Abstract Submitted
for the MAR08 Meeting of
The American Physical Society

Image Segmentation in Linear Time using the Potts Model
FRANK W. BENTREM, Marine Geosciences Division, Naval Research Laboratory, Stennis Space Center, Mississippi 39529 — A computational method is described which efficiently segments digital grayscale images using the Q-state Ising (or Potts) model. Since the Ising model was first proposed in 1925, physicists have studied lattice models to gain deep insights into ordered/disordered systems. Some researchers have realized that digital images may be modeled in much the same way as these physical systems (i.e., as a square lattice of numerical values). A major drawback in using this technique for image segmentation is that it processes in exponential time. Advances have been made via certain approximations to reduce the segmentation process to power-law time. However, real-time processing (such as for sonar imagery) requires much greater efficiency. We describe an energy minimization technique using four Potts (Q-Ising) models which processes in linear time. The technique is demonstrated on acoustic seafloor images as well as medical images.

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Date submitted: 02 Oct 2007 Electronic form version 1.4