

CeSnAP (C. elegans Snapshot Analysis Platform)

→ Run **CeSnAP.m**

A. SnapSegment

1. Switch to *SnapSegment* program.
2. Import videos or snapshots.
 - Load the folder containing MP4 or MOV files (Video files should be placed in relevant subfolders for different conditions).
 - Load the folder containing all ND2 files.
3. Outline the well's perimeter by identifying 3 points.
4. Update detection parameter if necessary.
5. 'Process All' snapshots.
6. 'Analyze' snapshots.
7. Save mask images of found objects.

Switch to SnapSegment

Import/Process/Save

Well-Round-Snapshot No.

Detected objects

Detection Parameters

Save mask images

Found objects' area histogram

Rounds check box

Wells check box

Color Code Legend

Previous/Next Snapshot

Legend/Process

Found objects' area histogram

L4440->DM	<input checked="" type="checkbox"/>	A1	<input checked="" type="checkbox"/>	A2	<input checked="" type="checkbox"/>	A3	<input checked="" type="checkbox"/>	A4	<input checked="" type="checkbox"/>	A5	<input checked="" type="checkbox"/>	A6	<input checked="" type="checkbox"/>	A7
L4440->LX1	<input checked="" type="checkbox"/>	B1	<input checked="" type="checkbox"/>	B2	<input checked="" type="checkbox"/>	B3	<input checked="" type="checkbox"/>	B4	<input checked="" type="checkbox"/>	B5	<input checked="" type="checkbox"/>	B6	<input checked="" type="checkbox"/>	B7
Bcat1->DM	<input checked="" type="checkbox"/>	C1	<input checked="" type="checkbox"/>	C2	<input checked="" type="checkbox"/>	C3	<input checked="" type="checkbox"/>	C4	<input checked="" type="checkbox"/>	C5	<input checked="" type="checkbox"/>	C6	<input checked="" type="checkbox"/>	C7
Bcat1->Fek	<input checked="" type="checkbox"/>	D1	<input checked="" type="checkbox"/>	D2	<input checked="" type="checkbox"/>	D3	<input checked="" type="checkbox"/>	D4	<input checked="" type="checkbox"/>	D5	<input checked="" type="checkbox"/>	D6	<input checked="" type="checkbox"/>	D7
Bcat1->Met	<input checked="" type="checkbox"/>	E1	<input checked="" type="checkbox"/>	E2	<input checked="" type="checkbox"/>	E3	<input checked="" type="checkbox"/>	E4	<input checked="" type="checkbox"/>	E5	<input checked="" type="checkbox"/>	E6	<input checked="" type="checkbox"/>	E7
Bcat1->LXF	<input checked="" type="checkbox"/>	F1	<input checked="" type="checkbox"/>	F2	<input checked="" type="checkbox"/>	F3	<input checked="" type="checkbox"/>	F4	<input checked="" type="checkbox"/>	F5	<input checked="" type="checkbox"/>	F6	<input checked="" type="checkbox"/>	F7

B. SnapTrain

Train network

1. Switch to *SnapTrain* program.
2. Load the image database into workspace (The main folder should contain subfolders for labels user intend to train on).
3. Change the labels of mask images using right or left clicks.
4. Train a convolutional neural network using loaded image database.
5. Once training process is finished, the trained network is automatically saved under the same name as the image database folder.
6. Analyze the performance of trained C-NN.

Optimize network

7. Load the previously trained network.
8. Use confusion checkbox to select subgroups to be shown in montage screen by clicking on 'Refresh' button.
9. Change the labels of mask images using right or left clicks.
10. Train a new convolutional neural network using modified database.

Switch to SnapTrain Database manager montage Right/Left click to change label

The screenshot displays the SnapTrain software interface. On the left, a 'Training session' window contains buttons for 'Load database', 'Load trained C-NN', and 'Train network'. Below this is an 'Output Class' section with a confusion matrix and a 'Confusion checkbox'. At the bottom left is a 'Label legend' with color-coded categories: Censored (red), Curled (yellow), Half/Curled (green), Near/Curled (cyan), and Straight (blue). The main area is a 'Database manager montage' grid of 8x8 image thumbnails, each with a colored border and a score array. A 'SaveXLSX' button is at the bottom left of the montage. Annotations include: a red arrow pointing to the 'SnapTrain' window title; blue arrows pointing to 'Load database', 'Load trained C-NN', and 'Train network'; a blue arrow pointing to the 'Refresh' button; a red arrow pointing to a right-click on an image; a green arrow pointing to a blue-bordered image; and a red arrow pointing to a score array.

Load database

Load trained C-NN

Train network

Confusion checkbox

Label legend

Box color => Target label

Score array => Output label

C. SnapMachine

1. Switch to *SnapMachine* program.
2. Import videos or snapshots.
 - Load the folder containing MP4 or MOV files (Video files should be placed in relevant subfolders for different conditions).
 - Load the folder containing all ND2 files.
3. Outline the well's perimeter if deemed necessary (Optional).
4. Load the trained neural network with best performance.
5. 'Run' the program to detect and categorize worms across all snapshots.

Switch to *SnapMachine*

Well-Round-Snapshot No.

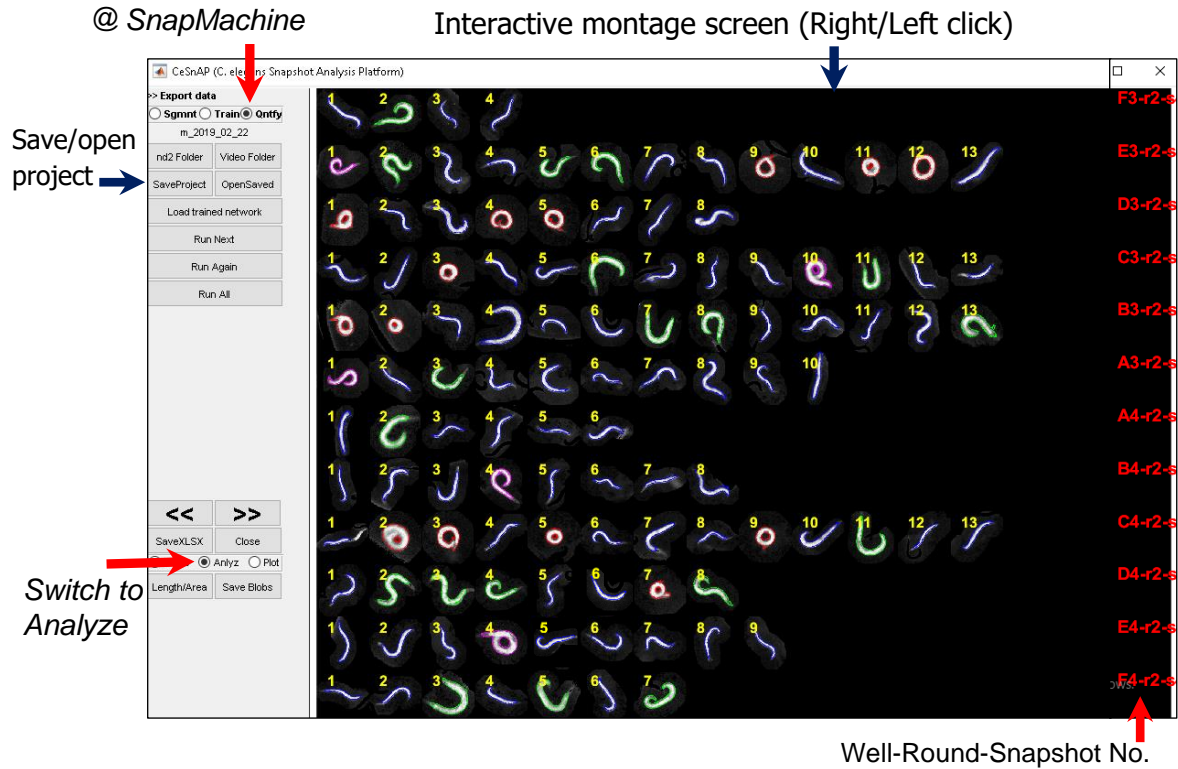
C-NN scores

Wells check box

Rounds check box

Condition1	<input checked="" type="checkbox"/> A1	<input checked="" type="checkbox"/> A2	<input checked="" type="checkbox"/> A3	<input checked="" type="checkbox"/> A4	<input checked="" type="checkbox"/> A5	<input checked="" type="checkbox"/> A6
Condition2	<input checked="" type="checkbox"/> B1	<input checked="" type="checkbox"/> B2	<input checked="" type="checkbox"/> B3	<input checked="" type="checkbox"/> B4	<input checked="" type="checkbox"/> B5	<input checked="" type="checkbox"/> B6
Condition3	<input checked="" type="checkbox"/> C1	<input checked="" type="checkbox"/> C2	<input checked="" type="checkbox"/> C3	<input checked="" type="checkbox"/> C4	<input checked="" type="checkbox"/> C5	<input checked="" type="checkbox"/> C6
Condition4	<input checked="" type="checkbox"/> D1	<input checked="" type="checkbox"/> D2	<input checked="" type="checkbox"/> D3	<input checked="" type="checkbox"/> D4	<input checked="" type="checkbox"/> D5	<input checked="" type="checkbox"/> D6
Condition5	<input checked="" type="checkbox"/> E1	<input checked="" type="checkbox"/> E2	<input checked="" type="checkbox"/> E3	<input checked="" type="checkbox"/> E4	<input checked="" type="checkbox"/> E5	<input checked="" type="checkbox"/> E6
Condition6	<input checked="" type="checkbox"/> F1	<input checked="" type="checkbox"/> F2	<input checked="" type="checkbox"/> F3	<input checked="" type="checkbox"/> F4	<input checked="" type="checkbox"/> F5	<input checked="" type="checkbox"/> F6

6. Once finished, the project is automatically saved. The color-coded montage of found worms are shown in 'Analyze' mode.
7. User can override trained neural network's decision using right and left clicks.



8. Switch to 'Plot' mode for quick quantification of curling analysis.
9. The results are calculated using data from wells and rounds that are checked in 'Process' mode.
10. Plot length and area figures.
11. Write data to an EXCEL file for further statistical analysis.

