PROCEDURE

1. Take the SEM image of the microstructure in .pgm format.
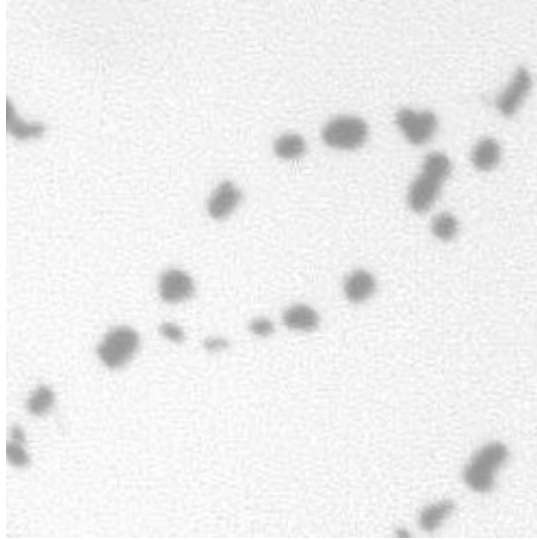

Fig. Grayscale micrograph

2. Use the **/img_to_ell/threshold** tool to convert the .pgm image into a black & white .pgm image containing the inclusions.

Fig. B&W micrograph

3. Use an image editor to open the black & white image from Step 2 and save it as a B&W (dithered) .pbm image. The despeckle algorithm of the image editor can be used to smooth the edges of the particles.

4. Use the **/img_to_ell/img-to-ell** tool to analyze the .pbm image and produce a random1.dat file, which describes the inclusions in a simple format to be used by the mesh generator.
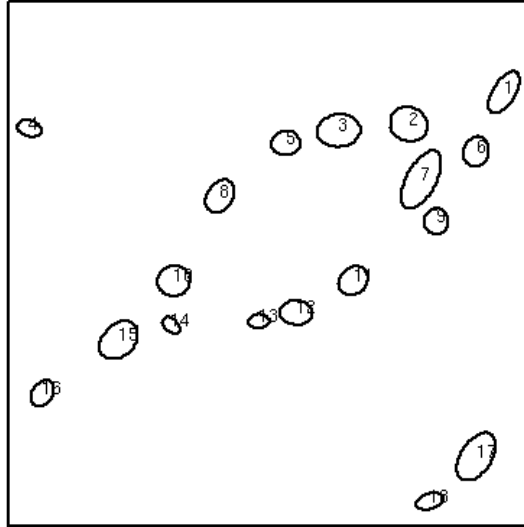

Fig. Inclusions plot from random1.dat file

5. To plot the inclusions described in the random1.dat file, use the MATLB program **/img_to_ell/plotell/plot_ell_dat.m**

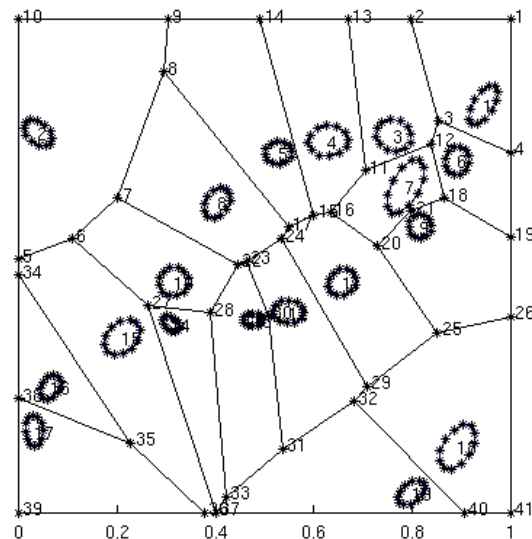6. Use **/meshgen/mesh** to read the random1.dat file and create a preliminary VCFEM mesh in the file vchomo.inp.

Fig. Plot of vchomo.inp mesh file.

7. This vchomo.inp file is used as a input for the **/meshgen/add_node** tool to add more nodes in the mesh. The new output file is finalmesh.inp

Note 1: Make any relevant changes to the geometry of the mesh in vchomo.inp before using add_node to create the final mesh.

Note 2: The source code in meshgen/add_node.f90 can be changed to output custom material properties and to control the number of nodes added to the preliminary mesh.

8. The file **/meshgen/plot_mesh.m** is a MATLAB script that can be used to plot both the vchomo.inp and the finalmesh.inp VCFEM mesh.

9. Copy the finalmesh.inp file to the simulation directory and run the simulation.

10. The EQV_CURVE.dat file generated by the simulation has the equivalent stress-strain curve.

11. Use **/postproc/extract/extract_m2** to extract the data from the results_un.dat file generated by the simulation to create two new files: matrix.dat and inclusion.dat.

    Note: For executing the extract_m2 tool, use /postproc/extract/extract_m2

12. Use /**postproc/contour/** to create contour plots from matrix.dat and inclustion.dat

    Usage: vtkpython CMRL.py

    Note: Both the matrix.dat file and the inclusion.dat file must be inside the "/postproc/contour/" folder.