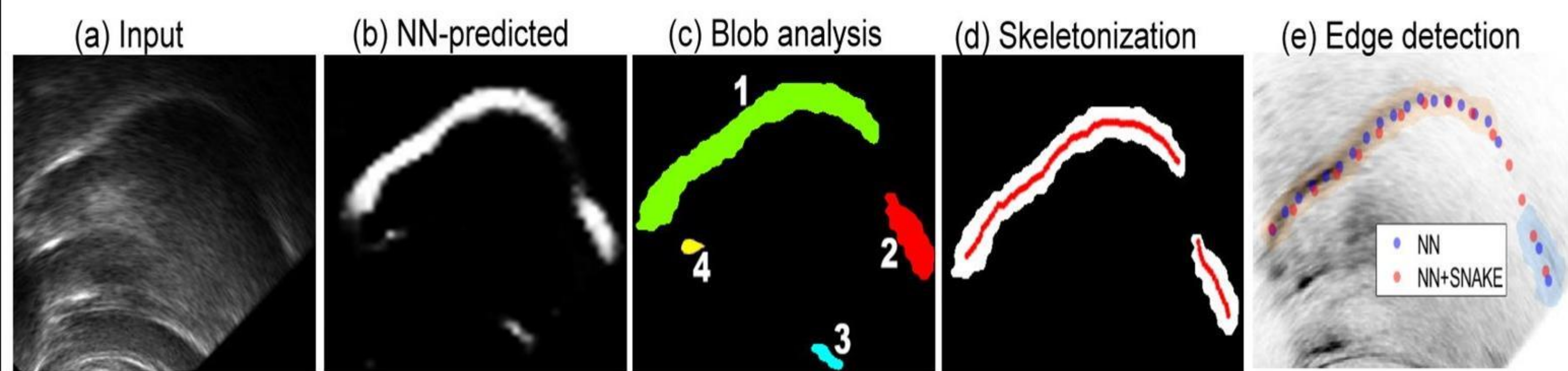


Introduction 1

- DeepEdge**: MATLAB-based interactive tool for **automatic ultrasound tongue contouring**, using **deep neural network** and **edge detection**.
 - Recent improvements in methods of ultrasound imaging (USI) contouring:
 - Edge detection/tracking algorithms (ET)**.
 - e.g., EdgeTrak (SNAKE-based edge detection) (Li et al, 2005), SLURP (Laporte & Menard, 2018), etc.
 - Requires “seeds” near true edge; Heavily affected by noise; Error increases as frame proceeds.
 - Deep learning (neural network) model (NN)**. (a.k.a. Artificial Intelligence, AI)
 - e.g., Convolution Neural Net (CNN) (Zhu et al., 2018)
 - Requires large (human-labelled) training samples.
 - Poor spatial resolution (e.g., 128x128 pixel in Zhu et al. 2018)
 - We combine both:
 - **NN**: determine broad region of interest (ROI) in low resolution.
 - **ET**: refine the edge within ROI in high resolution.
- We have presented part of the algorithm at ASA San Diego (Chen et al, 2019)
 Here we present the software (GUI)

Method 2

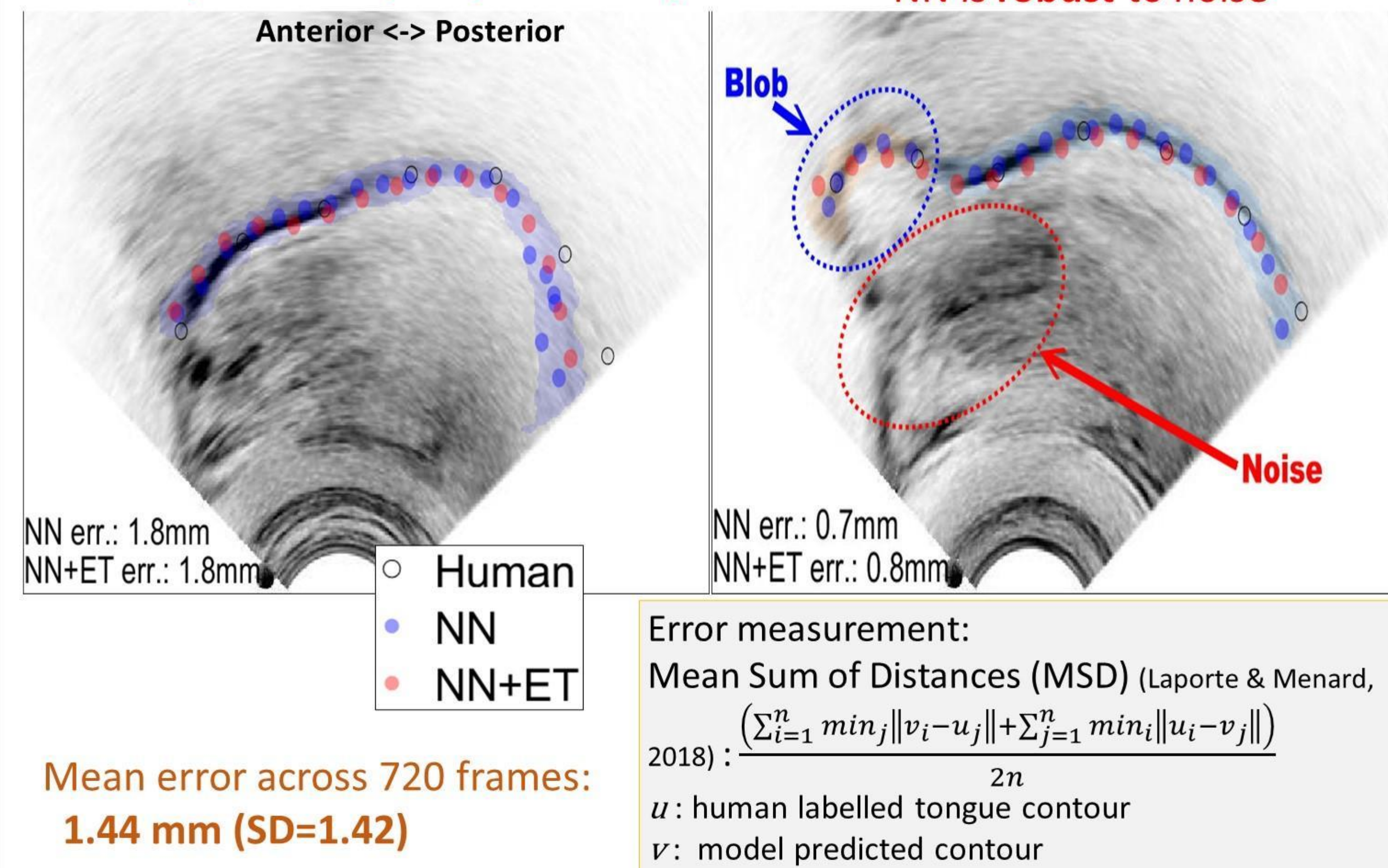
- Training data**: Manually contoured 2189 US images. (Kim et al., 2019) (Diphthongs in Japanese, Korean & Mandarin.)
 - Test data**: Manually contoured 720 US images (Whalen et al., 2019). (Russian CVC syllables.)
- STEP 1: Train NN model: U-Net (Ronneberger et al., 2015) (CNN-based NN architecture commonly used in medical image contouring) Image down-sampled to 64x64.
 STEP 2: Blob detection (ROI): Retain blobs >20% of largest blob.
 STEP 3: Skeletonization (medial line along ROI).
 STEP 4: Up-sample then SNAKE edge detection (taken from SLURP).



Accuracy Evaluation 3

SNAKE improved output qualitatively.

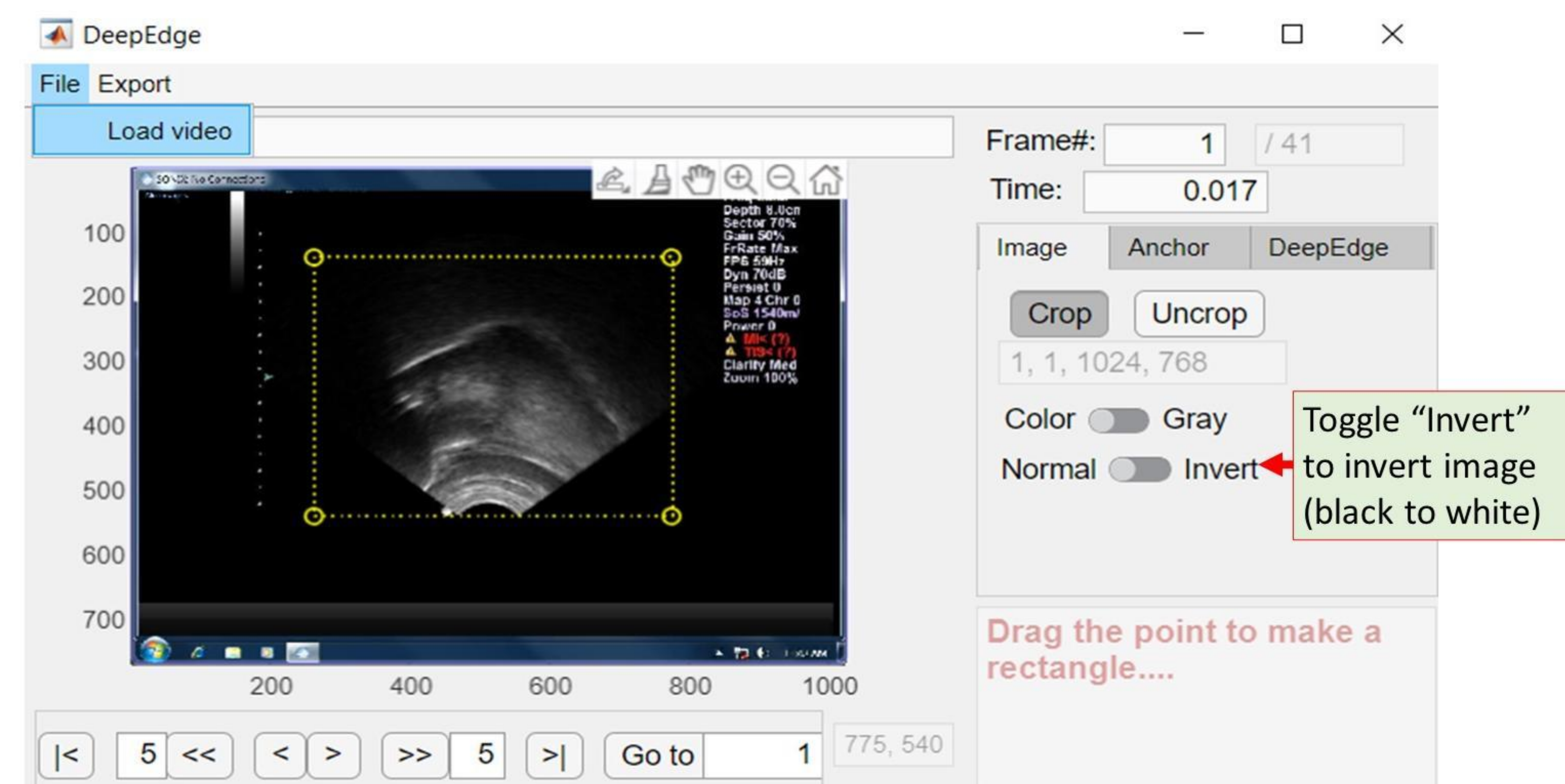
NN is robust to noise



Software – Load video & crop 4

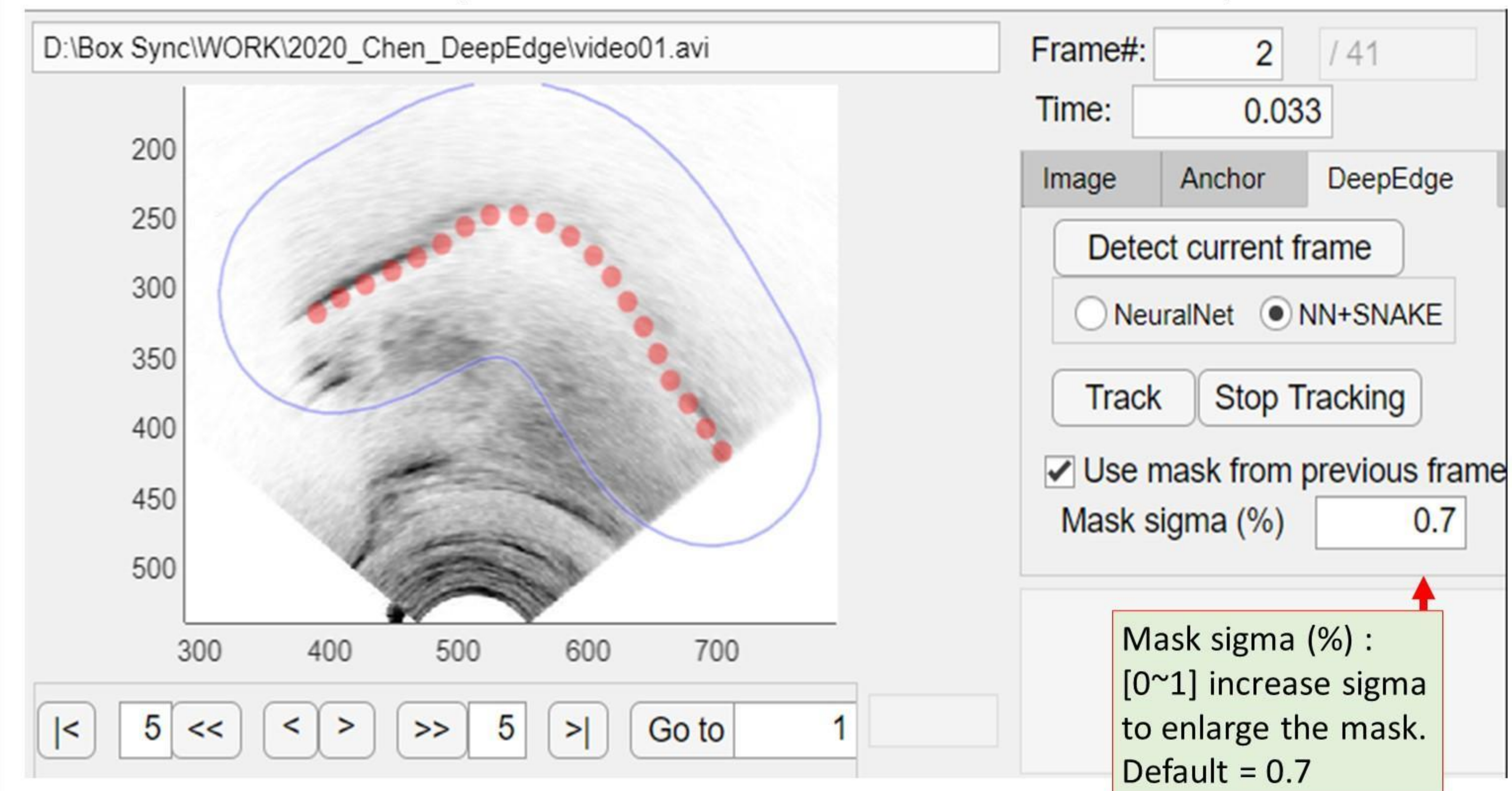
Requirements: MATLAB R2018b or newer.

- File -> Load video.
- Crop image: Image tab -> Click “Crop” (actually only changes the view)
 Click on image & drag to select area contains only tongue contour (very important).



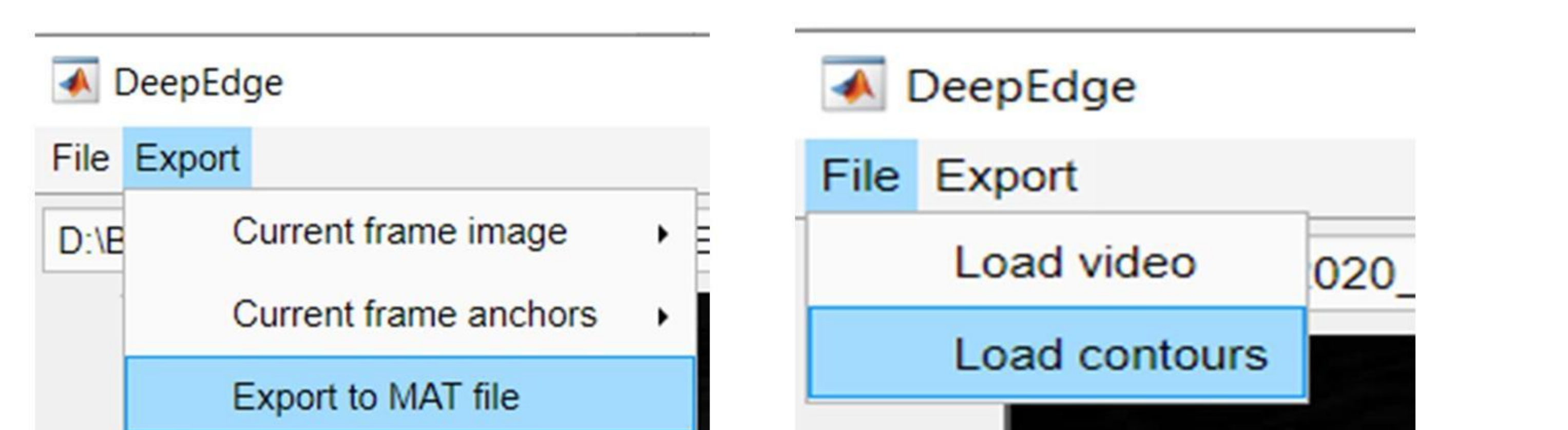
Software - Track 5

- In “DeepEdge” tab, select “NeuralNet” only or “NN+SNAKE”.
- Click “Detect current frame” to detect tongue edge for this frame.
- Click “Track” to continuously detect all the following frames.
- Check “Use mask from previous ...” to restrict search area based on previous contour.



Software – Import & Export 6

- Click “Export” -> “Export to MAT file” to save the result (same file name and folder with the video).
- Click “File” -> “Load contours” to import previously saved contour .mat file.



- The saved contours can be imported into *GetContours* (Tiede, 2018) and then edit.
- Contours can be converted to text file by *GetContours*.



DOWNLOAD: <https://github.com/WeirongChen/DeepEdge>

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