

# WormLab® 2020 Release Notes

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WormLab 2020.1.1 was released on Feb. 7, 2020

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 2020. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## New features and enhancements

- Detection & Tracking
  - Back tracking is now optimized significantly improving throughput
  - Head/tail assignment utilizes predominant movement direction for low resolution videos
  - Default values for overlap/interaction tracking based on video frame rate
  - Enhanced Multiple Hypotheses Tracking algorithm for improved tracking through entanglements, coiling and self-overlap.
  
- Analysis
  - Enhanced label analysis and track summary
    - User may now define the active region of the label (i.e. inside or outside the contour)
    - All metrics previously available in Track Summary are now available in Track Summary by Label
  - Peristaltic distance and speed metrics better describe worms predominantly moving in reverse
  - Pirouette analysis added
  - Mobility cumulative forward, idle and reversal time added to track summary
  - Improved handling of large datasets
  
- Repair
  - Worm-reindexing added to the Repair tab
  
- General
  - Analysis only licensing option (contact [sales@mbfbioscience.com](mailto:sales@mbfbioscience.com) for details about WormLab Explorer)

## Issues resolved

- Fixed an issue where undocking the workflow tool panel and closing would prevent WormLab from launching due to corrupted ini file.
- Fixed an issue where registered worm hypotheses are validated using detection fit instead of registration fit parameters
- Fixed an issue where live display would not properly shut down when switching to group analysis causing instability
- Fixed issue which allowed users to include several videos in a single project file using the import sequence function even though this format is not supported by the project file
- Fixed memory leak during label restricted tracking



# WormLab® 2019 Release Notes

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WormLab 2019.1.1 was released on Jan. 15, 2019

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 2019. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## New features and enhancements

- Detection & Tracking
  - New image segmentation mode for tracking semi-transparent worm images
  - Automatic thresholding optimization
  - Speed enhancement using label restricted tracking
- Analysis and Exporting
  - Position Speed, Body Shape and Swimming statistics
  - Enhanced label analysis and track summary
    - Total forward distance/time, total reverse distance/time
  - Display/plot all worm tracks using a common start position
  - Batch analysis and exporting capability
  - Multi-track export capability
  - Analysis only licensing option (contact [sales@mbfbioscience.com](mailto:sales@mbfbioscience.com) for details)
- Stimuli Delivery
  - Manual control of LEDs with correlated labels
- Misc. Feature
  - Added automatic notification of new version of WormLab available.

## Issues resolved

- Fixed an issue exporting speed values in mobility analysis
- Fixed an issue where the video capture window would not close using X in upper right corner of window



# WormLab® 2018 Release Notes

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WormLab 2018.1.1 was released on May. 23, 2018

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 2018. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## New features and enhancements

- Detection & Tracking
  - Adjustable Head/Tail detection that incorporates geometry and bending amplitude
  - Live tracking: Tracking worms on live video camera feed.
  - Live project: analysis & playback
  - New worm to track assignment algorithm to improve tracking performance for swimming worms
  - Optimized Track Hypothesis sorting algorithm
- Editing
  - Added “Undo” capabilities to the following operations: Delete/Split/Join worm tracks.
- Analysis
  - Added the track summary analysis segmented by labels
  - Expanded the export window options to allow the user to manually set the export range of the data
  - Turn count and track duration added to the track summary analysis
- Video support
  - Support for variable framerate video formats added

## Issues resolved

- Fixed a crash that occurs when trying to switch to batch mode during tracking.
- Fixed a bug where Manual Stimulus buttons can cause a crash
- Fixed an issue with track splitting creating unused track ids
- Fixed a crash on Windows 10 where pressing the 'enter' key in the stimulus dialog could cause a crash
- Fixed a bug with causing incorrect head swap during tracking
- Fixed a Row-based frame navigation bug in the analysis window
- Fixed a Frame-based Row navigation bug in data with frame offset
- Fixed a table truncation bug in track summary analysis

- Fixed a consistency issue between displayed and exported table - Empty rows are now correctly exported
- Fixed a crashing issue when selecting an empty track in histogram analysis
- Fixed an issue with the persistence of the Kalman filtering option
- Fixed an issue where the user can change camera setting during acquisition and cause crashes
- Fixed an issue when creating videos with framerate less than 1fps
- Fixed a rare crash occurring when decoding videos containing one single frame

# WormLab® 2017 Release Notes

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WormLab 2017.0.1 was released on Sept. 22, 2017

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 2017. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## New features and enhancements

- Expanded the export window option to allow the user to export empty rows at the start or end of a sequence.
- Support for variable frame rate video formats added
- Added plug and play compatibility for WormLab Video Acquisition System hardware
- Improved swimming tracking algorithm
- Turn count and track duration were added to the track summary analysis

## Issues resolved

- Removed restriction on minimal tracing length
- Fixed data table-video sync issue when offset tracking range is specified
- Fixed issue with head/tail swap during tracking
- Fixed a table truncation issue in the track summary analysis
- Fixed a crashing issue when selecting an empty trackin histogram analysis
- Fixed a persistency issue with Kalman filtering option
- Fixed crash caused by connecting worm tracks with varying spinal axis sampling values

# WormLab® 2017 Release Notes

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WormLab 2017.0.0 was released on June 9, 2017

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 2017. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## New features and enhancements

- [Group Analysis](#) – view data from multiple project files and aggregate data in user defined sets
- [Swimming Metrics](#) - 10 novel swim behavior metrics reporting dynamic changes in posture and speed\*
- [Enhanced Automated Stimulus Control](#) (Optional Extension Module)
  - Time based or frame based stimuli may be defined.
  - Stimuli intensity control is supported using WormLab hardware
  - Plug and Play compatibility: WormLab hardware supports dynamic parameterization of the stimulus interface
  - Support for TTL control of external devices
  - Preview stimuli display graphically represents your defined stimuli patterns prior to acquisition
- [Enhanced Label Analysis](#) – Labels may be used to display aggregate results (calculated over the entire video) OR split results (results specific to each period of time corresponding to the recurring label)
- Support for Mobile Licensing – enables WormLab license to move easily between various computers using a USB license key. Contact MBF Bioscience for details.
- Video slider control allows you to quickly scroll through acquired video sequence
- Angular direction plots may be viewed in standard mode or you may restrict the angle range +/- 180°
- Buffered encoding support – allows the user to specify frame buffer size to encoder short videos at high framerate

## Issues resolved

- 4K monitor resolutions are now supported properly.
- Memory access errors corrected when using multiple hypotheses
- Correctly determine frame rate from variable framerate videos
- Fixed crash caused by connecting worm tracks with varying spinal axis sampling values

\* Metrics are described in [CeleST: Computer Vision Software for Quantitative Analysis of C. elegans Swim Behavior Reveals Novel Features of Locomotion](#) (Restif, Ibáñez-Ventoso, Vora et al., 2014).



# WormLab® 4.1 Release Notes

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WormLab 4.1 was released on July. 8, 2016

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 4.1. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## New features and enhancements

- Multi-threaded tracking: The tracking algorithm is now fully multi-threaded and runs significantly faster.
- [Configuration Manager](#): Ability to save and re-use your tracing settings.
- Selected tracking: Ability to only track the worms currently displayed by setting the [detection](#) frequency to 0 (zero).
- [Curvature map analysis](#): Length restriction has been removed.
- Zooming system: Allows zooming centered at mouse position

## Issues resolved

- The detection algorithm was improved to prevent rare crashes caused by the detection of very small worms.
- When exporting large mobility analysis data sets, there is no longer the possibility of an error message stating that the application has run out of memory and will need to be terminated.
- After completing [batch processing](#) of multiple files, it is now possible to select additional files to be processed again without restarting the software.
- [Curvature map analysis](#): The correct frame range is displayed.
- [Track splitting](#): New tracks created through track splitting after loading an existing project file are now assigned the correct Id.
- Data sets with blank cells now [export](#) correctly.



# WormLab® 4.0 Release Notes

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WormLab 4.0 was released on Dec. 11, 2015

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 4.0. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## New Features and Improvements:

**Batch Processing**– WormLab can perform tracking of multiple videos without manual intervention. Significantly improves throughput and efficiency.

**Video Labeling** – WormLab labels are used to mark portions of a video in both time and space defined by a 2D graphical overlay (user defined circle or rectangle), a start frame and an end frame.

- Quickly navigate between labelled portions of video using the “Go to label” feature
- Region of interest (xy and t) analysis and tracking. May be used to eliminate artifacts within the field of view or decrease tracking time focusing only within the region or time of interest
- Chemotaxis analysis – a label is assigned to a user defined region and WormLab will provide distance and speed measurement of the worms relative to the labeled area.

## Acquisition and Control

- Added support for Basler USB3 Vision cameras
- Precise software control of the WormLab illuminator output
- Support for a new Stimulus Track – manual or automated I/O to correlate external events during video acquisition

**Whole Plate Tracking** – improved whole plate tracking of low resolution worms

**User interface enhancements** – improved the general User Interface with new icons for workflows and video controls, added context sensitive help buttons and Tooltips

## Bugs Fixed:

**File formats** – WormLab was able to save images in .png format but was unable to open .png images. Users are now able to load .png image sequences.

**Omega bend analysis** – report tab indicated number of omega bends as reversals. Corrected report label information.

**Analysis plotting** – units added Direction plot, Bending angle plots and correct the legend in the Curvature map.



# WormLab<sup>®</sup> 3.5 Release Notes

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WormLab 3.5 was released on Oct. 7, 2014

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 3.5. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## Features Modified:

**Scalability** – Long video sequence of more than 10,000 frames are now fully supported. We also dramatically improved our software responsiveness for the display and plotting of very large data tables.

**File format** – Our effort to better handle larger data sets associated with longer video sequences is complemented by a new modified project file utilizing a more efficient binary file format. WormLab is capable of reading the original XML project file formats and converting them automatically upon saving to the more efficient binary format.

**Loading files** – If the software cannot locate the video file at the path specified in the project file, it will look for the file in the current directory. If a video file with the appropriate name is located within the directory where the project file is located, the user is then asked if he wants to use this file instead.

**Plotting** – Added unit of measure (Radians or Degrees) to the Direction, Bending Angle (Mid-point and Multiple) plots and histograms and Curvature map

## Bugs Fixed:

**File names** – WormLab was unable to load data when the file name contains blank spaces. Users are now able to utilize file names with blank spaces

**Plotting** – The Y-axis labels of the position/center plot were inverted compared to the data table coordinates. Data table and plot coordinates now agree.

**Loading files** – If the project file referenced a video file path that was no longer valid, a file search window would display. If the user clicks “Cancel”, WormLab would quit unexpectedly. File searches may be canceled without terminating the program.

**Mobility Analysis** – Some project files would cause WormLab to run out of memory when displaying a mobility analysis plot. Mobility analysis has been corrected eliminate this issue.

**Histograms** – Switching between degrees and radians may produce incorrect histogram display. Correct histograms to display the appropriate data regardless of unit of measure (radians or degrees) chosen.



# WormLab® 3.1 Release Notes

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WormLab 3.1 was released on April 9, 2014

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 3.1. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## New Features and Improvements

**Kalman Smoothing** - The analysis now provides for a Kalman smoothing option to reduce the positional error associated with worm model fit and video jitter. This filter significantly reduces the sporadic, single-frame backward speed for slowly moving worms, giving a more accurate measure of the total track length traveled in both forward and backward directions.

**Track Summary Analysis** - Now includes new metrics for: Peristaltic Track Length, Peristaltic Speed and Straight-Line distance.

**Mobility Analysis** - This is a new analysis used to report on total time spent going in the forward direction, the reverse direction or remaining idle. The user can set thresholds for the min speed to be considered making forward or reverse progress, and the number of frames such a speed must be maintained. A graphical plot is produced showing the forward and backward mobility overlaid on a plot of the worm speed.

## Bugs Fixed

**Tracking** - In some instances, multiple hypothesis tracking reduced to using just a single hypothesis. This fix improves tracking when using multiple hypothesis for worms that are coiling or moving through Omega bends.

**Curvature Map** - The colors of the curvature map (blue+/red-) were not consistent with the colors for the bending angles (red+/blue-). The colors have been flipped to (red+/blue-).

**Whole Plate Track Re-indexing** - When whole plate tracking results in empty tracks, these tracks are now eliminated from the analysis. The remaining tracks are re-indexed, starting at number 1.

# WormLab® 3.0 Release Notes

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WormLab 3.0 was released on Oct 10, 2013

## **New Features and Improvements**

This release contains a significant number of new features, and so has been labeled as a major release.

**Analysis** - We have added a full set of interactive plotting and reporting tools to create line charts and histograms based on worm position and shape data. This includes 18 analyses and 6 histogram summaries. The new Analysis window contains a list of selectable analyses, a data table display area and a charting area. The data can be exported to excel, and the charts can be copied to your clipboard or saved in common image file formats or in PDF format. The charts are customizable for color and text and support zoom and pan operations to examine the data.

**Swimming Mode** - Track multiple swimming worms at once. We've added a new fitting model specifically for swimming worms. You'll find the option in the Tracking step offering a choice between crawling and swimming mode.

**Hot Spot Correction** - For larger fields of view under a microscope or camera stand, the light source often creates a brighter spot at the center of the light source. WormLab now contains a specific filter to flatten the light field. The background light is modeled by the software and removed from the image. The result is better tracking across the hotspot light gradient. This is completely automatic when turned on and applies to videos already captured.

**Synchronized Views** - The Video view and the Analysis view are now synchronized. Click on a row in the analysis data table, and the video jumps to the same frame. Move the video frame slider and the data view moves to the appropriate frame in the table. This makes it much easier to quickly match the worm shape metrics with the video visualization.

**Video Capture Duration** - If you have the optional Video Capture Module with WormLab, then you'll notice that you can now set the time duration for acquisition. This helps when capturing short sequences of video where you require each sequence to be the same length of time (e.g. 1 minute).

**Video Capture : Clipping** - When setting the camera exposure, it's best to attempt to maximize the dynamic range. You can do this by limiting the amount of overexposure. The Clipping check box will show you the parts of the image that are overexposed. Shorten the exposure time or closing down the lens aperture can reduce the overexposure.

**UI** : We've made general improvements in the User Interface (UI), including new icons, reduction of the workflow by one step, and redesign of the Video Capture window. We've also made the Analysis window its own standalone window owing to its larger size.

**Repair : Join Tracks** - It's now possible to join multiple tracks together at one time. Enter a list of tracks to join together, separated by commas.

**Editing : Manual and Click Detection** - You can now delete part of sequence of worms and redetect either with single-click detection or manual tracing detection. The software automatically joins the worm to the appropriate track.

**Image Adjustment** - The display has been modified to show the threshold settings as green worms on the image background. This replaces the black-and-white view previously used, making it easier to set a correct threshold.

**Tools Menu : Snapshot** - The snapshot tool has been moved to this menu. You can now also export portions of a video as a sequence of still images or a video file.

**Tools Menu : Reformat** - For videos that have an incorrectly specified frame rate (which affects playback and tracking) this tools offers the ability to recode the video to the correct known frame rate.

**Time-point Display** - All data tables in the Analysis window display both frame number and now time-point where appropriate.

### **Bugs Fixed:**

**Omega bend Head Assignment** - WormLab at times will incorrectly assign the head/tail ends to a worm after it emerges from an omega bend. This is because the head/tail are quite close together. We've improved this performance, although the confusion is still possible in some cases.

**Track Connection** - Manually traced worms would create a new track. Now the worm is connected to the correct track, if it exists. Otherwise a new track is created.



# WormLab<sup>®</sup> 2.3 Release Notes

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WormLab 2.3.1 was released on July 15, 2013

WormLab 2.3.0 was released on June 14, 2013.

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com/download>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 2.3. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## Feature Modified:

We modified the Swap Head/Tail feature on the "Repair" tab. There are now two ways to swap. 1) Swap head/tail for the entire track (same as version 2.2) 2) Swap head/tail from the current frame to the end of track (new). We added this second option to repair tracks where the head/tail are incorrectly swapped after a worm emerges from an omega bend. This is easier and faster than the previous way of splitting the track, swapping head tail on the secondary track and then rejoining.

## Bugs Fixed:

v2.3.1 Certain video files (.avi) would load with an incorrect frame rate of 1000 FPS. WormLab was changed to detect and correct situations where the video stream rate and the codec rate were mismatched.

v2.3.0 The threshold operation was quite slow for larger video frames (5 Megapixel size). We've modified the software to fix this problem.

# WormLab® 2.2 Release Notes

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WormLab 2.2.0 was released on April 30, 2013.

## How to Download

If you are an existing WormLab customer, you can download the latest WormLab software from the MBF Download center (<http://support.mbfbioscience.com/download>). Microsoft Windows 32bit, 64 bit and Mac OSX versions are available for WormLab 2.2. On Windows, if you have a 64 bit machine, we highly recommend using the 64 bit version of WormLab.

## Bugs Fixed:

Export for Centerline Points and Multi-Point Bending: A bug was fixed where the export would always write data for the entire range of frames to the export file. The correct range of data is now written to the export file.

Frame Detail: Frame Range Display: The frames were displayed as range 0..N-1. They now display correctly in the range 1..N.

Setup (Windows): WormLab now appears under "All Programs" on the Start Button list.

Omega Bend Detection - This was failing due to the way bending angles are newly calculated. In previous version, a straight angle was recorded as 180 degrees (pi). In newer versions, a straight angle is zero degrees so that angles for single and multi-bending angle analyses are consistent. The omega bend detection has been updated to use the new angle convention.

## Tracking - Speed Optimization

Changes were made to optimize the initialization of tracking for each video frame. This change improves speed, decreases memory usage but does not change the tracking results.

## Camera - AVT Format-7

WormLab now supports larger image formats using Format-7. This allows for full frame use of the AVT-Stingray-F504B/C cameras, as well as other DCAM/IIDC compliant cameras with large image sizes. This only affects WormLab systems with the optional Camera Interface module.

## Camera - Firewire A/B Fallback

The camera interface will fall back to the slower Firewire A (400 Mbps) if the connection to Firewire B fails.

## Camera - Connect/Disconnect

WormLab now supports camera connection/disconnection while the application is still running.

## Camera - Video File Write

We improved the speed of video writing, which now supports faster frame rates and larger image frame sizes. The throughput still depends on the processing and I/O speed of your computer.

## **Camera - Exposure Display**

For cameras that support this feature, WormLab now display the correct exposure setting time units.

# WormLab 2.1 Release Notes

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WormLab 2.1 was released on Jan 25, 2013.

## **Centerline Points Analysis - New**

WormLab can now export multiple points in (x,y) coordinates along the worm centerline. The user can choose the resolution as a number of points to sample along the spline basis centerline. The data is available as an export to Microsoft Excel, in .CSV (comma separated value) format and can be imported into third party products such as Matlab® by The Mathworks.

## **Multi-Point Bending Analysis - New**

This analysis provides a measurement of the bending angle at multiple points along the worm centerline. The centerline is modeled as a spline basis, and the user can choose the number of points to sample from this curve. The bending angles are exported in either radians or degrees, and an angle of 0.0 indicates no bend.

## **Video Snapshot - New**

With the optional Camera Capture Module, WormLab can save a snapshot of the view through the camera while simultaneously recording video. This feature is useful for capturing a still-image of the scale bar or for making a record of interesting events that appear in the view finder while recording.

## **Bug Fixes**

**The Wavelength Analysis:** The wavelength measurements reported some wavelengths as negative numbers when a wavelength could not be determined. These values now appear as blank.

**Direction Analysis:** The direction measurement previously reported headings in radians with a range greater than  $2\pi$ . This has been corrected so direction measurements are in the range  $[-\pi \dots \pi]$ ; an angle of 0 aligns with the positive x-axis (horizontal).

**Minimum Track Length:** The value for minimum track duration during detection is measured in frames. A caption with the word "frames" now appears in the software to make this clear.

**Video Playback:** The timing for video playback has been improved and now more accurately reflects the playback rate requested by the user. This has no impact on analysis.

**Video Recording:** The Camera Capture Module now encodes the video frame rate using the camera's configured frame rate rather than the mean frame rate measured during acquisition. This eliminates frame rates with decimal residuals (i.e. 15 FPS instead of 15.094 FPS)

**Video Decoding:** Some improvements to video decoding to handle .wmv format videos that encode time stamps in milliseconds instead of as frame numbers.

Camera Capture with AVT cameras: user interface now uses conventional values for gain (dB) and exposure (sec) in place of AVT camera register values. The gamma setting is now properly supported for AVT cameras.

Time-Lapse Duration: Maximum value is now 99,999 seconds. Minimum value is 0.25 s.

Improved memory management.

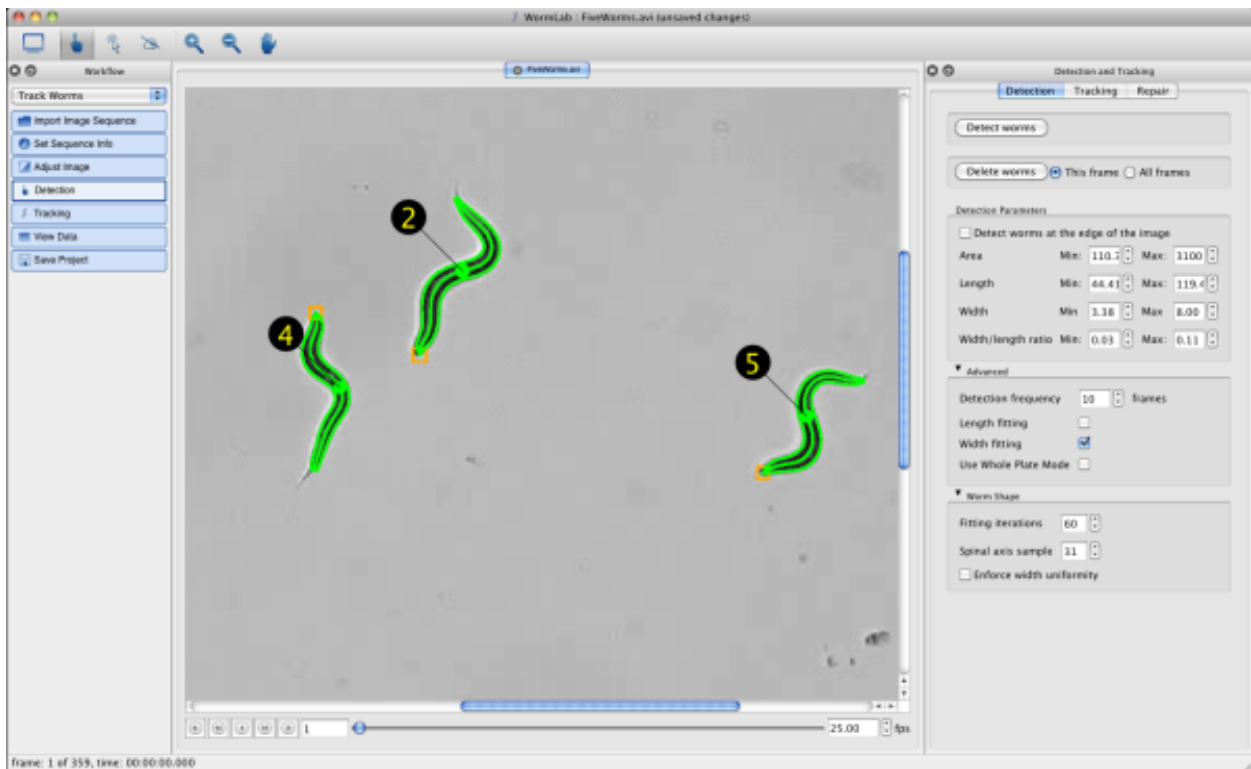
# WormLab 2.0 Release Notes

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WormLab 2.0 was released on Nov 1, 2012.

## Apple Mac OSX® Version

WormLab is now available on the Mac®. This new version software is designed for the native Mac user interface and runs just as quickly and accurately as the Microsoft Windows® version with identical tracking results.



## Extensive Camera Support

WormLab has an optional *Video Capture* module designed to making the capture and processing of worm videos simple and efficient. The capture module offers streamed-capture or time-lapse-capture with intervals as short as 1/4 second. In WormLab 2.0, we've updated the interface to support the IIDC standard (Instrumentation and Industrial Digital Camera) for Firewire IEEE 1394. There are now over 1400 different camera models supported by WormLab, including cameras from Point Grey and Allied Vision Technologies (AVT). Contact MBF to see if you interested in purchasing a camera with WormLab or to check if WormLab supports your existing camera.

## Faster Tracking and Improved Accuracy

We've improved our tracking algorithms for version 2.0, particularly through self-overlap and entanglement. We've also added options to turn on/off width and length fitting—options that help

improve tracking performance and accuracy through entanglement. Tracking is much faster throughout, and the 64-bit version is even faster than the 32-bit version.

### **Whole Plate Mode**

WormLab now includes an option to track many worms on a plate captured at low magnification. This new mode runs faster than regular tracking. The difference is that worms are tracked up to the point that they interact (touch, cross) and tracking resumes when entanglement ends.

### **New Data Export**

This new version now exports data to .CSV files, opening up more options to use and analyze your data with more third-party software such as Microsoft Excel®. We have included examples demonstrating how to import your data into MATLAB® (MathWorks®, MA), a popular software program for data analysis used by many of our customers.

### **New Analysis**

This new version of the software includes reporting on the shape of the worm centerline, exported as a set of coordinate points. You can choose the number of sample points along the worm centerline and which track to analyze. We've even included an example of how to import this data into MATLAB and create a simple plot animating the worm centerline.

### **Track Editing (Join/Split)**

New options are now available to join separate worm tracks. This is useful when tracking of a worm drops due to imaging, but picks up a few frames later. Our tracking in 2.0 is smarter and joins split tracks automatically—but if two tracks aren't connected properly, use this tool to manually join these tracks.

### **Manual Worm Trace**

For difficult to detect worms, you can use the mouse to trace the worm centerline from head to tail by clicking just a few points, giving WormLab a very strong hint on the shape of the worm for better detection. WormLab 2.0 automatically connects manually traced worms onto the appropriate track from adjacent video frames.

### **Still Easy to Use**

Many of our customers have remarked how easy it is to download and start using WormLab . The new version features the same intuitive step-by-step workflow, from loading or capturing videos through to data analysis and export. Our excellent customer support can help you with tracking and improving your video capture techniques.

### **Windows 8 Ready**

If you are running Windows 8, then you'll find that WormLab 2.0 works just fine (we suggest using the 64-bit version).