GETTING A NETWORK FILE FROM A SKELETONIZED IMAGE

AIDAN BROWN

Laura and Gia have provided skeletonized images of the ER, Fig. 1 is an example. The idea is to get a network file we can use in the particle diffusion program from the skeletonized image.
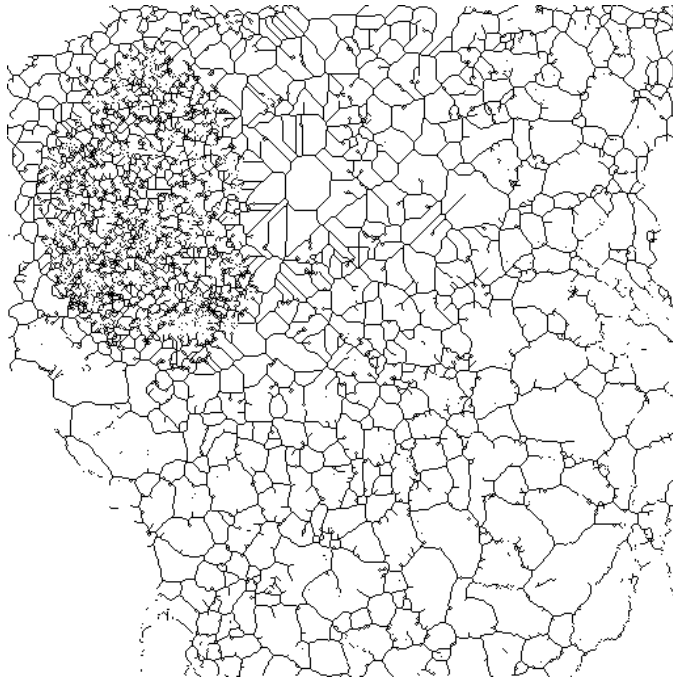

FIGURE 1.

Open this image in FIJI. From the Analyze menu, select Skeleton → Analyze Skeleton (2D/3D). From the options that come up, click Show detailed info, and then click OK. A window called Branch information pops up with columns containing the detailed information about the branches in the skeletonized image. Copy this table into a text editor and save it.

The text file has 13 columns, with each column containing data about a single branch or 'edge.' Columns 4, 5, and 6 contain the x, y, and z positions of one end of the edge, while columns 7, 8, and 9 contain these positions for the other end of the edge. Column 3

Date: February 16, 2018.

contains the Branch length, which I assume is the contour length of the edge. Column 10 contains the Euclidean distance between the two ends of the edge.

My program pulls out the xyz coordinates of both ends of each edge. If these are the same, then I discard the edge. All edges that end in a different position than they begin are collected and these xyz positions for the edge ends are printed to a new file (for some reason FIJI calls the top of the image y=0 and the bottom of the image y>0, so I flip these to get the images to look the same).

My program then compares all the edge-end coordinates to label each node (with an integer list), so that nodes with multiple edges are not listed twice (if they are within a distance of 0.001, only one node is kept). The edges are then also labelled with an integer. The edges alone are shown in Fig. 2, while the edges with the nodes indicated are shown in Fig. 3.
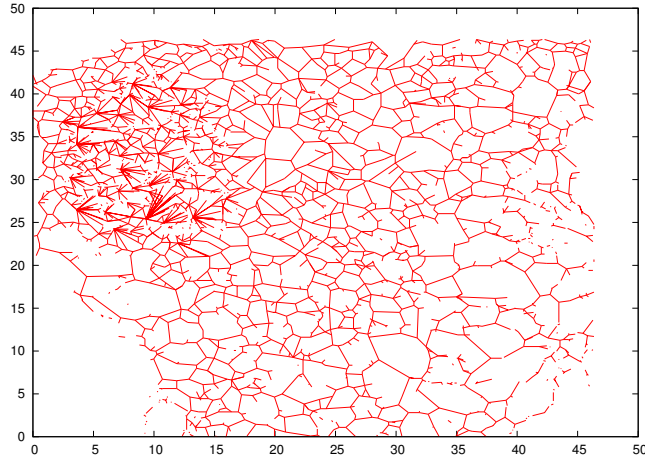

FIGURE 2.   All the edges FIJI finds from the skeletonized image of Fig. 1.

All the nodes in Fig. 3 are not connected to all other nodes by edges. The program then finds all nodes connected by edges to an initial seed node. These connected nodes, and all edges attached to these connected nodes, are shown in Fig. 4 on top of all nodes, allowing the unconnected nodes and edges to stand out.

The program then prints the list of nodes and edges to file in the format needed for the particle diffusion program.

For now I have ignored the branch length extracted by FIJI from the skeletonized image because the diffusion simulation program has edge lengths that are the distance between nodes, and does not handle other edge lengths right now.

My program also assumes that the network the zeroth node is connected to is the largest network. This could be improved by evaluating all networks and keeping the largest.
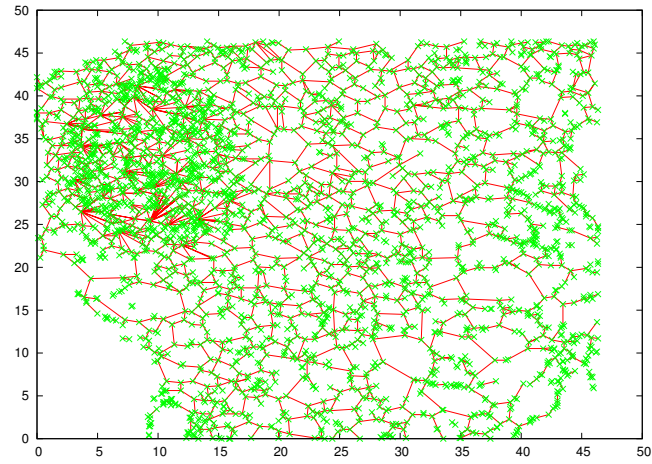
FIGURE 3. All the edges (red) FIJI finds from the the skeletonized image Fig. 1, and nodes the edges join to (green).
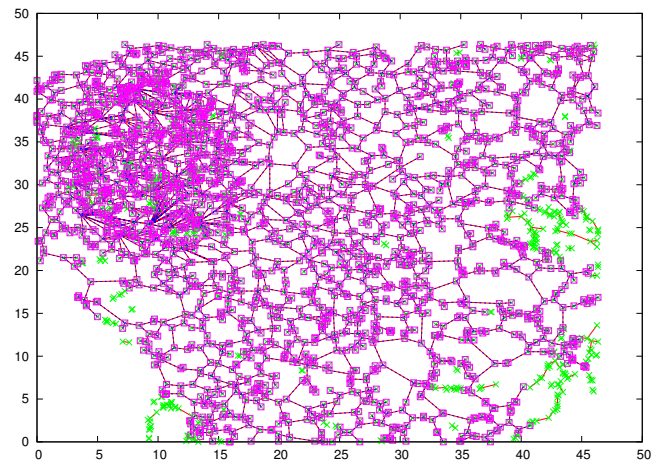

FIGURE 4. Connected edges (blue) and nodes (purple), along with unconnected edges (red) and nodes (green).