Assignment 5 COMP/BMME 576, spring 2018 27 March 2018
Spline removal of shading Due Tuesday, 10 April 2018

Consider a 2D image that has resulted from an object reflectance distribution R(x) and an incident light distribution L(x). It is reasonable to assume that the image R is dominated by strong small-level-of-detail-containing edges at its object boundaries, whereas the image L is rather smooth. The resulting image I will be R × L, i.e., the pixel by pixel product of the image R and the incident light image L. Therefore, since one desires to know the reflectance image R, which characterizes the scene, one can compute it as the pixel by pixel result of dividing I by L.

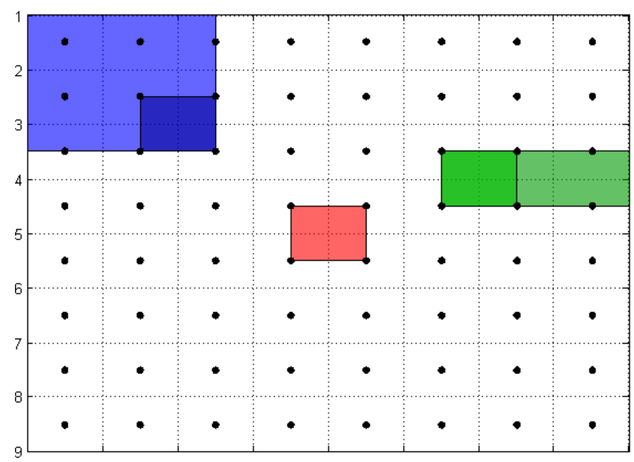
The challenge is to find the incident light distribution image L. In this problem you will assume that L can be found as a smooth version of I and that you can compute that smooth version by averaging I over local regions of significant size and then fitting a 2D B-spline to the resulting regional averages.

Find a $2^n \times 2^n$ image with a gradual change of shading, that is, that is more well lit in some parts than the other. Divide it into 8 × 8 equal-sized boxes (so if the original image were 512 × 512, each box would be 64 × 64).

At each box center, we will want an intensity for the box. Compute that box-center-intensity as the average intensity in the box. You should then let these box centers be control points and each box-average value be the control value for that control point. Thus, the B-spline patches will be so-called "crack boxes" centered at the crack between 4 surrounding original boxes and of the same area as the original boxes.

Using these intensity values as control values, compute a B-spline function. The patches for this B-spline function will be formed by a crack box that has a full set of 4 × 4 control points surrounding it (see the Fig.). Thus, this B-spline will be usable as the value of L at all pixel centers in all of those patch boxes. For all pixels outside of these patch boxes, extend the polynomial that is the spline for its nearest inside patch box for application to pixels in these outside regions, and use that result as L for those pixels. Compute this B-spline function at all pixels and define the result to be L(x).

Divide the input image I by the spline L, to produce R. Turn the 3 images: I, L, and R to the grading program.



The original boxes are shown bounded by dashed lines, and their centers, which are control point positions, are shown as heavy dots. Some of the crack boxes, which are the spline patches, are shown with dashed sides. Three inside patches are shown. One patch, whose values are only used in its patch, is colored red. The other two are shown in different colors (blue and green). The pixels in these last 2 affect are not only in their own patch but also those in the adjacent same color but lighter regions.