15 Probabilistic Chan-Vese

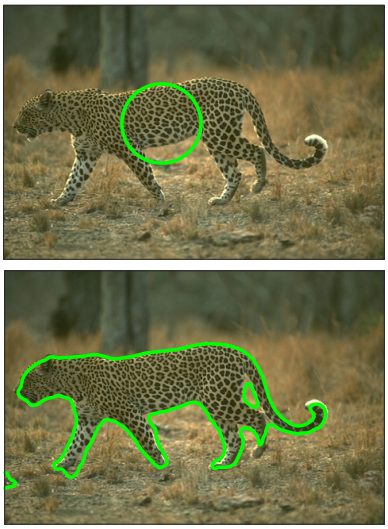

Figure 15.1: A deformable model used for segmenting forward-background image where two regions are characterized by different textures.

Chan-Vese segmentation algorithm alternates between two updates: update for mean intensities of the two regions given region boundaries, and update of the boundary between the two regions given mean intensities. The use of mean intensities implies that the two regions are distinguished by having different mean intensities. There are situations, where this is not the case, see Figure 15.1. Regions can be characterized by distributions of intensities or other features.

In this mini-project you will investigate generalizations of Chan-Vese algorithm, which allow for segmenting more challenging situations than with the original Chan-Vese. Some inspiration can be found in paper by Dahl and Dahl [1], which proposes a intensity-distribution approach Figure 15.2 and patch-distribution approach Figure 15.3. The approach is illustrated in Figure 15.2. Once the curve is initialized, instead of computing mean intensities for the inside and outside region, the distributions of intensities are collected for the inside and the outside region. For every pixel value we now have an information on how often it is in the inside and outside region, which can be translated into a probability that this pixel value is inside or outside. Computing such probabilities for all image pixels leads to probability image which can be used to deform the curve. Alternating, in a Chan-Vese manner, between computing probability image given the curve, and deforming the curve given probability image leads to segmentation.

For even more general case, instead of working with distributions of pixel intensities, distributions of image features may be used to compute the probability image. Figure 15.3 shows an example of using dictionary of image patches. For every patch from the dictionary we can compute the probability of it occurring in the inside or outside region.

[1] Vedrana Andersen Dahl and Anders Bjorholm Dahl. A probabilistic framework for curve evolution. In *Scale Space and Variational Methods in Computer Vision*, pages 421–32. Springer, 2017

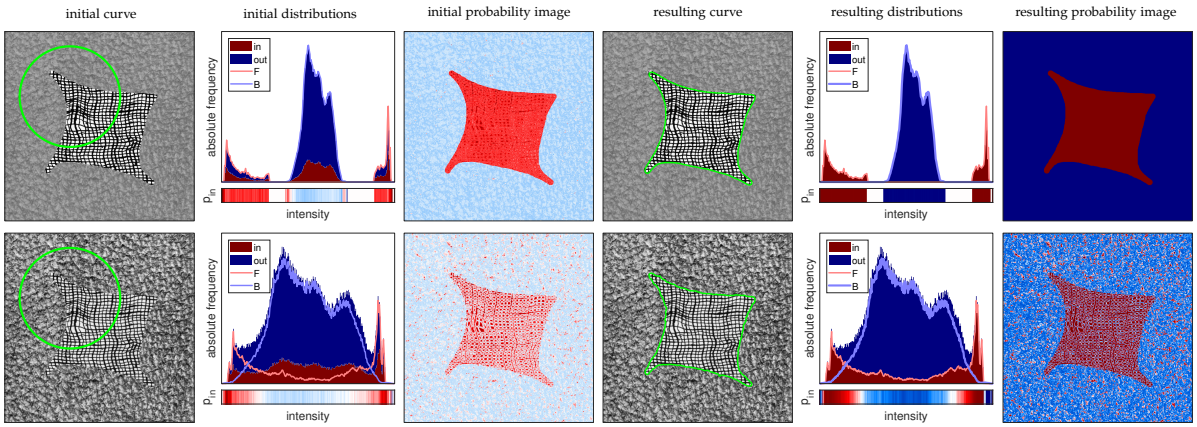

Figure 15.2: A probabilistic Chan-Vese approach when regions inside and outside are characterized by different distributions of pixel intensities. Top row shows easier problem of non-overlapping distributions, bottom row shows two overlapping distributions. Colums 1–3 show initialization, columsn 4–6 show result after iterating.

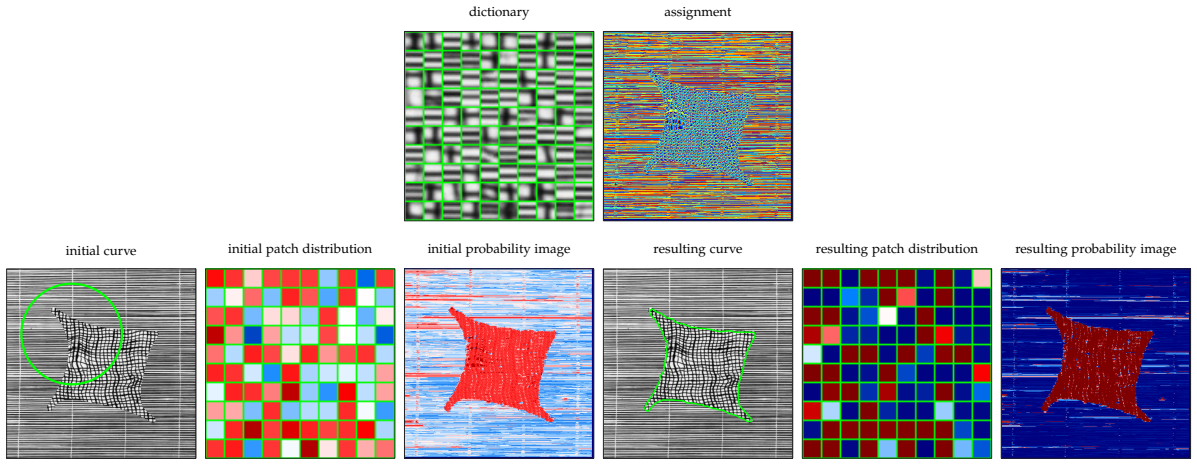

Figure 15.3: A probabilistic Chan-Vese approach when regions inside and outside are characterized by different texture. Top row shows used dictionary of image patches, and an assigmnent of image pixels to dictionary. In the second row, Images 1–3 show initialization and images 4–6 show result after iterating.