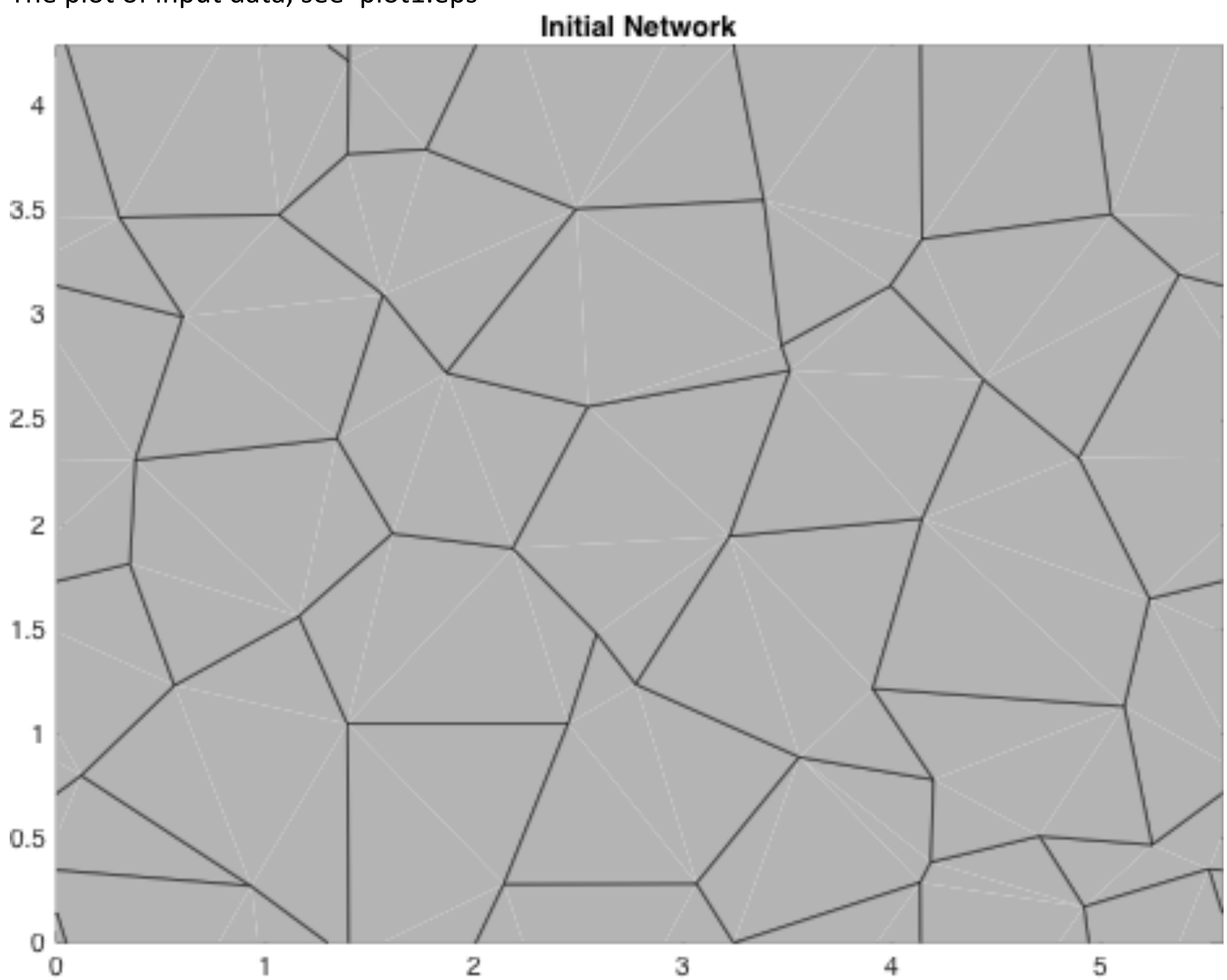
Vertex Model

Dingjue Ji

Minimizing the Vertex Model

1. The plot of input data, see ‘plot1.eps’



2. Verify the energy function:

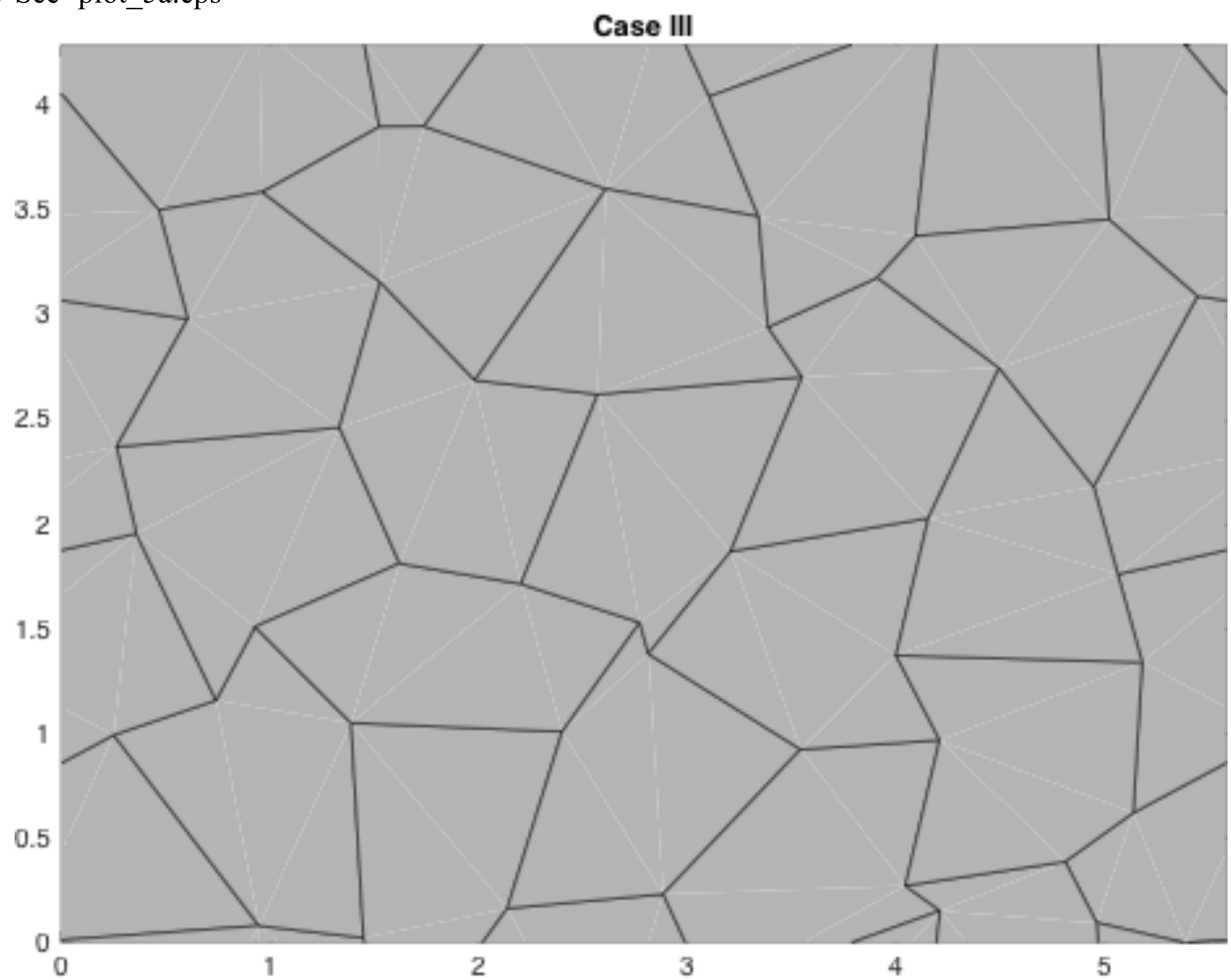
   See ‘vertexenergy.m’.
   Calculate the energy:
   For all parameters equal 1, we only need to check the values
   E_elastic = 0.54859
   E_tension = 50.2365
   E_contractility = 212.158
   These values are consistent with those in the reference

3. See ‘vertexforces.m’.

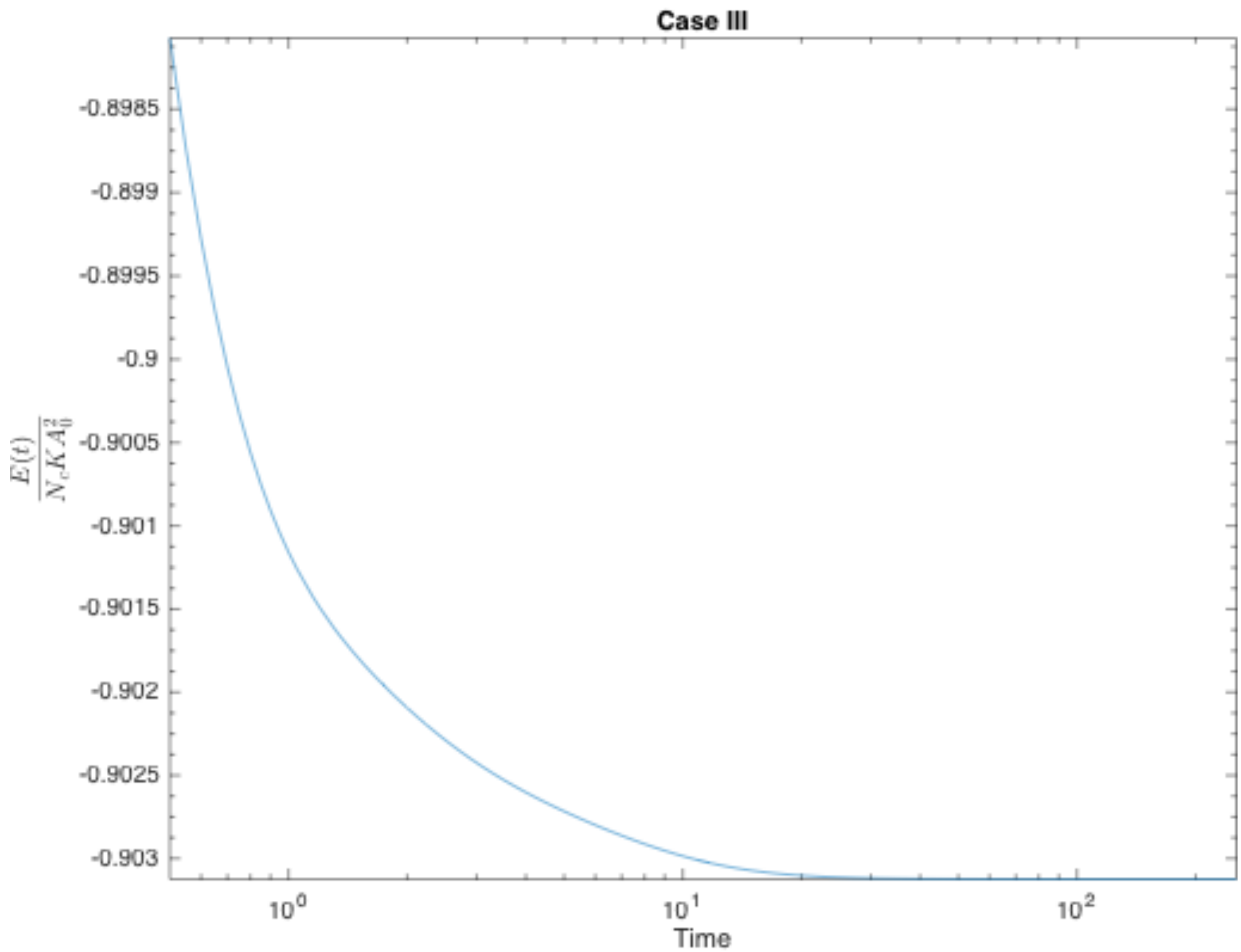
4. Print out the value you get for dE and the value you used for ε.

   dE = 0.99997 with epsilon = 0.000001

5. Case III energy minimization:
   (a) See ‘plot_5a.eps’



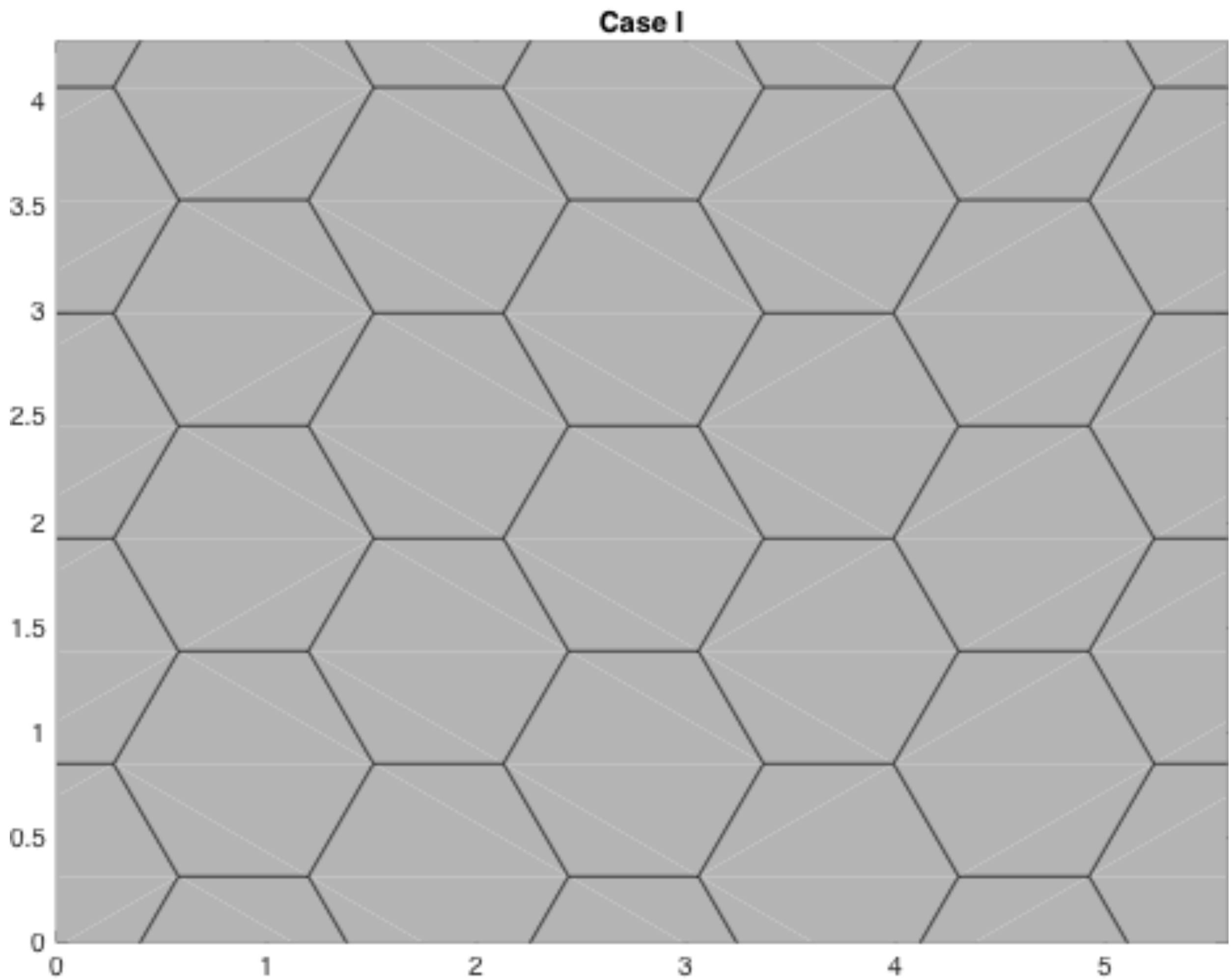
   (b) See ‘plot_5b.eps’



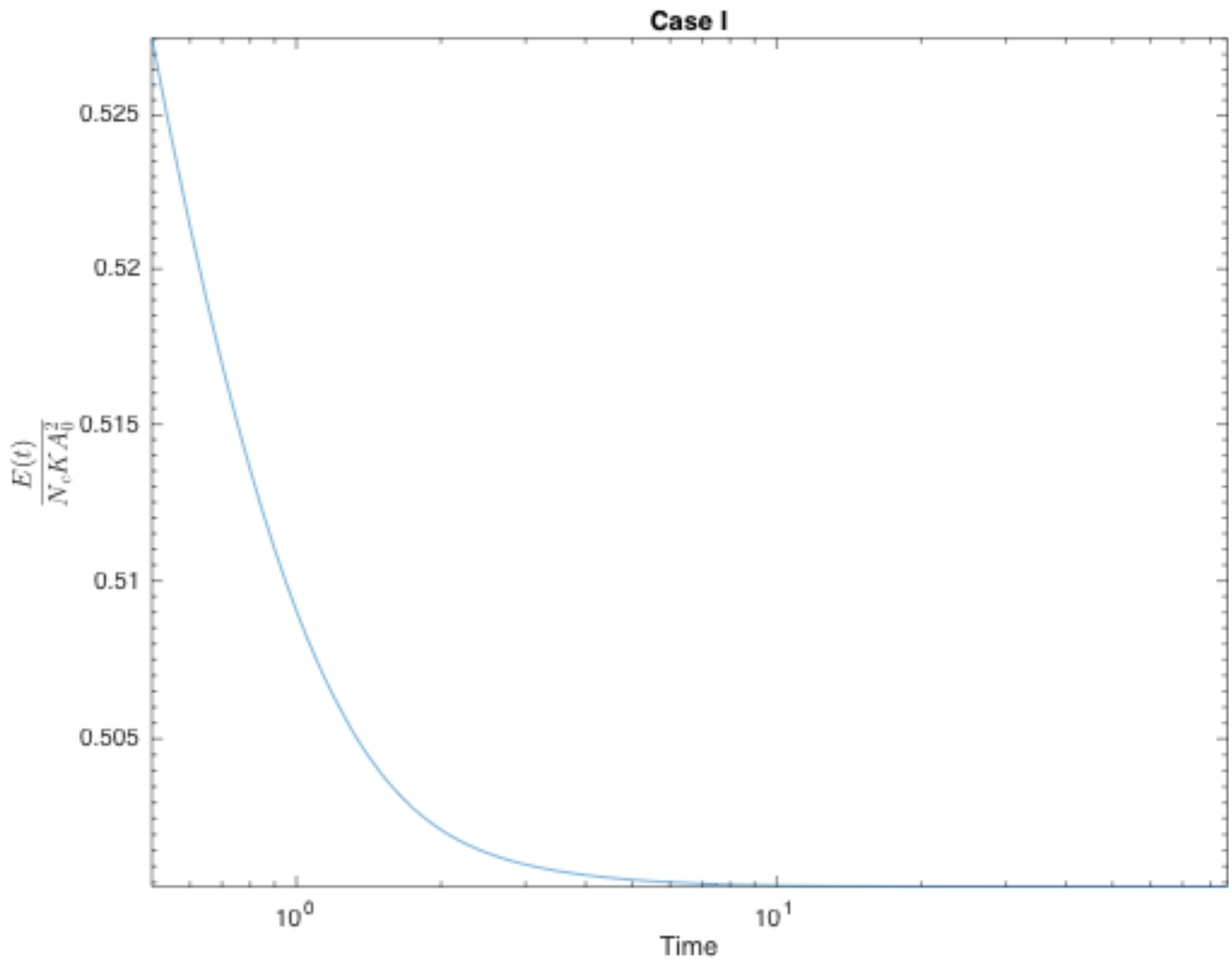
6. To verify the energy of soft network:

   Calculate the energy:
   E_elastic/(Nc*K*A0^2) = 3.125e-08
   E_tension/(Nc*K*A0^2) = 0.22332
   E_contractility/(Nc*K*A0^2) = 0.27706
   E/(Nc*K*A0^2) = 0.50038
   These values are consistent with those in the reference

   (a) Plot of cells, see 'plot6_a.eps':



(b) Plot of energy, see ‘plot6_b.eps’:



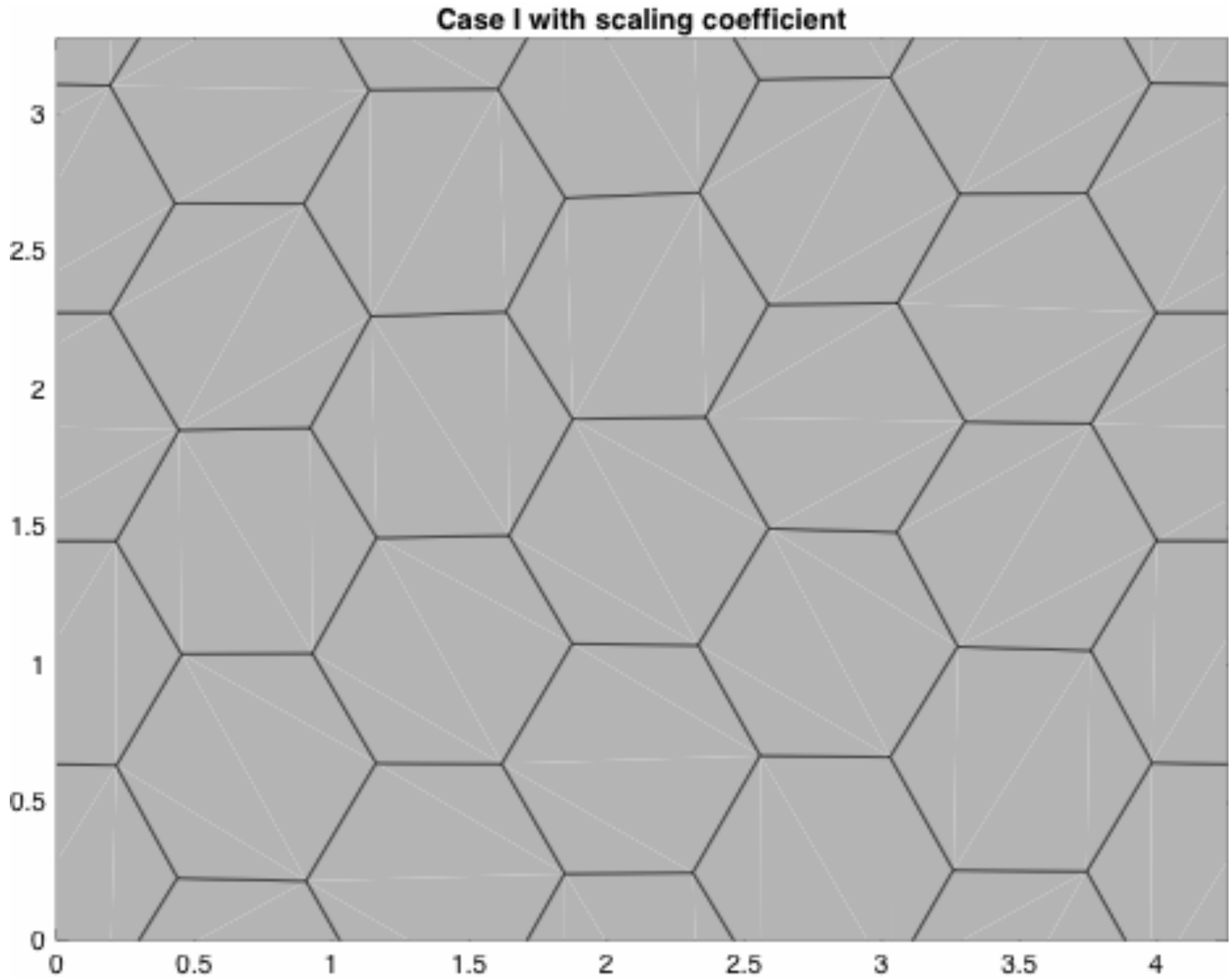
7. Add a barostat to your code.

   See ‘scaleenergy.m’ and ‘scaleforces.m’.

   We will still calculate dE when epsilon and epsilon_L are small enough, namely the ratio of energy increment and the reference calculated increment, which should give a value near 1.

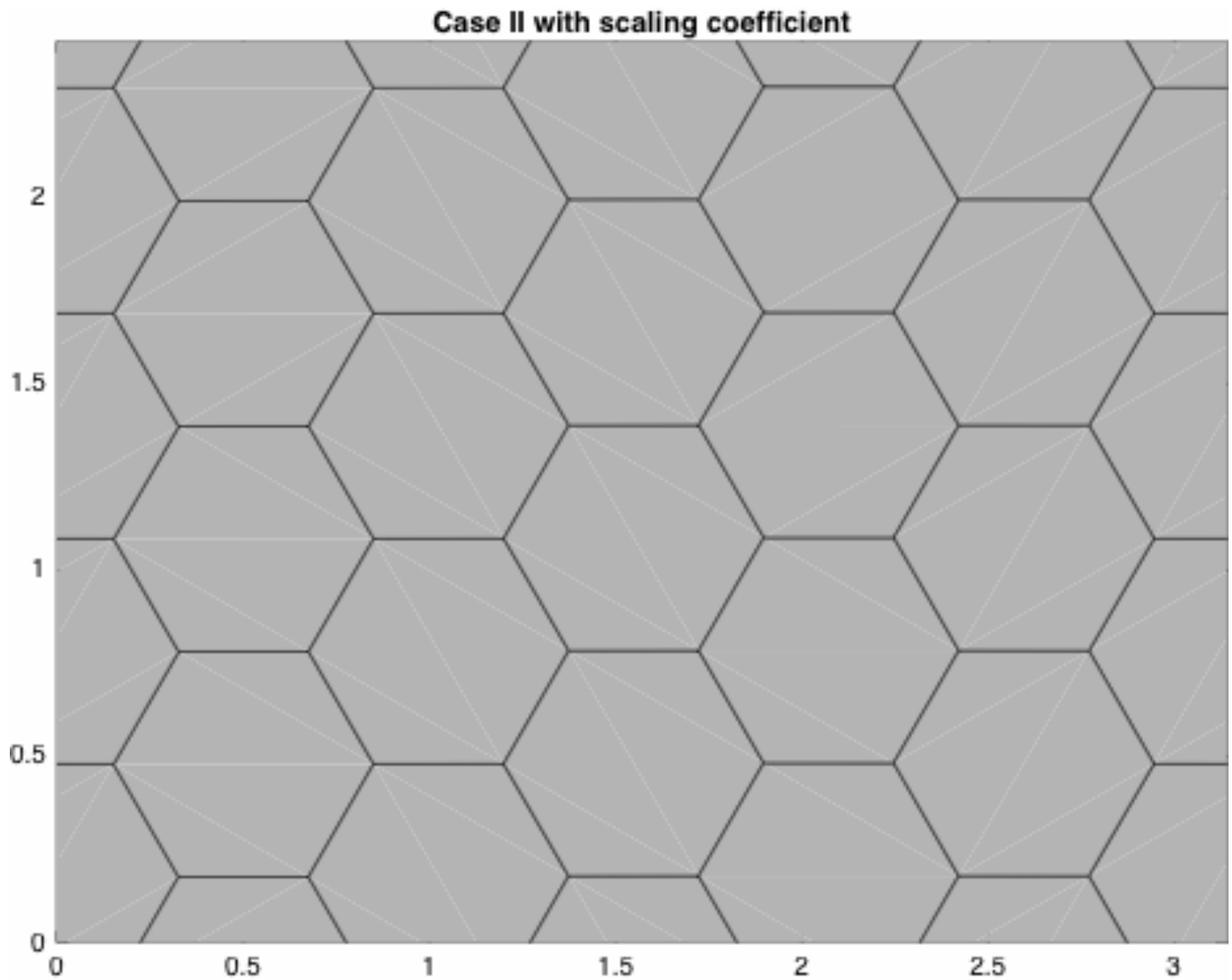
   dE = 0.99724 when epsilon and epsilon_L are 0.00001

   Case I:
   It is minimized into hexagons.
   Calculate the energy:
   E/(Nc*K*A0^2) = 0.41912
   This value is consistent with that for case I in the reference



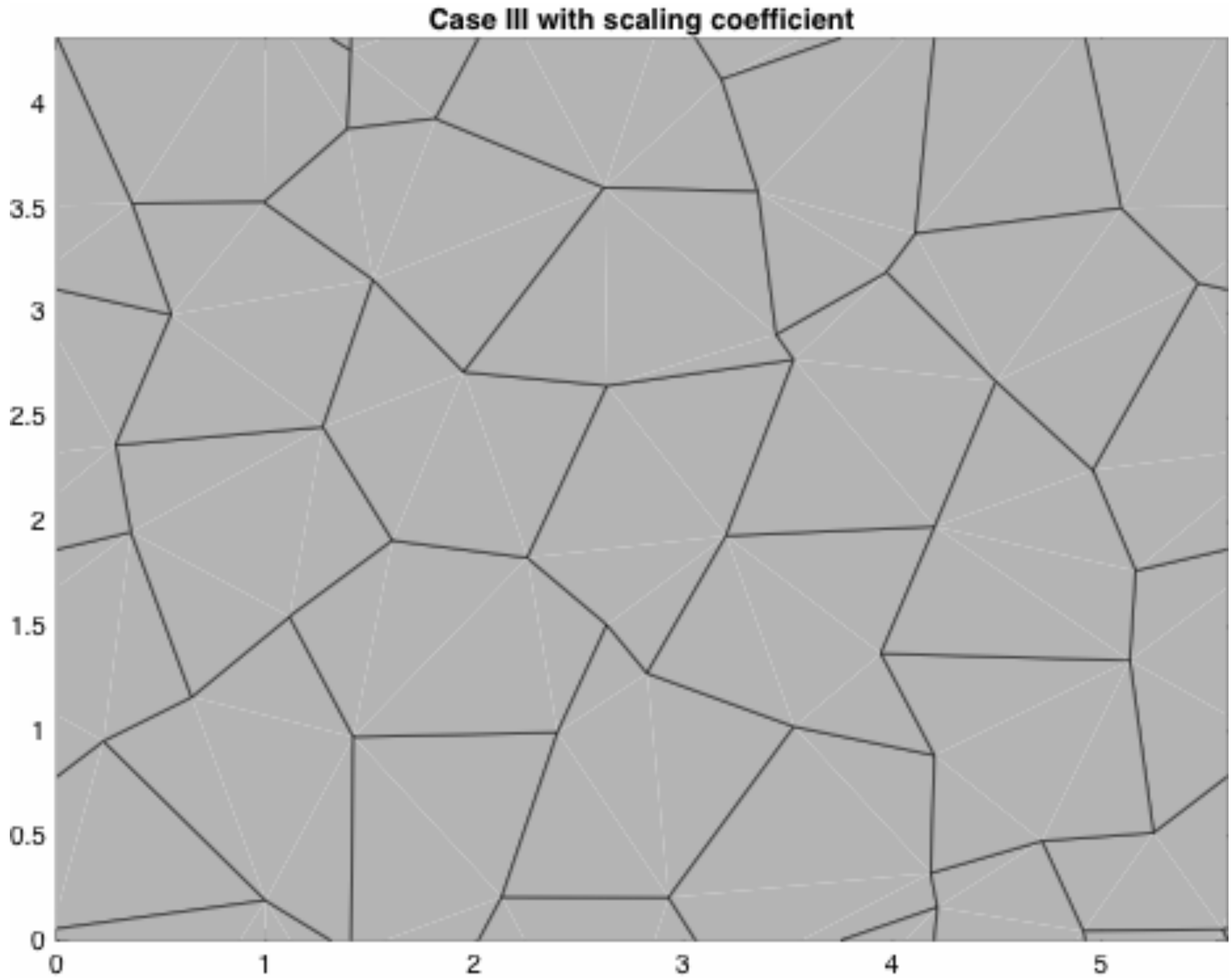
Case II:

It is minimized into hexagons.
Calculate the energy:
E/(Nc*K*A0^2) = 0.45287
This value is consistent with that for case II in the reference.



Case III:

It is not minimized into hexagons.

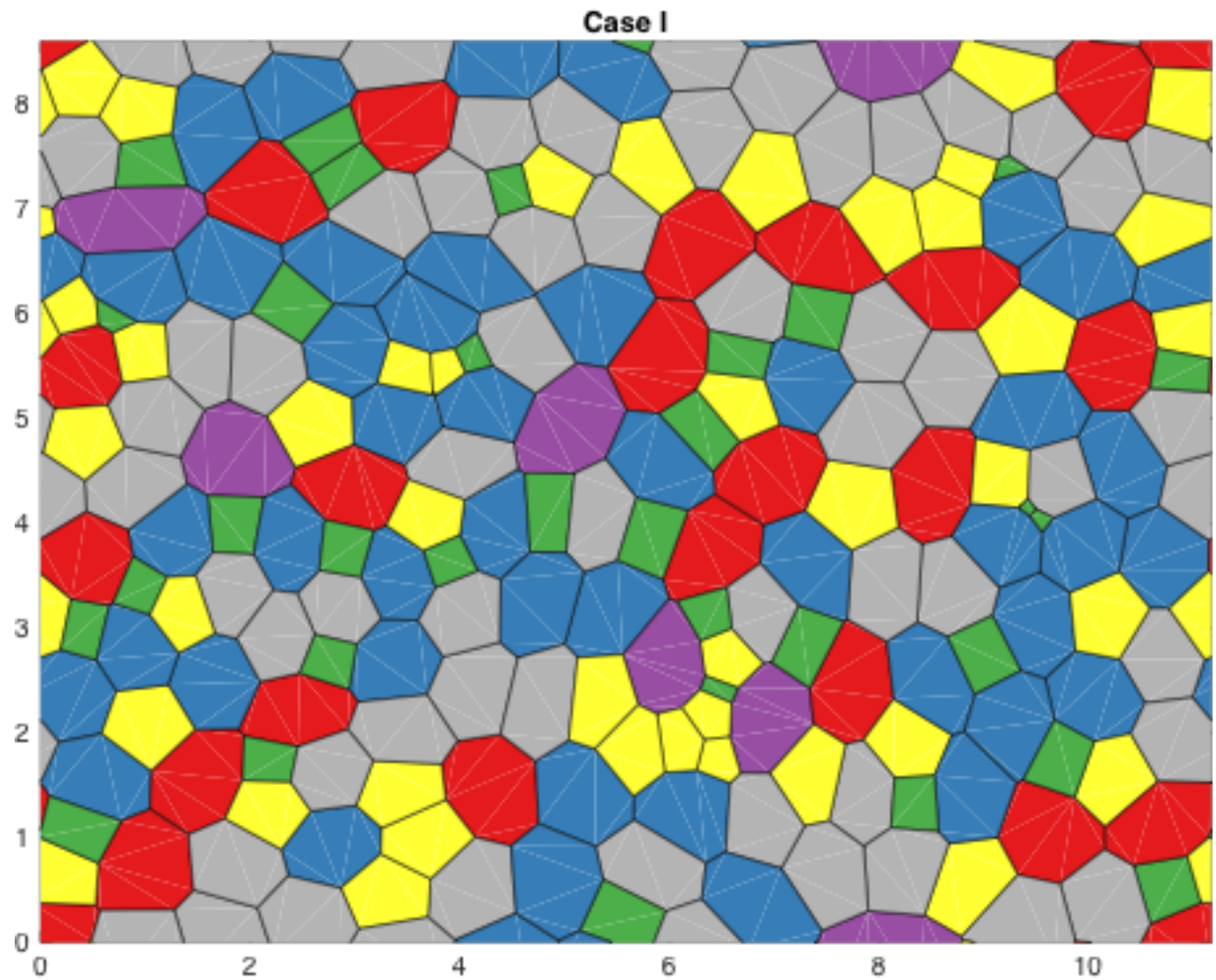


8. See ‘celldiv.m’

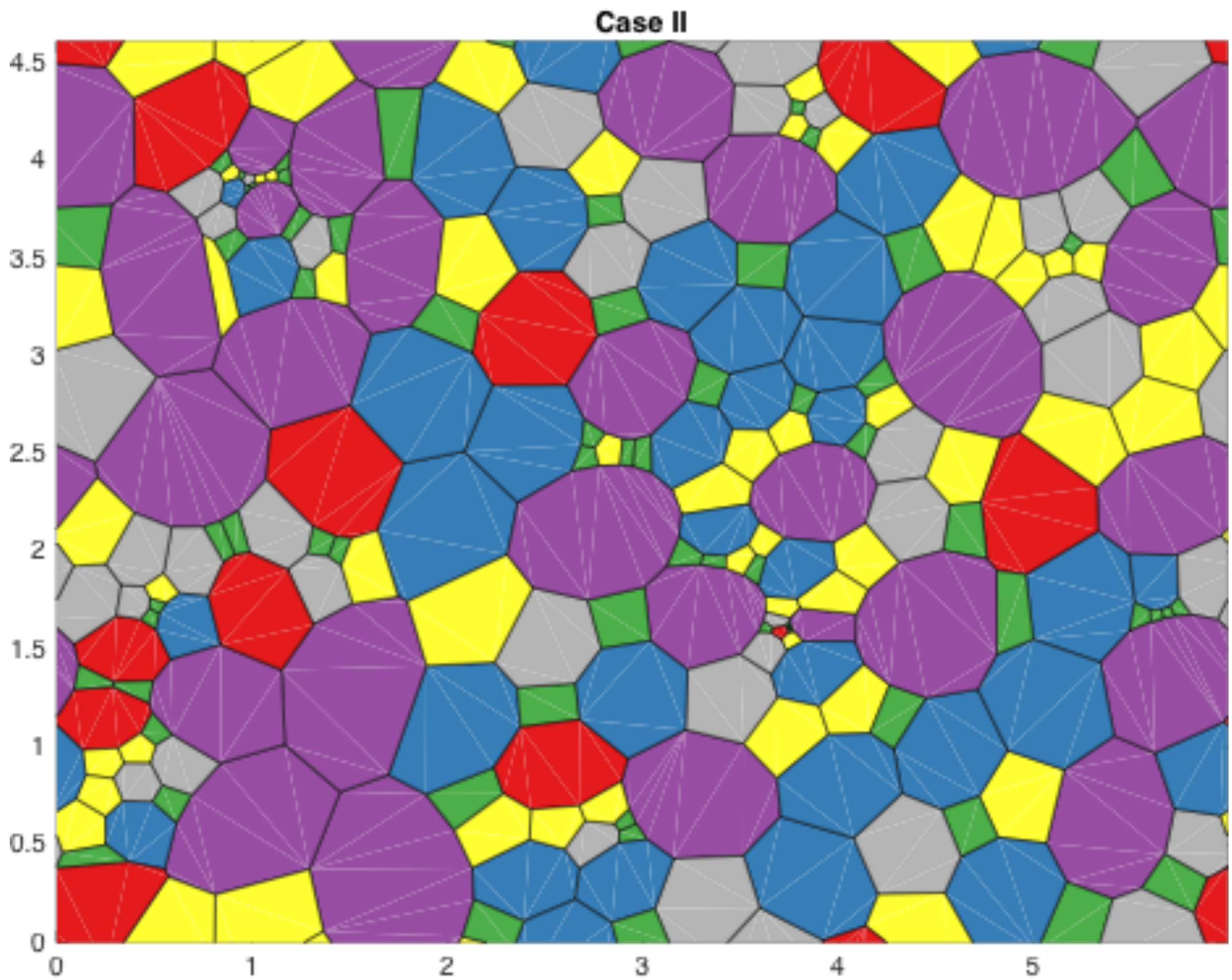
9. See ‘Case I’, ‘Case II’, ‘Case III’ section following ‘full operation’.

10. 360 divisions were adopted.

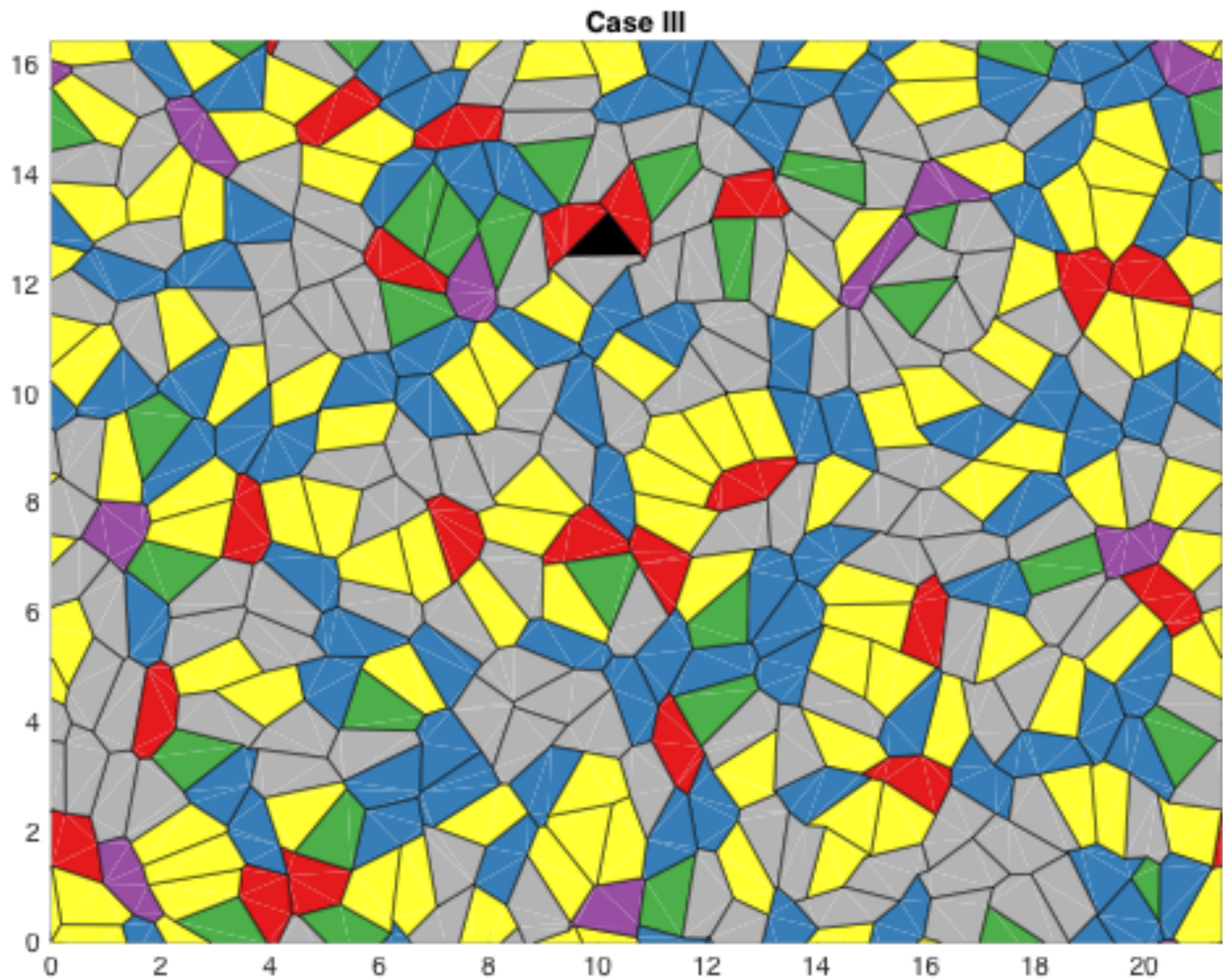
    Case I (see ‘full_model_case I.eps’):



Case II (see ‘full_model_case_II.eps’):

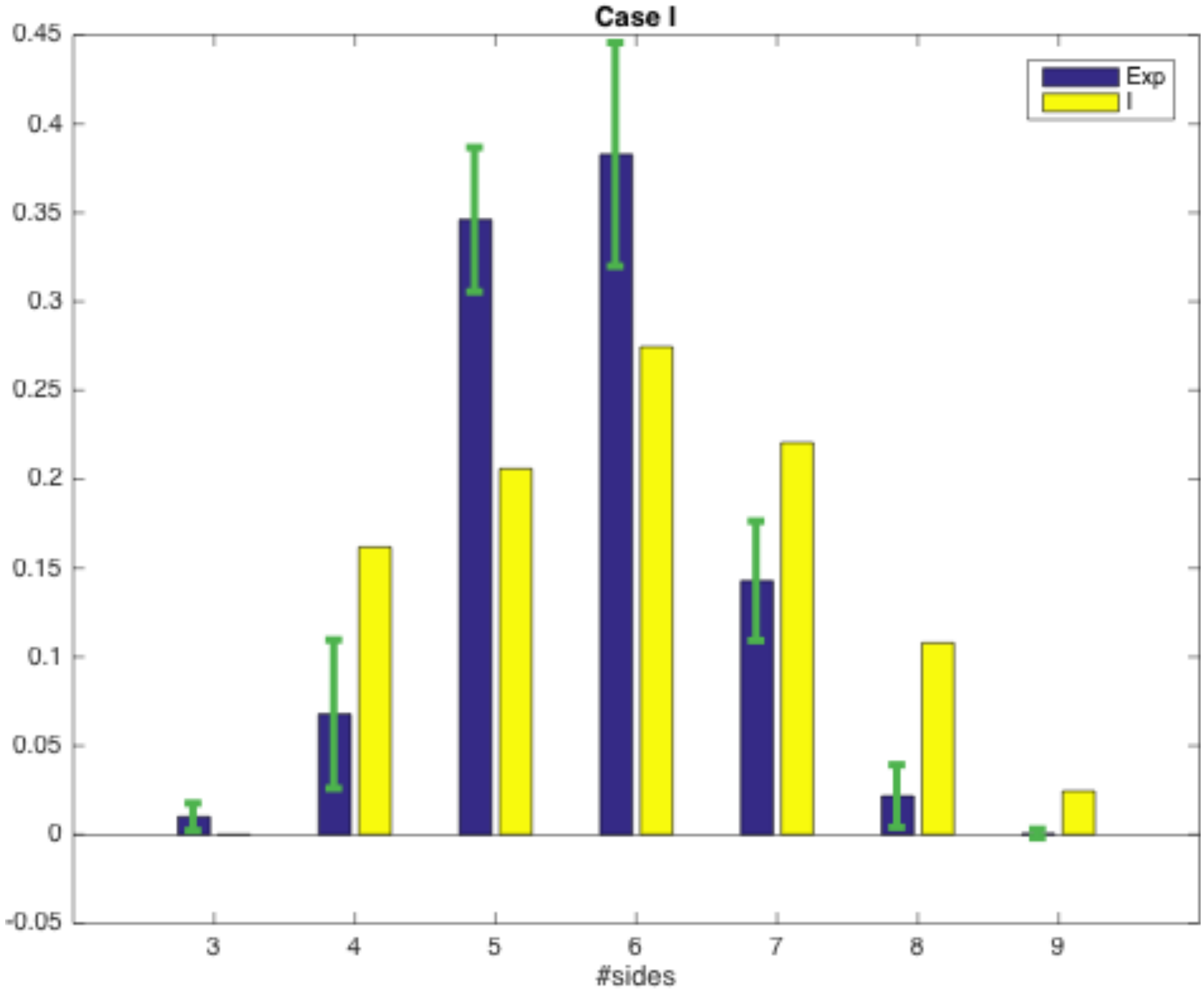


Case III (see 'full_model_case_III.eps'):

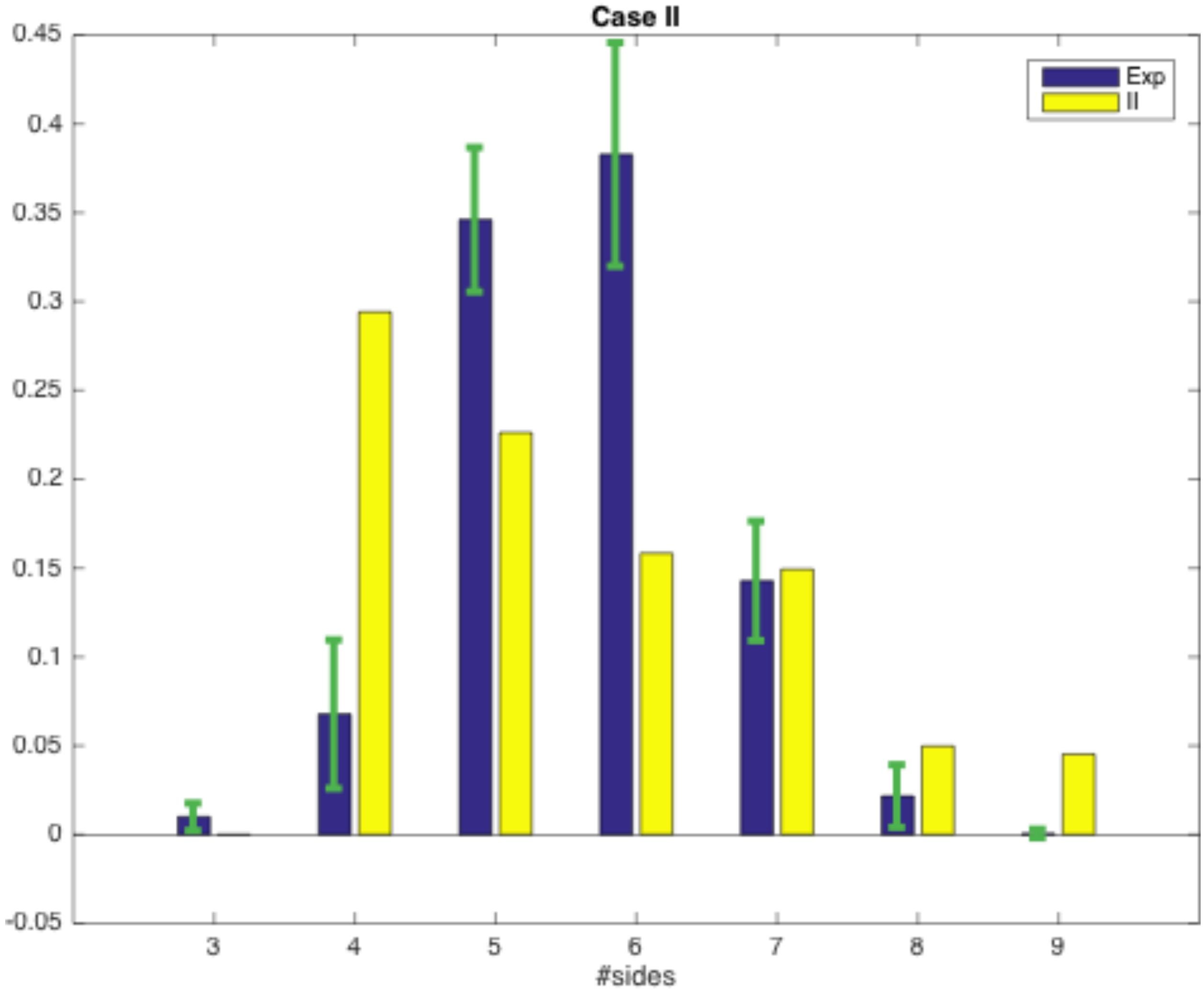


11. Histogram of #sides for each cell

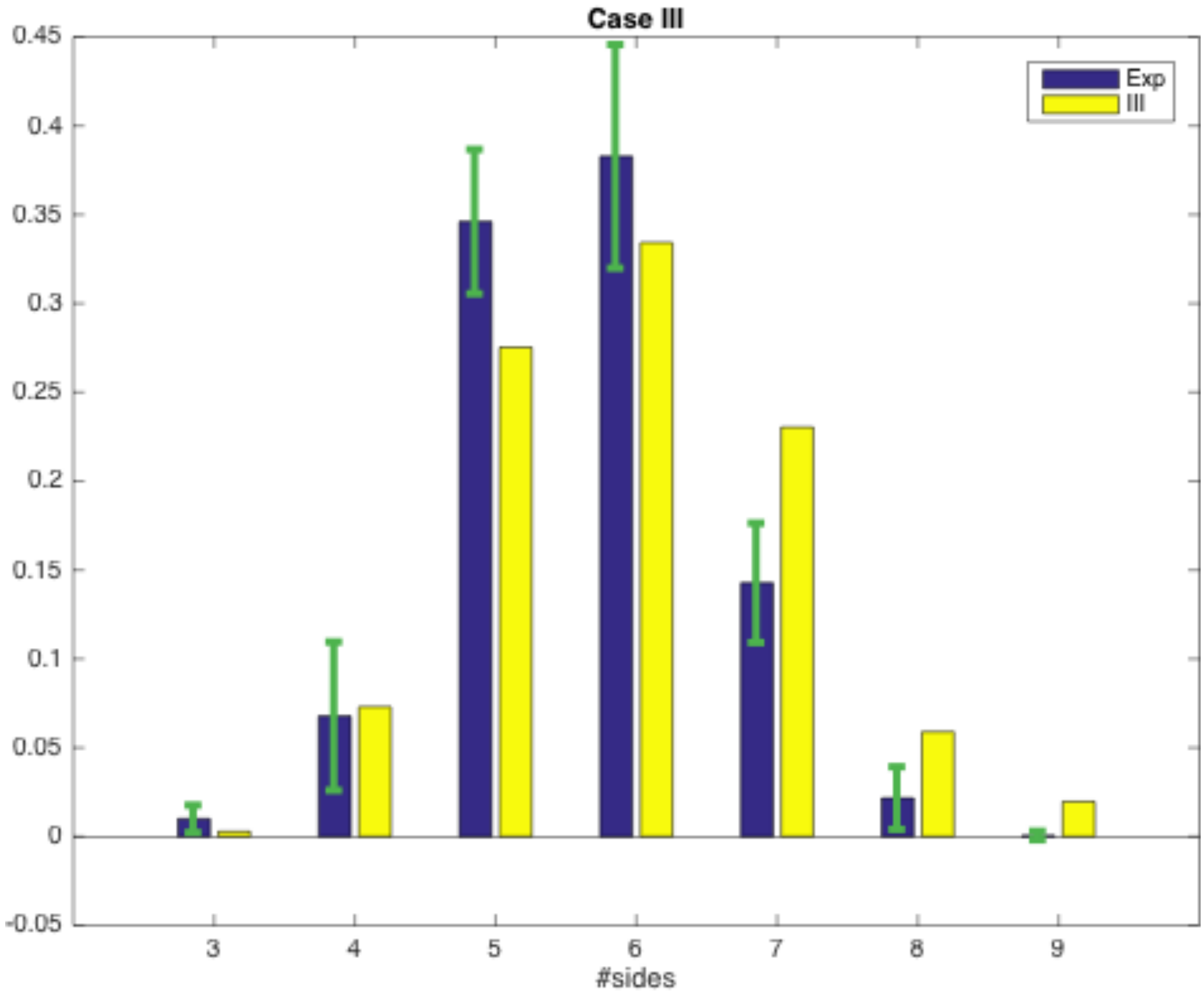
Case I (see ‘hist_case_I.eps’):



Case II (see ‘hist_case_II.eps’):

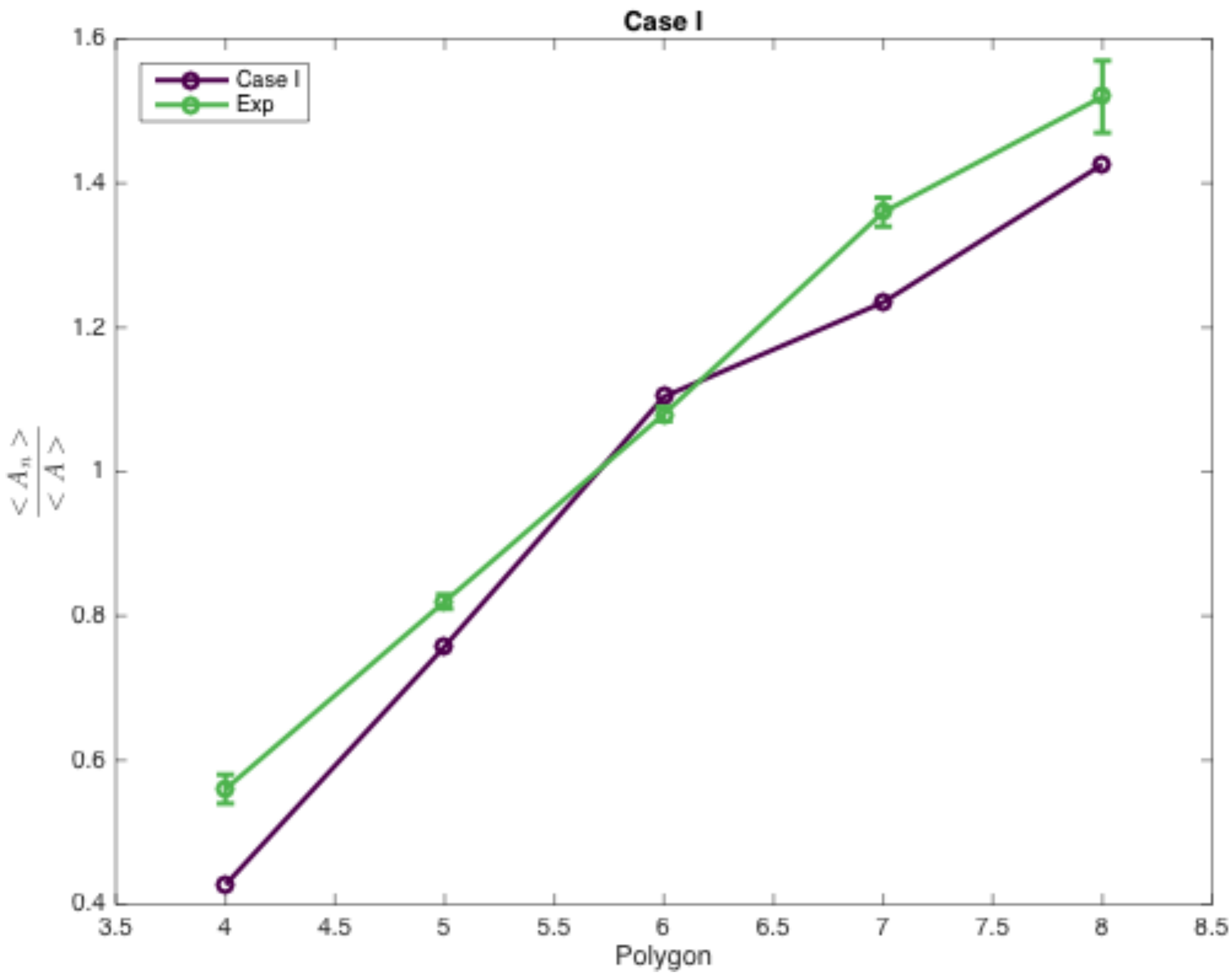


Case III (see ‘hist_case_III.eps’):

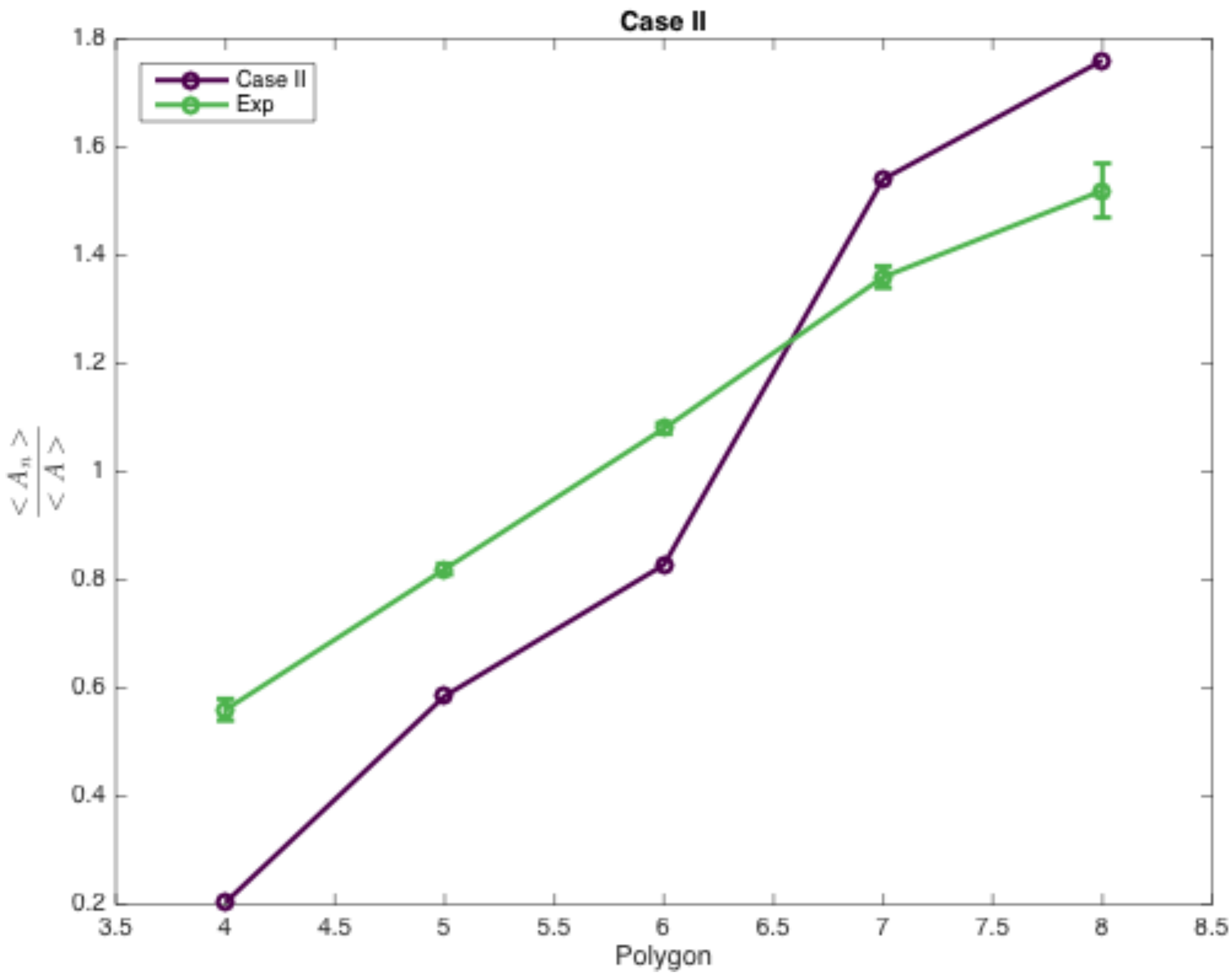


12. Calculate the relative area of polygons

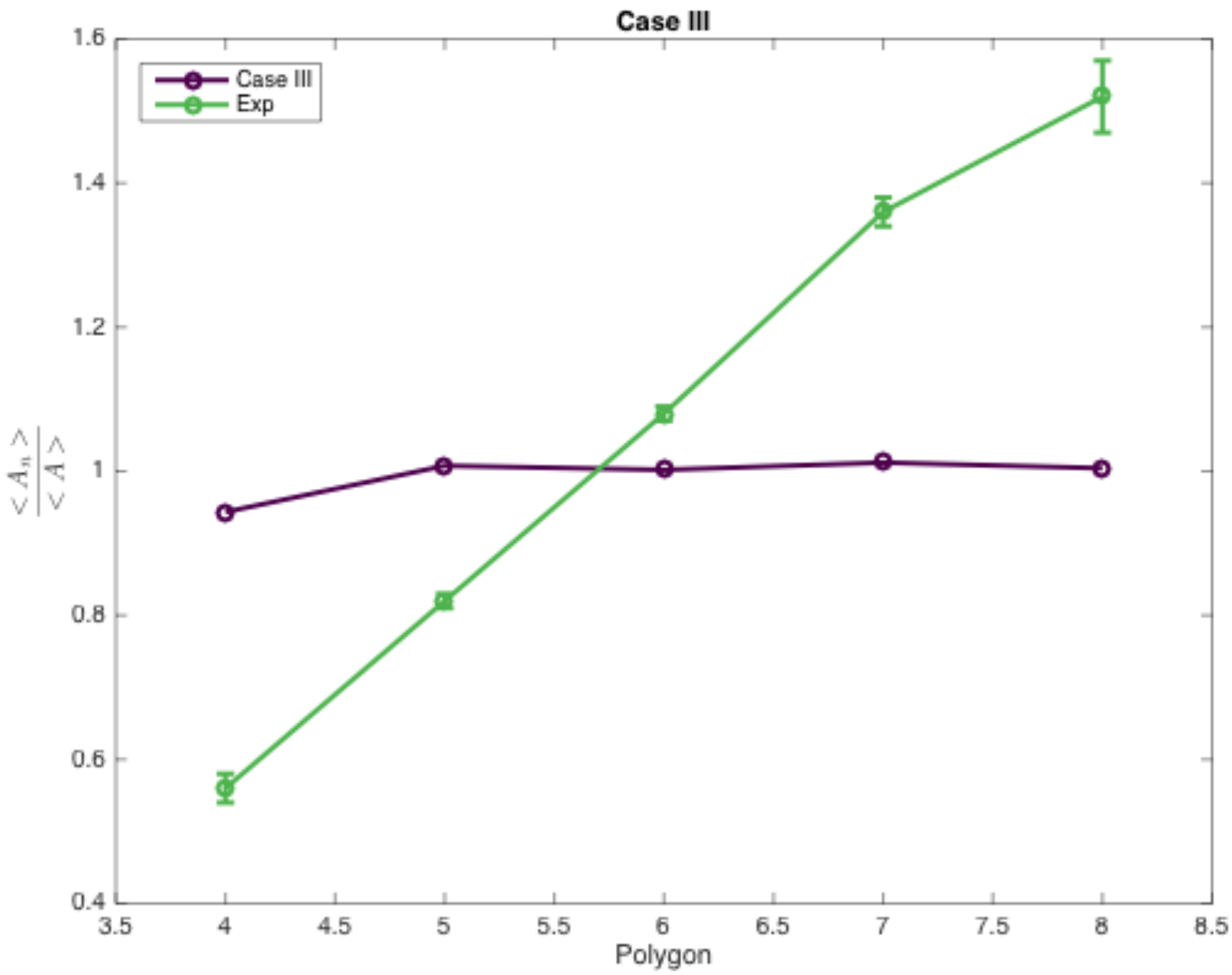
Case I (see ‘area_case_I.eps’):



Case II (see ‘area_case_II.eps’):



Case III (see ‘area_case_III.eps’):



13. Calculate the shape index

    p0 of Case I = 3.8835
    p0 of Case II = 3.9407
    p0 of Case III = 4.3002
    Based on the calculated value, all these cases are more likely to be fluid, because they are greater than 3.81.
    in these cases, Case I seems to be a little glassy, and Case II and Case III are more fluid-like.
    Compared with the target shape index, an increasing pattern of case shape index along with the increase of target shape index.

Acknowledgement:
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Thanks for your efforts. I feel really happy to receive these trainings both from this course and your lab.
Hope everything goes better and better for all of you!