Video Wizard

(April 2, 2025)

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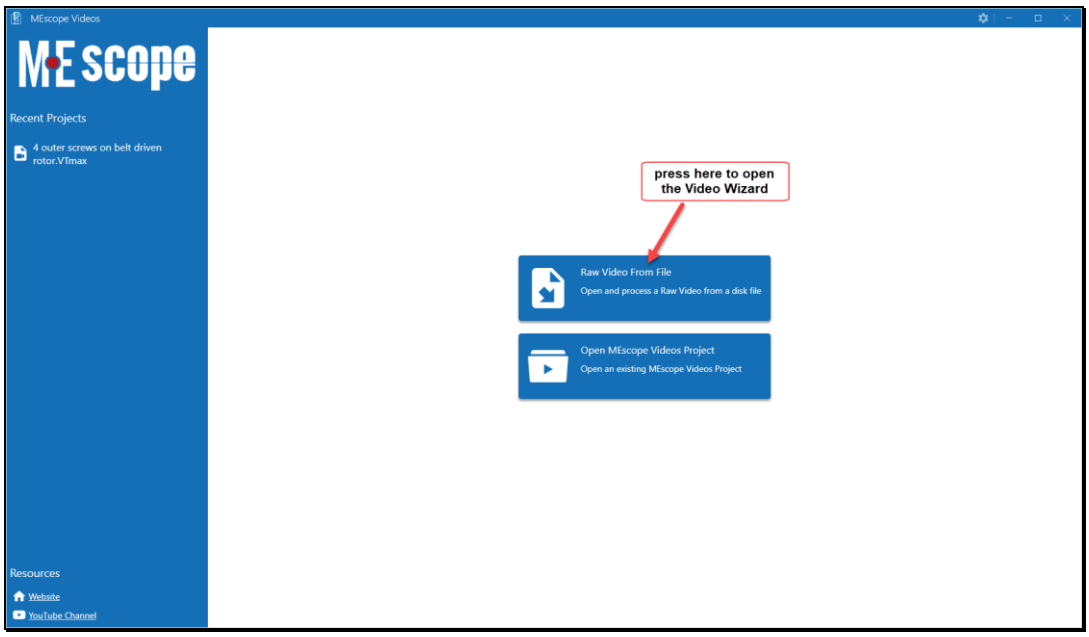
Table of Contents

Video Wizard

The opening window in MEscopeVIDEOS allows you to process a raw video recording from a digital camera, including the camera in your cellphone.

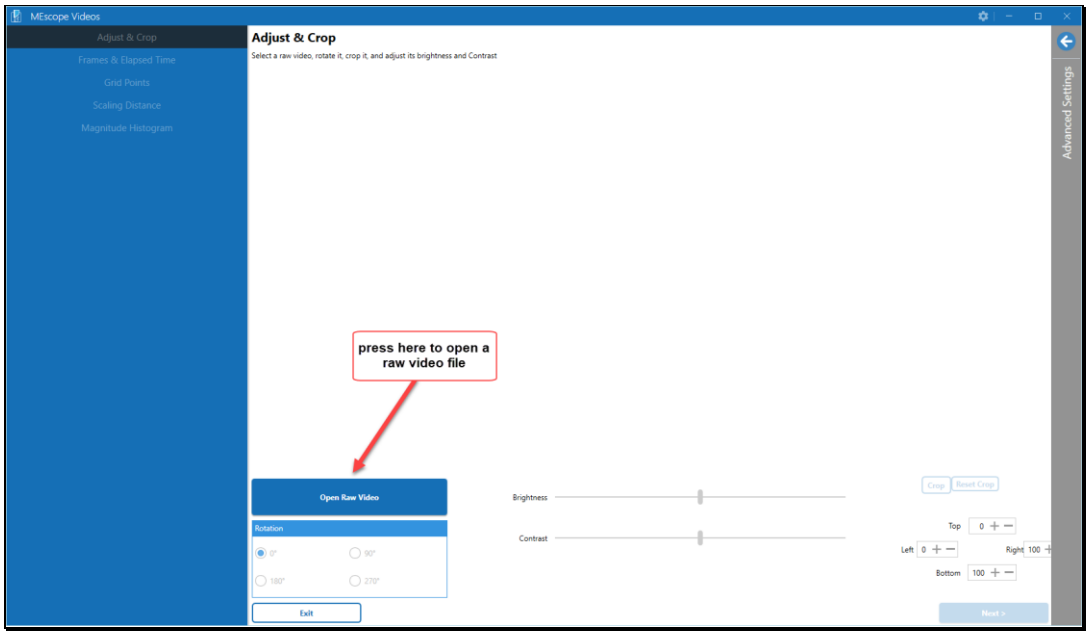


*Opening **MEscopeVIDEOS** window.*

Processing a Raw Video

- To open the **Video Wizard**, press **Raw Video From File** in the opening MEscopeVIDEOS window, as shown above

The first step of **Video Wizard** will open, as shown below.



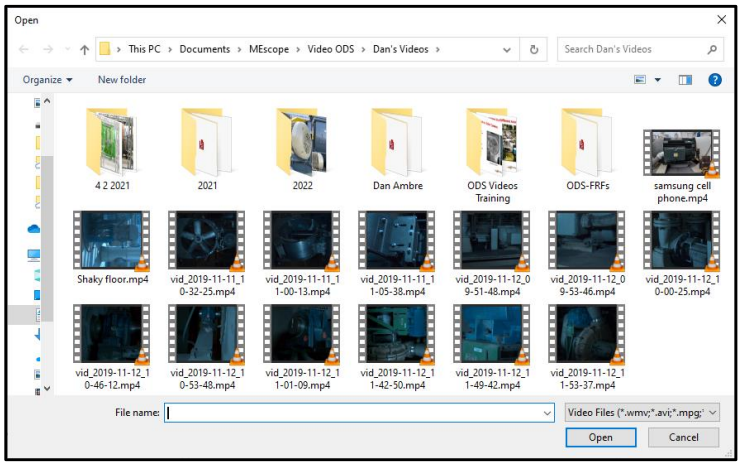
*First **Video Wizard** Step.*

- Press the **Open Raw Video** button
- Navigate to the raw video you wish to process in the **Video Wizard** and open it

A raw video in any one of the following formats can be processed in the **Video Wizard**
.mov, **.wmv**, **.avi**, **.mpg**, **.mpeg,** or **.mp4**

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

- Select the raw video file and ***press*** the **Open** button, or ***double-click*** on a video file to open it in the **Wizard**



File Dialog Showing Video Files

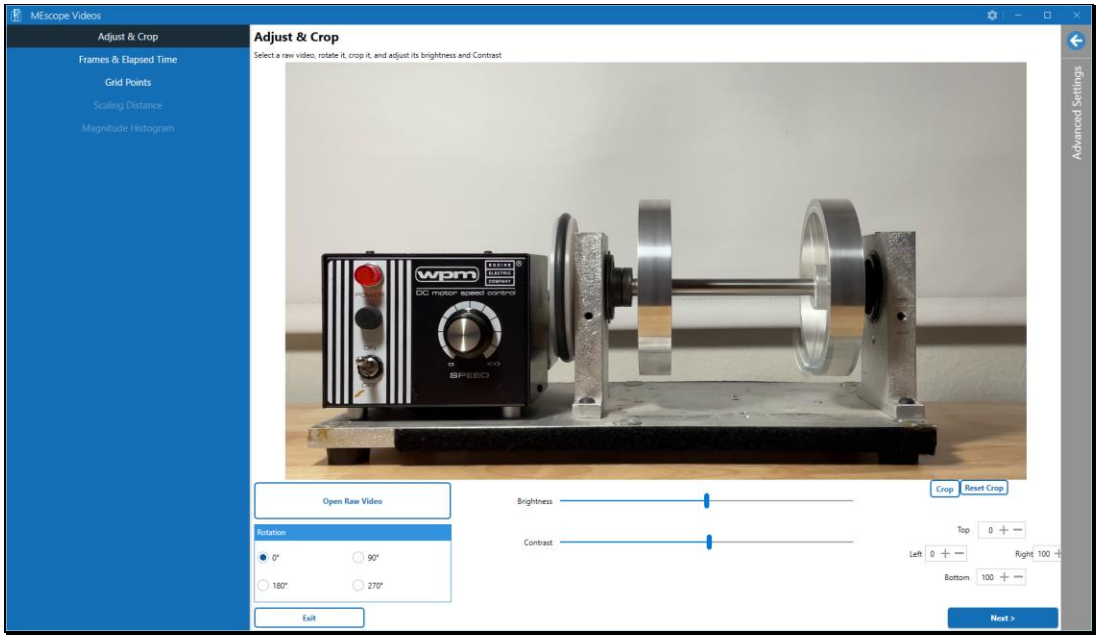
Video Wizard Steps

The **Video Wizard** uses five steps for processing raw videos. The steps are listed on the ***upper-left*** side of the **Video Wizard**, as shown below. The **Video Wizard** extracts Time Waveforms (**TWFs**) from a raw video by calculating the displacement of each pixel in each frame of the video relative to its location in each successive frame.

The extracted **TWFs** are saved in a **TWF** Data Block.

The digital frequency spectrum of each **TWF** is calculated by using the **FFT** (Fast Fourier Transform) algorithm to calculate the **DFT** (Digital Fourier Transform).

The **DFT** of each **TWF** is saved into a **DFT** Data Block.



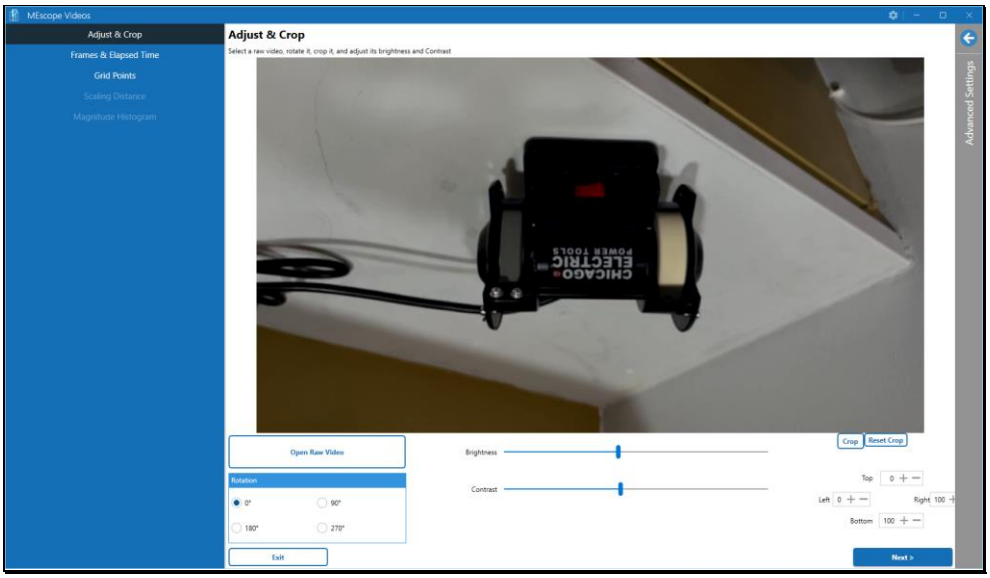
Video Wizard *for Step 1- Adjust & Crop*

Step 1 - Adjust & Crop

After a raw video has been opened in the **Wizard**, several operations can be carried out on the video in this step.

Rotating the Video

The video may have been recorded with the camera position that was different from the vertical position. In the example shown below, the camera was ***upside-down*** when the video was recorded.



Raw Video Rotated 180 Degrees from Correct Vertical.

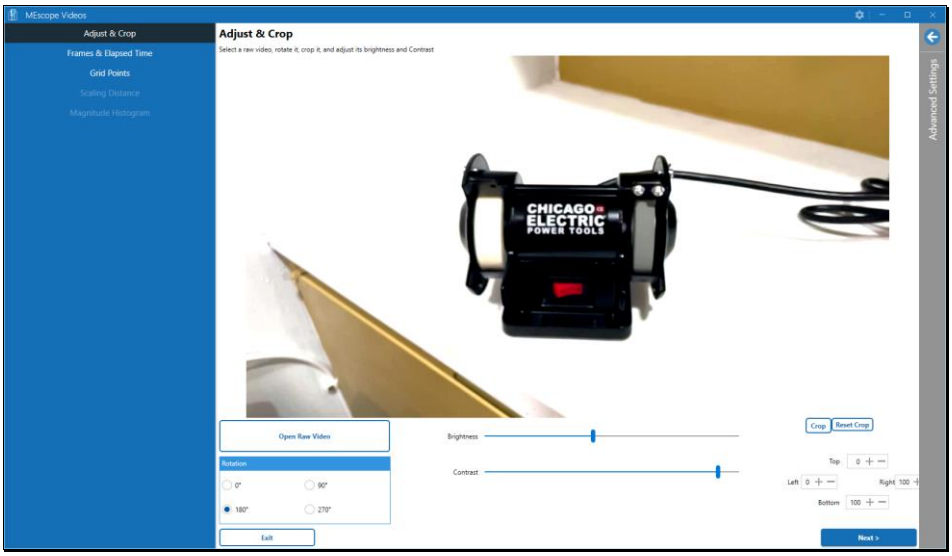
To rotate a video like the one above so that the test article is ***top-side-up***,

- ***Click* on 180°**on the ***lower-left*** side of the **Wizard**

Brightness & Contrast

If a video recording is too dark, its **brightness & contrast** can be improved by using the sliders in this first step of the **Wizard**.

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



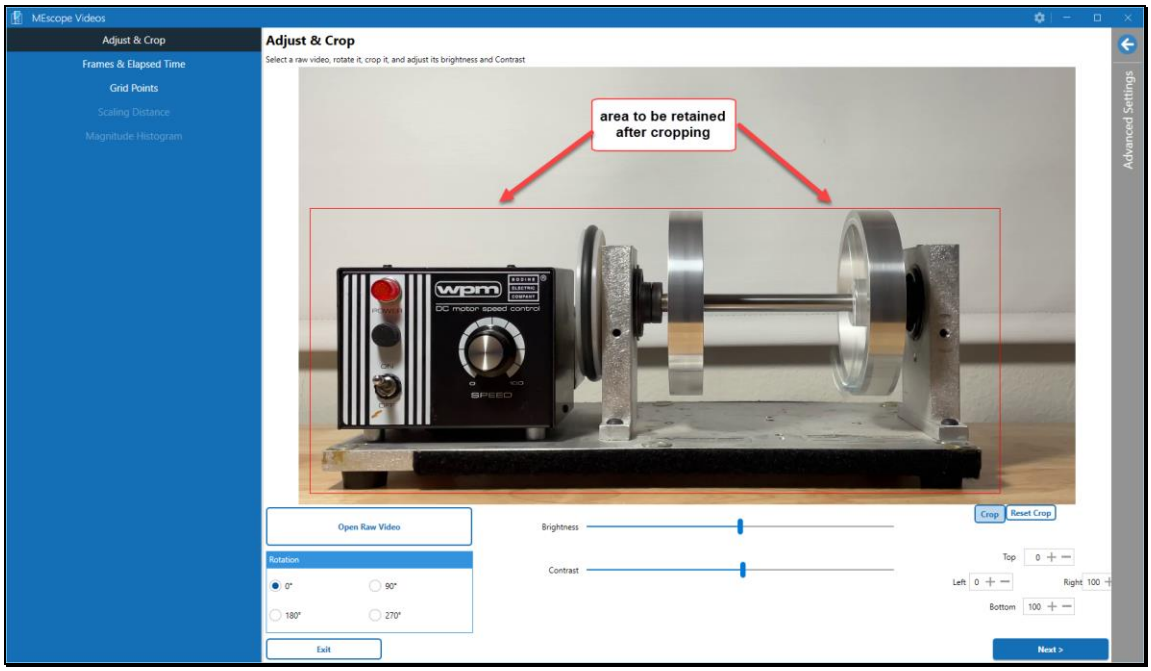
Video With Brightness & Contrast Improved

Cropping The Video

Your videos will usually capture some background areas which are not of interest to you.

> All the surroundings of the area of interest in a video should be removed by cropping.
>
> Cropping can be applied multiple times to remove as much of the video background as possible.
>
> The time required for **TWF** extraction in Step 3 of the **Wizard *is greatly reduced*** by cropping the video as much as possible.

- To initiate cropping, ***press*** the **Crop** button on the ***lower-right*** of the **Wizard**
- ***Draw*** a **red cropping box** around the area to be retained in the video, as shown below



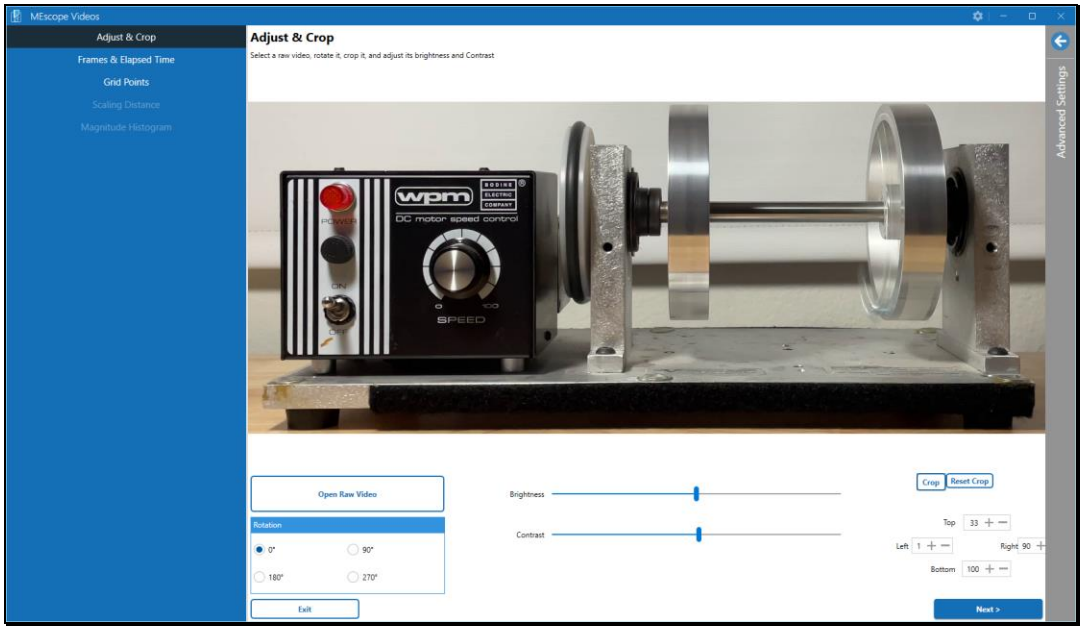
Red Cropping Box Drawn on the Video.

- To return to the un-cropped video, ***press*** the **Reset Crop button** on the ***lower-right*** of the **Wizard**

Using the Cropping Controls

A video can also be cropped by pressing the arrow controls next to the **Top, Bottom, Left, Right** boxes on the ***lower-right*** of the **Wizard**.

> The **Top, Bottom, Left, Right** cropping boxes contain the current Crop amounts ***as percentages*** of the video dimensions in each respective direction.
>
> These percentages are retained in the MEscopeVIDEOS settings on your computer and can be used to apply the same cropping percentages to multiple videos.



Cropped Video with the Background Removed

Step 2 - Frames & Elapsed Time

To move from this step from Step 2,

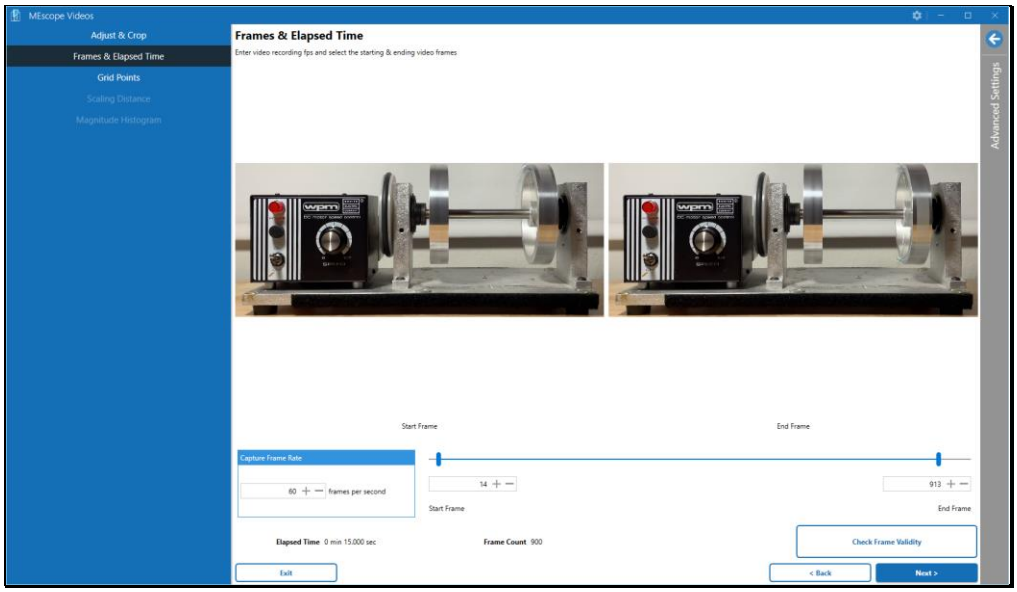
- Either ***press*** the **Next button** on the ***lower-right side*** or ***press*** **Frames & Elapsed Time** on the ***upper-left side*** of the **Wizard**

In this step, video frames can be removed from the beginning and the end of the video. Frames are removed by using the sliders below the video. The correct recording speed of the video, (in **frames per sec, or fps**), must be entered into the box on the **lower-left** side.

The elapsed time of the video is calculated from the **number of frames** and the **fps** using the formula,

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

The Elapsed Time is displayed on the lower-left side of the **Wizard**.



Frames Per Second = 60, Frame Count = 900 ➔ Elapsed Time = 15 seconds

- Use the ***left horizontal slider*** to change the **Start Frame**
- Use the ***right horizontal slider*** to change the **End Frame**
- Enter the **Capture Frame Rate** into the **frames per second** box on the ***left side*** of the **Wizard**

The **fps** of the video determines the **maximum frequency** of the **DFTs** calculated from the **TWFs**.

The **elapsed time (T)** of the video determines the **frequency resolution (Δf)** between samples in the **DFTs**.

The **frequency resolution (Δf)** is equal to the ***inverse*** of the **elapsed time (T).**

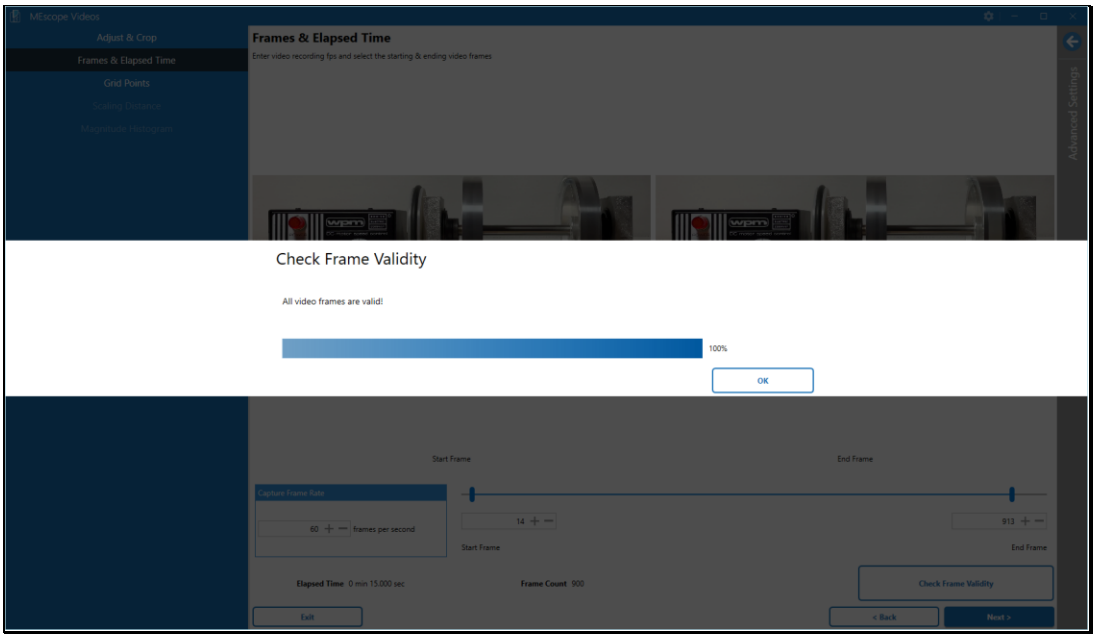
$$\Delta f = 1 / T$$

Check Frame Validity

Sometimes a video might have one or more corrupted frames in it. Before extracting **TWFs** from the video in the next step, the validity of all its frames can be checked in this step.

- To verify the validity of the frames in the video, ***press*** **Check Frame Validity** on the ***lower-right side*** of the **Wizard**

If all the frames of the video are valid, the message shown below is displayed.



Check Frame Validity Showing All Frames are Valid.

If some frames at the beginning or the end of a video fail the validity check, use the slider bars to remove them before proceeding to the next step.

Step 3 - Grid Points

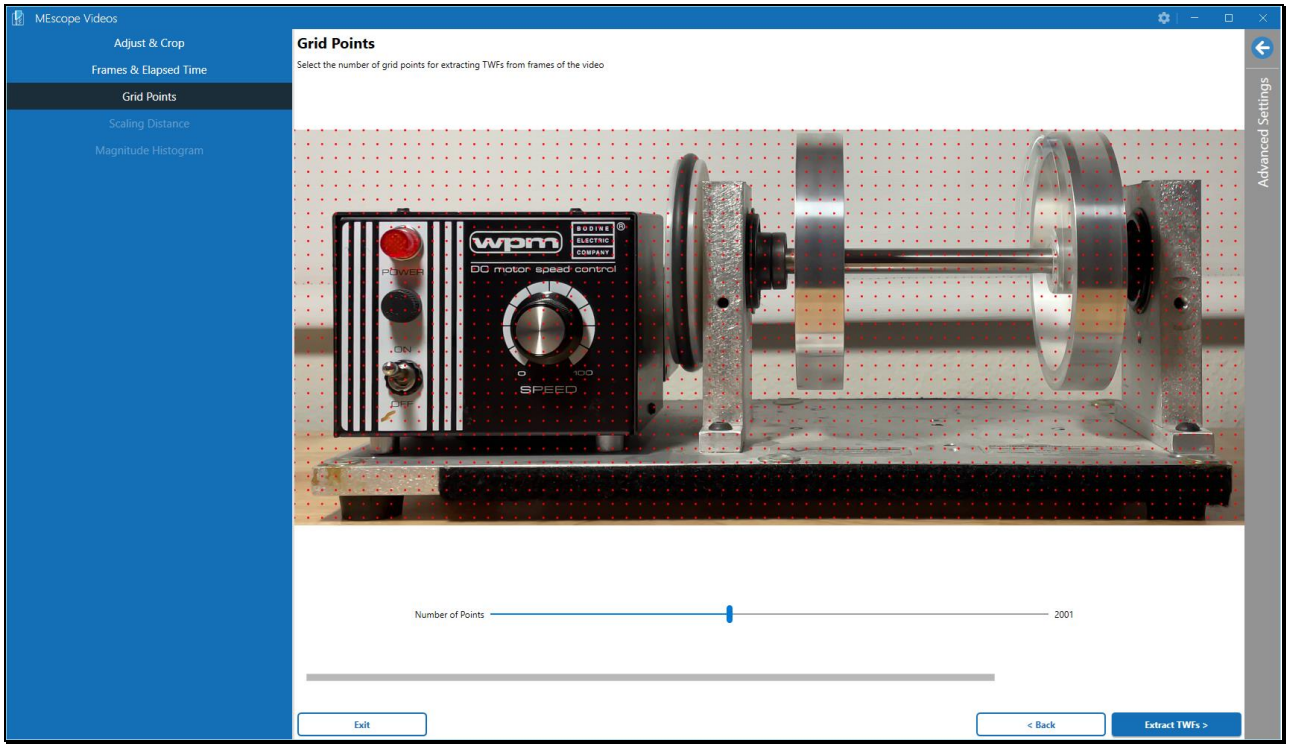
To move to this step from Step 2,

- Either ***press*** the **Next button** on the ***lower-right side*** or ***press*** **Grid Points** on the ***upper-left side*** of the **Wizard**

In this step, a rectangular **Point Grid** is created. The points in the **Point Grid** are deformed during video animation using data for either the **TWFs** Data Block or the **DFTs** Data Block. Frames from the video are attached to surfaces of the **Point Grid** to provide a ***photo-realistic*** structure model during animation.

Number of Grid Points

The points in the rectangular **Point Grid** are displayed as **red dots**, as shown below.



***Point Grid** Showing 2001 Points.*

- **To increase** the number of grid points in the **Point Grid**, ***drag*** the **horizontal slider** to the ***right***
- **To decrease** the number of grid points in the **Point Grid**, ***drag*** the **horizontal slider** to the ***left***

Extracting TWFs

To extract **TWFs** for each point in the **Point Grid**,

- Press the **Extract TWFs** button on the ***lower-right side*** of the **Wizard**

When this button is ***pressed***, several functions are performed.

1. Two **TWFs** are extracted for each pixel in each frame of the video. One **TWF** is the ***horizontal displacement,*** and the other is the ***vertical displacement*** of each pixel.
2. Two **TWFs** are calculated for each point in the **Point Grid** from the **TWFs** of the pixels surrounding each grid point.
3. Two **TWFs** for each point in the **Point Grid** are saved in a **TWFs** Data Block, and ***each pair*** of **TWFs** in the **TWFs** Data Block is linked to a point in the **Point Grid,** one for the ***horizontal*** deflection and the other for the ***vertical*** deflection.
4. **Two DFTs** for each point in the **Point Grid** are calculated from each pair of **TRFs** and saved in the **DFTs** Data Block. ***Each pair*** of **DFTs** is linked to a point in the **Point Grid,** one for the ***horizontal*** deflection and the other for the ***vertical*** deflection.

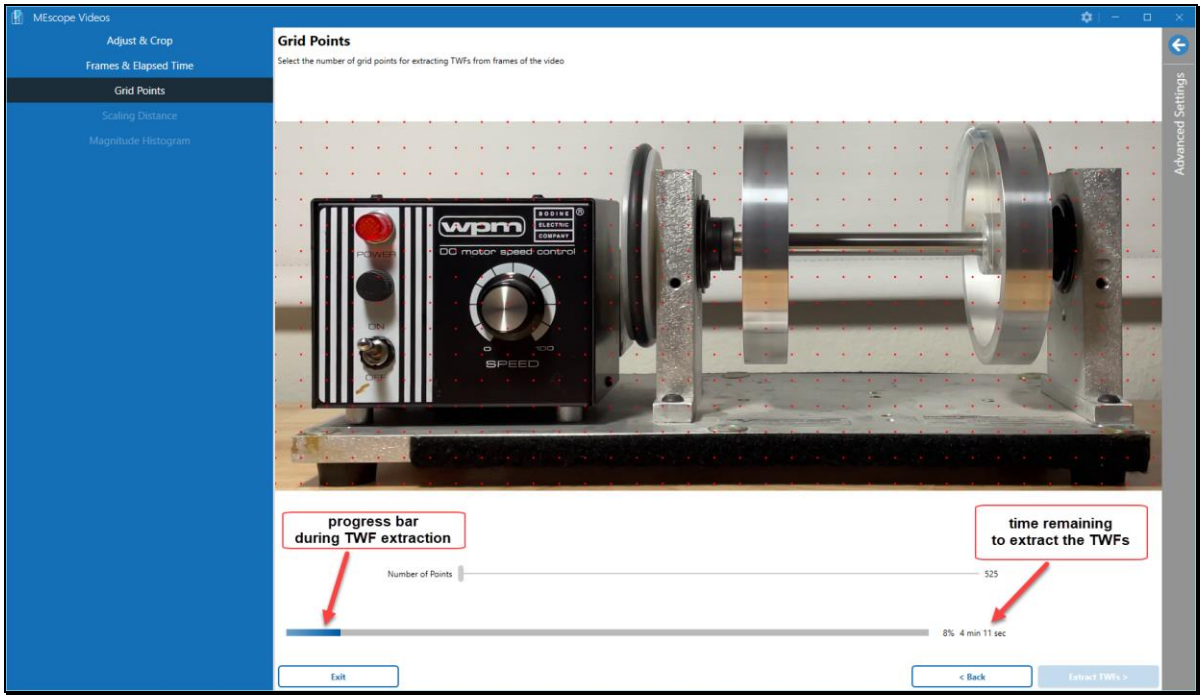
Extraction of the **TWFs** from the video is the most time-consuming step in the **Video Wizard**.

The amount of time required to extract **TWFs** from a video depends primarily on the ***number of frames*** in the video and the ***number of pixels*** in each frame.

A video should be cropped, and a suitable number of points in the **Point Grid** chosen before pressing the **Extract TWFs** button in this step.

It is advisable to make ***an initial pass*** through the steps of the **Video Wizard** using heavily cropped frames and a small number of grid points to verify that you are getting a valid **Enhanced Video Animation** (**EVA**) from your video.

- ***Press*** **Extract TWFs** to extract displacement **TWFs** from the video for each point in the **Point Grid**
- ***Press*** **Back** to stop the **TWF** extraction and return to previous steps of the **Video Wizard**
- ***Press*** **Exit** to return to the beginning step of the **Video Wizard**



Progress During **TWF** *Extraction from a Video*

When the **Extract TWFs** command has completed, the **Scaling Distance** step is displayed in the **Wizard**.

Step 4 - Scale Distance

To move to this step from Step 3,

- Either ***press*** the **Next** button on the ***lower-right side*** or ***press*** **Scaling Distance** on the ***upper-left side*** of the **Wizard**

In this step, the **TWFs** extracted from a video are ***scaled to physical displacement units*** so the **ODS's** displayed during an **EVA** accurately reflect the deflections of the test article captured by the video.

This step is optional but is required to scale the **TWFs** and **DFTs** into displacement engineering units.

After the **TWFs** and **DFTs** are scaled to **displacement** units, **ODS's** obtained during an **EVA** can be displaced in **velocity** units or **acceleration** units.

To scale the **TWFs** and **DFTs**, two points in a frame of the video are selected and the physical distance between those two points is entered into the **Wizard** in English or metric units.

For accurate scaling, the scaling endpoints should be chosen as close as possible to be in a plane parallel to the recording plane of the video.

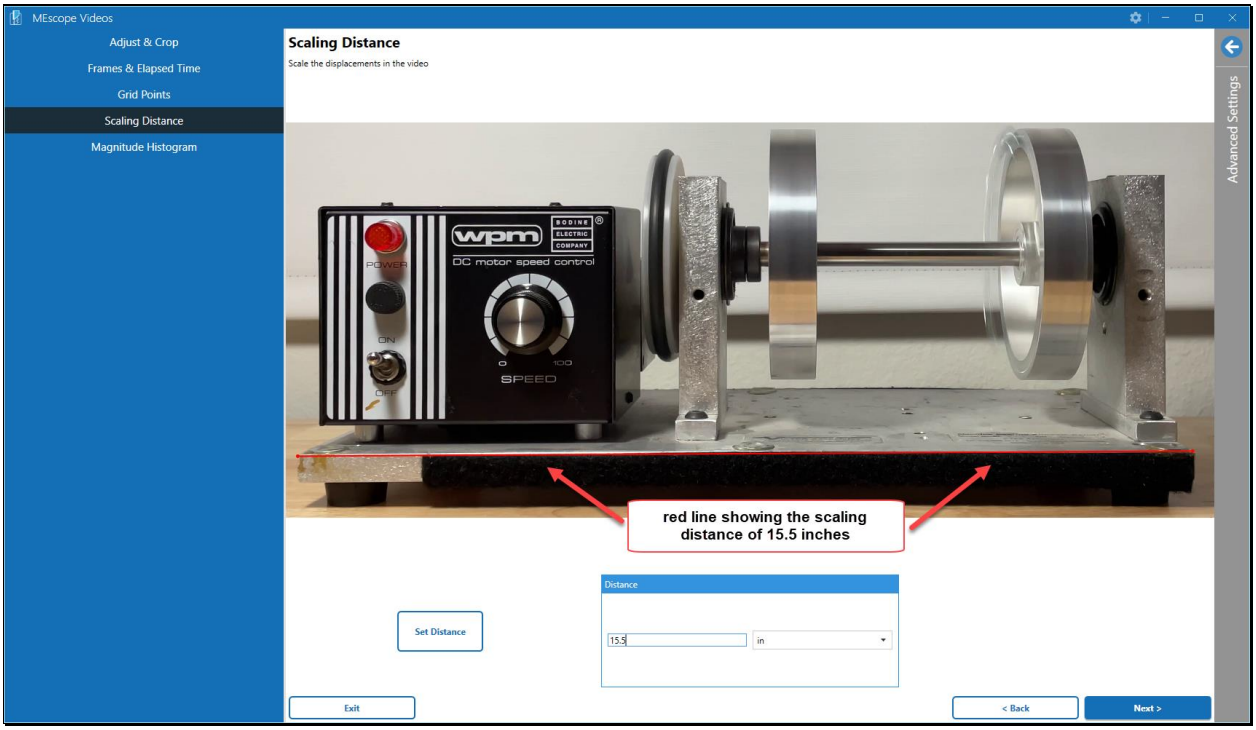
When the endpoints are chosen in a plane parallel to the plane of the video, the distance between them will be an accurate measure of the distance between the pixels closest to the endpoints in the raw video.

The scaling distance line ***can be at any angle***, but its endpoints should be chosen as close as possible to the plane of the video.

- ***Press*** the **Set Distance button**
- ***Click*** on a **beginning endpoint** and then click on an **ending endpoint**

A red line will be displayed between the two chosen points, as shown below.

- Select the **engineering units** and enter the distance between the two points in the box on the ***lower-left*** of the video



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

Zooming the Display

You can zoom and pan the display in the **Wizard** to pick the two endpoints of the distance line more accurately.

- Touch the **Wizard** touch screen display and use two fingers to **zoom** and **pan** the display
- To **zoom** the display with a mouse, place the mouse pointer on the video and ***spin*** the mouse wheel
- To **pan** the display with a mouse, ***hold down*** the **Ctrl key** on the keyboard and ***drag*** the mouse pointer

Step 5 - TWF Magnitudes

To move to this step from Step 4,

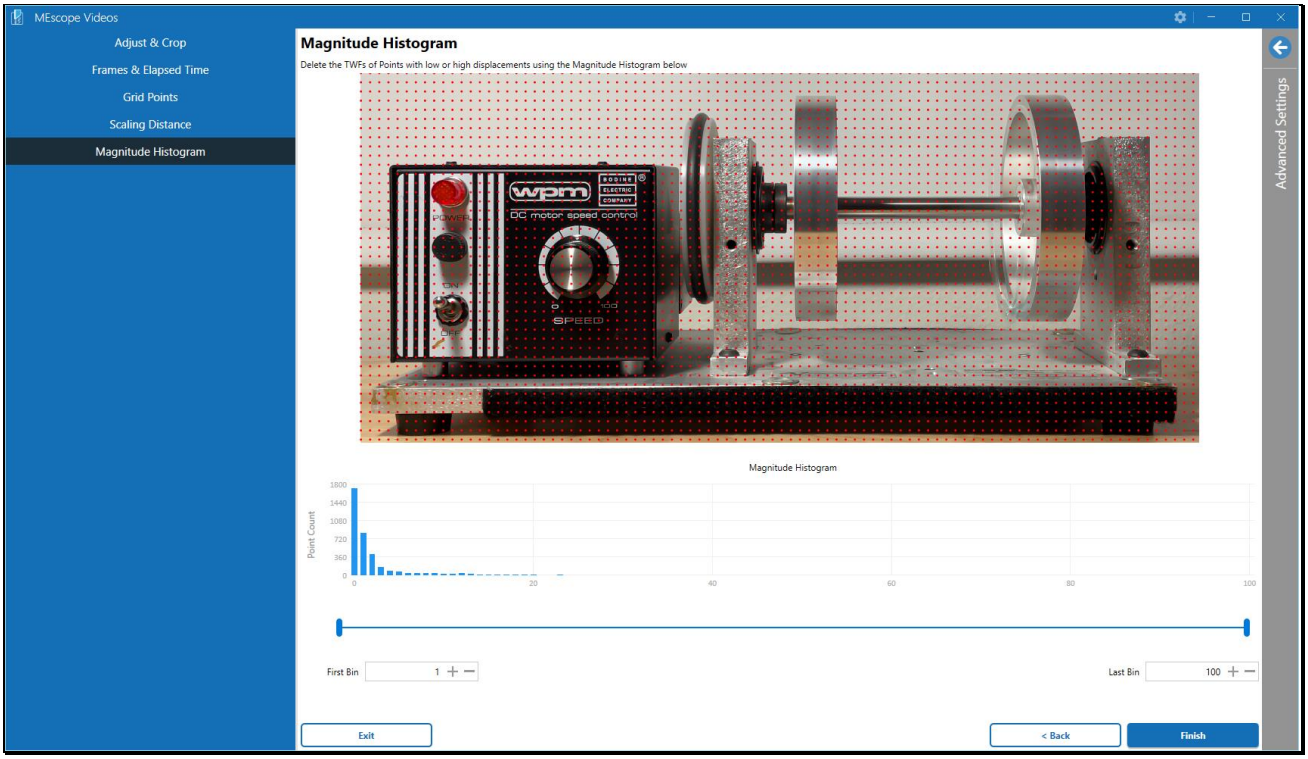
- Either ***press*** the **Next** button on the ***lower-right side*** or ***press*** **TWF Magnitudes** on the ***upper-left side*** of the **Wizard**

Magnitude Filter

In this step, the magnitude of the deflection of each point in the Point Grid is calculated, and a histogram of point counts is displayed using 100 bins from the smallest deflections to the largest deflections.

The 100 bins with counts of points from the **smallest** to the **largest** magnitudes is called the **Magnitude Filter**.

Point counts with the ***smallest deflections*** are displayed starting on the ***left side*** and point counts with the ***largest deflections*** are displayed starting on the **right-side** of the **Magnitude Filter**.



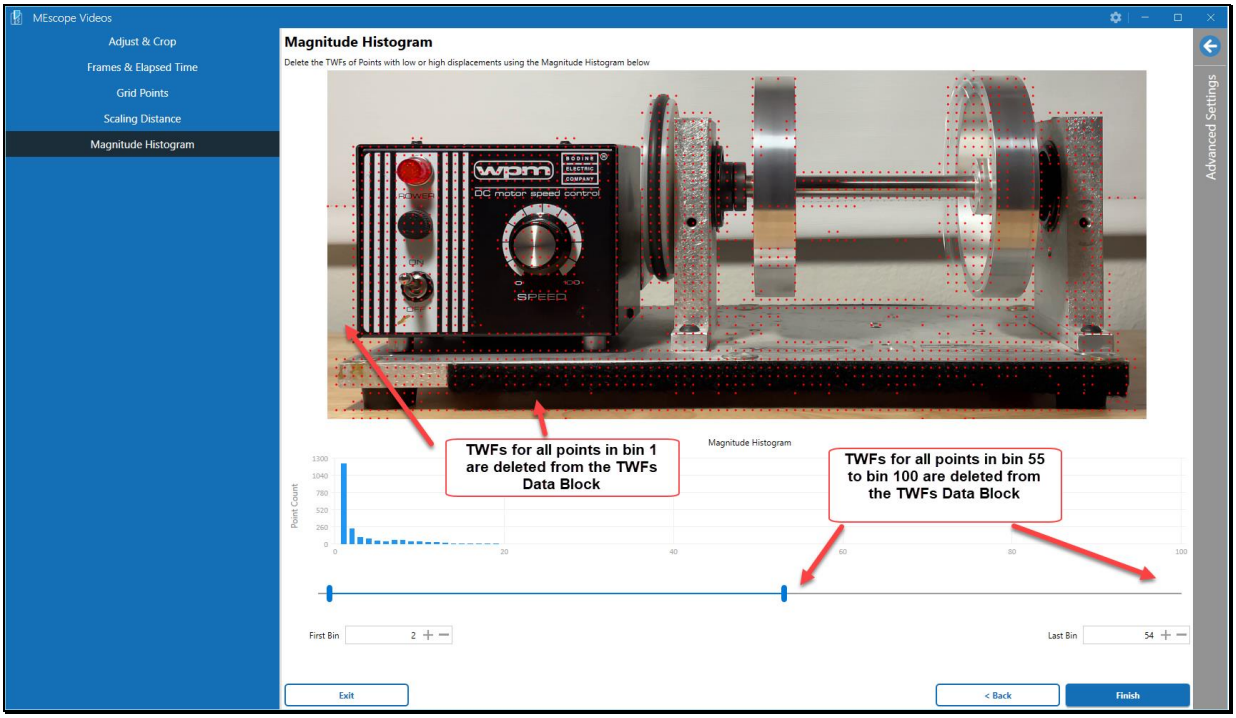
Magnitude Histogram Showing 100 Magnitude Bins

During an **EVA**, points with ***small deflection magnitudes*** will not deflect as much as points with ***larger magnitudes***.

- To filter out points with the **smallest** magnitudes, ***drag*** the ***left-hand*** slider to the ***right***
- To filter out points with the **largest** magnitudes, ***drag*** the ***right-hand*** slider to the ***left***

When the **Smallest** bin number is ***increased above*** **1**, the grid points with the smallest deflection magnitudes are not displayed on the **Point Grid** and their **TWFs** & **DFTs** are removed from the **TWFs** & **DFTs** Data Block.

When the **Largest** bin number is ***decreased below*** **100**, the grid points with the highest deflection magnitudes are not displayed on the **Point Grid** and their **TWFs** & **DFTs** are removed from the **TWFs** & **DFTs** Data Block.



Points With Low Magnitudes and High Magnitude Not Extracted

- ***Press*** the **Finish** button on the ***lower-right side*** of the **Wizard**

When the **Finish button** is pressed in the **Wizard**, a time-based sweep **EVA** will begin from the **Line** cursor position in the **TWFs** Data Block.