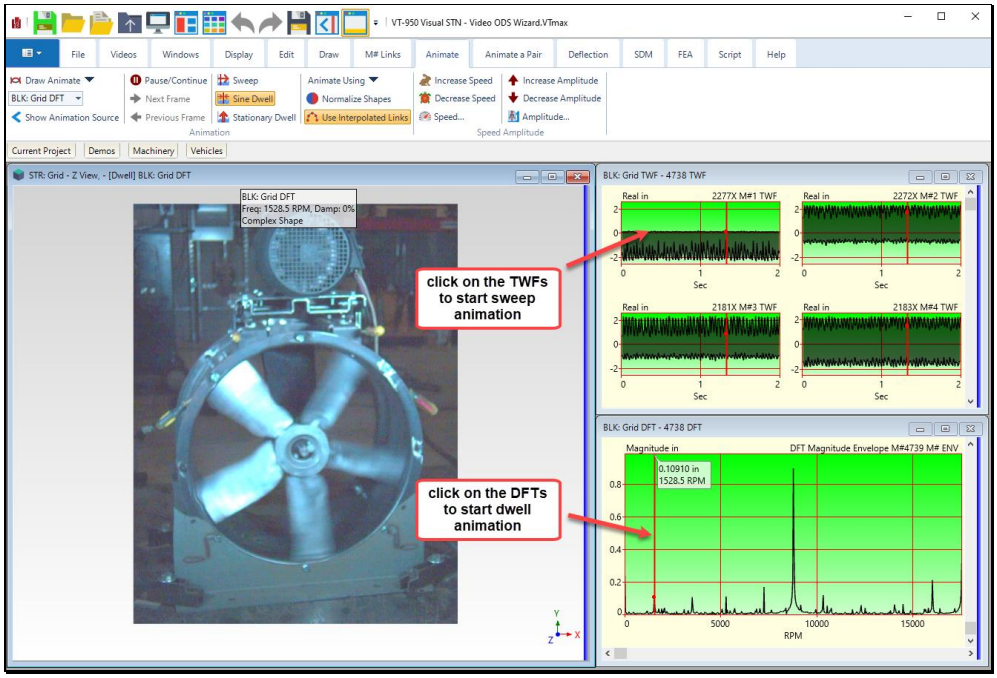


*Time-Based **ODS** Sweep Animation*

When time-based sweep animation is begun in the Data Block of **TWFs**, the video frame that matches the time sample of the **TWF**s is attached to the surface of the **point grid**. This adds any machine rotations captured by the video to the **ODS** animation.

Time-Based or Frequency-Based ODS Animation

- Sweep animation of the **ODS** is initiated from the **Line** cursor position in the **TWFs** by ***clicking*** on the **TWFs** in the Data Block on the **upper right** of the MEscope window
- Dwell animation of the **ODS** at the cursor position in the **DFTs** is initiated by ***clicking*** on the **DFTs** in the Data Block on the **lower right** of the MEscope window



Time-Based or Frequency-Based **ODS** Animation.

Videos | Reprocess Video

This command can be used while the Project file is still open wherein the **Video Wizard** was used, and the **raw video** is available for reprocessing.

- When this command is executed, the **Video Wizard** is re-opened

Structure (STR) Window Deflection Menu

When VES-9000 is authorized, new commands are added to the **Deflection** menu in the Structure (**STR**) window.

Deflection | Remove Background Motion

When vibration is recorded in a video and there is any movement of the camera, the pixel motions recorded in each frame of the video will have the same background motion of the camera added to them. This camera motion will also be added to each **TWF** extracted from the video.

Background motion is removed from Points on the test article by averaging together the motions of a ***few selected*** **background Points**. Then the average motion of the ***selected*** **background Points *is subtracted*** from the motion of the **Points of interest** on the test article.

The following steps are recommended for using this command,

- Start the shape animation from the Data Block of **TWFs**

After identifying **a few points** with common background motion

- Execute **Deflection | Remove Background Motion**

The grid points are displayed, and the floating **Select Objects** dialog box is displayed at the bottom of the window, as shown below.

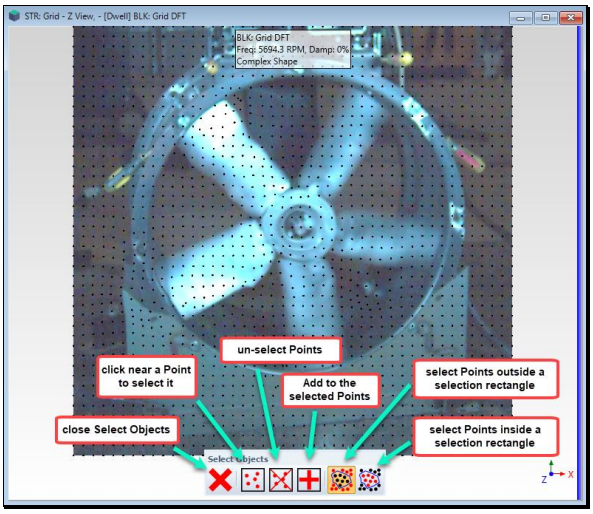
- Execute **Animate | Pause /Continue** to pause the animation

The **Select Objects** box is used for selecting background Points. Selected Points are **displayed in red** on the point grid.

The functions of the commands in the **Select Objects box** are shown below.

- After the background Points are selected, ***press*** **the close button (X)** to close the **Select Objects** box at the bottom of the **STR** window

The motion of the ***selected*** **Points** is set to **"zero"** and their average motion is subtracted from the ***un-selected*** **Points**.



Functions in the Select Objects Dialog Box.

All the **TWFs** and **DFTs** that were linked to the background Points **are deleted** from the **TWFs** & **DFTs** Data Blocks.

Deflection | Use First Video Frame

This command only applies during sweep animation from the **TWFs** Data Block.

Each frame of the raw video corresponds to a sample of **TWF** data in the **TWFs** Data Block

- When this command ***is not checked***, each frame of the raw video is attached to the point grid during sweep animation
- When this command ***is checked***, only the first frame of the raw video is attached to the point grid during sweep animation