

Deblurring of an Astronomical Image



The purpose of this challenge is to experiment with deblurring of the astronomical image `dfsc6215.png`. The two images above show the upper left fourth of the image (left) and a zoom on one of the bright stars (right).

The point spread function is unknown for this problem, but we can estimate it by assuming that one of the bright stars should, ideally, be shown as a single bright pixel – and hence the image of the star gives the PSF array. We also assume that the blurring is spatially invariant.

- Extract a small image centered at a bright star; for example, use

```
PSF = dfsc6215(700:715,665:680);
```

- If you wish to keep computing times small, also extract a sub-image of the star image; e.g., the 512×512 image:

```
B = dfsc6215(500+(1:512),500+(1:512));
```

- Before we can use the deblurring routines included in this book we must pad the PSF array with zeros so that we obtain an array `P` with the same size as the image `B`. For this purpose use the MATLAB function `padPSF`.
- Now try to use both TSVD and Tikhonov regularization to deblur the image. Since the background is zero we can conveniently assume periodic boundary conditions and use the FFT-based methods implemented in `tsvd_fft` and `tik_fft`. If you use `[]` as the third argument then the function will determine the center of the PSF by locating the largest pixel of `P`. Choose the regularization parameters by experiments.
- Also try to let the deblurring functions determine the regularization parameter (they use the GCV method); this is done by leaving out the fourth input parameter.
- Comment on the quality of the reconstructions.