

Physics 7653: Statistical Physics
<http://www.physics.cornell.edu/sethna/teaching/653/>
Material for Week 4
Exercises due Tuesday Sep 19
Last correction at September 18, 2017, 3:25 pm
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Pre-class Preparation

Papers can be downloaded from the book Web site [1], or from links in the pdf version of these exercises <http://pages.physics.cornell.edu/~sethna/teaching/653/HW/ps04.pdf>.

Thursday

Read: [Fracture strength of disordered media: Universality, interactions and tail asymptotics](#), Claudio Manzato, Ashivni Shekhawat, Phani K. V. V. Nukala, Mikko J. Alava, James P. Sethna, and Stefano Zapperi, *Phys. Rev. Lett.* **108**, 065504, 2012; see [Physicists predict when brittle materials fail](#) in the Cornell Chronicle (Anne Ju).

Failure of extreme value statistics. This paper shows that extreme value statistics (EVS, commonly used by engineers to estimate fracture failure probabilities) is a poor description for the failure of a fuse network model with disorder given by random missing bonds. We have seen that EVS can be viewed as a renormalization group, which involves a coarse-graining and a rescaling step. Which step of the renormalization group failed? Could one imagine a different rescaling that would lead to a DLB fixed-point? (Submit electronically by 9:30 Wednesday evening.)

Tuesday

Read: [“From damage percolation to crack nucleation through finite size criticality”](#), Ashivni Shekhawat, Stefano Zapperi, and James P. Sethna, *Physical Review Letters* **110**, 185505 (2013). See also [“The Breaking of Brittle Materials”](#) by Elisabeth Bouchaud and [“Shattered glass: New theory explains how things break”](#) in the Cornell Chronicle by Anne Ju.

Singular corrections to scaling. Notice in Fig. 2(c) that the ‘scaling collapse’ does not collapse. How do the authors explain this? Do you find the explanation convincing? Even so, can we ignore these large finite-size effects in an experiment? (Submit electronically by 9:30 Monday evening.)

Exercises

12.3: Nonlinear flows, analytic corrections, and hyperscaling.

12.4: Beyond power laws: Nonlinear flows and logarithms in the 2D Ising model.

12.22 (12.9): Period doubling and the renormalization group.

References

- [1] Sethna, J. P. and Myers, C. R. (2004). *Entropy, Order Parameters, and Complexity* computer exercises: Hints and software. <http://www.physics.cornell.edu/sethna/StatMech/ComputerExercises.html>.