# Binary Image Inpainting by a Modified Cahn-Hilliard Equation

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Image inpainting is the process of filling in missing or damaged regions of an image (such as scratches on an old photograph) with information from surrounding intact areas. For binary images, we propose solving the following equation

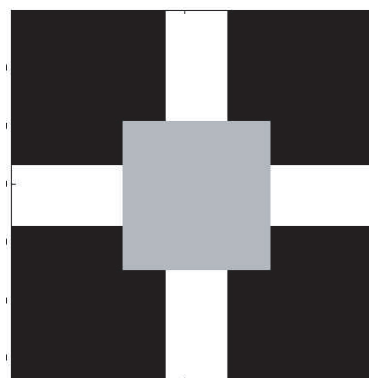$$u_t = -\Delta\left(\varepsilon\Delta u - \frac{1}{\varepsilon}W'(u)\right) + \lambda\mathbf{1}_{D^c}(f-u)$$

in order to inpaint the given image f in the damaged region D. The repaired image is the steady state u of this equation. This partial differential equation (PDE) is a modified version of a model arising in the study of phase transitions in alloys, for which there are efficient numerical schemes available. Our model takes advantage of these fast solution techniques. The gray regions of the left hand side images indicate damaged regions; they are filled in with our PDE as shown in the images on the right hand side.
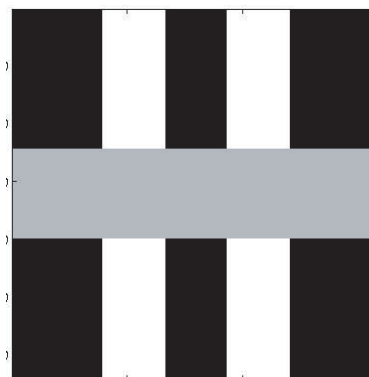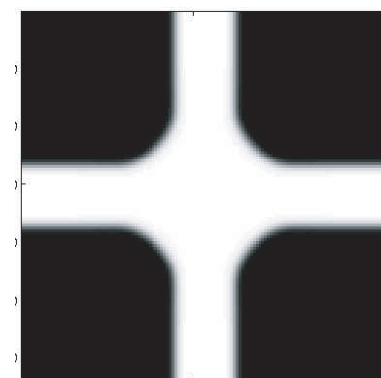

Damaged image
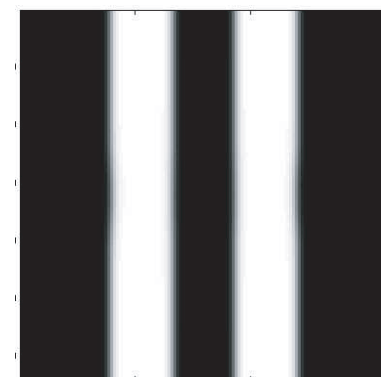
Repaired image

Damaged image

Repaired image