Exercise standard solution: Depth Perception - Energy Model

Expected time: 3h

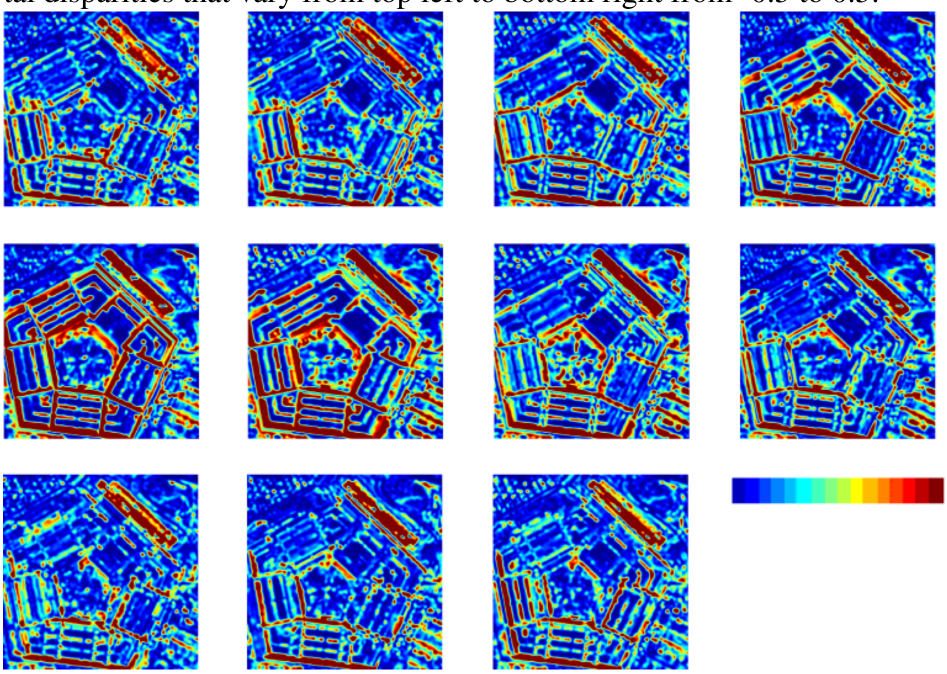
A. Random dot stereograms

Build a random dot stereogram that can be fused to perceive depth from it with a shape of your choice (e.g. a simple rectangle, see basic algorithm in the lecture).

Try to fuse it on the monitor or print out the random dot stereogram.

B. Energy model

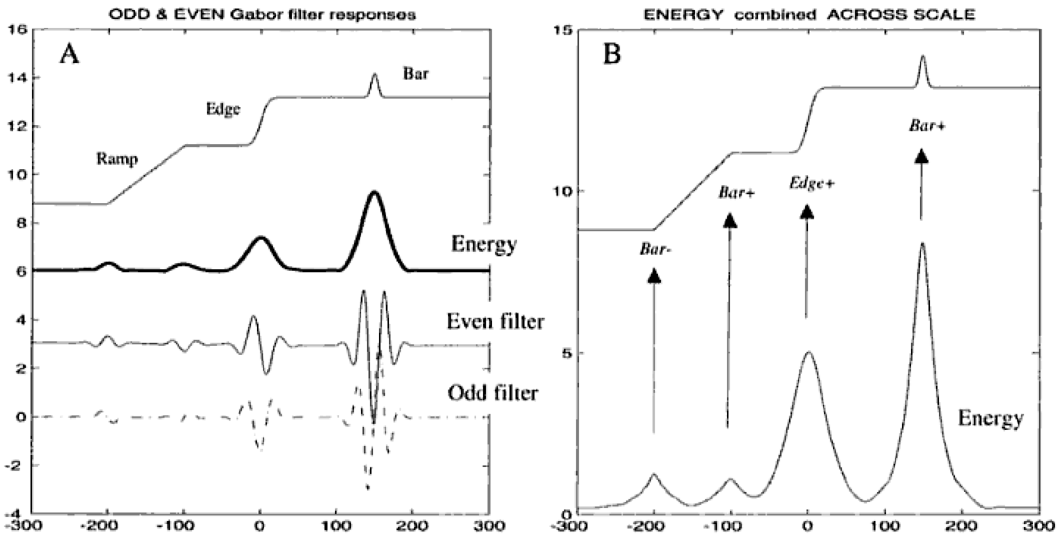
- **Take a look at exerciseEnergyModel.m and understand what the program is doing.**
- **Alter it to filter the image at one specific orientation (spread the 6 needed orientations between 30 and 180 over the exercise group) and one spatial frequency and for zero vertical disparity and a small range of horizontal disparities (-0.3, -0.2, -0.1, 0, 0.1, 0.2, 0.3).**
- **Plot the results and see how far the responses give a clue for depth.**
  Here you see the plotted mean results over different orientations with different horizontal disparities that vary from top left to bottom right from -0.5 to 0.5.



What one can see is that different areas like the part of the Pentagon in the top left corner could be encoded and reconstructed from disparity detectors at a specific horizontal disparity which indicates that depth is somehow encode with the help of absolute disparity detectors. But it is also obvious from the images that the responses of the energy model cells are not a direct representation of depth.

- **What is the meaning of the difference of RF 1 and RF 2 in the function EnergyModel(...) ?**

  The function EnergyModel(...) calculates the binocular response to receptive fields with a prefered vertical disparity (which is zero here), a prefered horizontal disparity and phase disparity and outputs the energy for complex cells. In the Energy function even symmetric receptive fields and odd symmetric receptive fields get used to build the response. At any given location x the energy response reflects the amount of image contrast present within the receptive field aperture centered at x. Thus the energy response peaks at points of high contrast but does not represent the fine structure of the image at that point. RF1 represents the even symmetric receptive field $G(x) * cos(2\pi fx)$ and RF2 the odd field as $G(x) * sin(2\pi fx)$.



The second image shows the response of energy cells combined across four spatial scales.