kernels for image interpolation [5-7]; but, these come at an obvious increase in computational cost.

Images often have components above the Nyquist rate, leading to aliasing of the higher frequencies. Reconstruction of the continuous function becomes an ill-posed problem with infinite number of solutions. Some prior information is required to pick the most plausible one. In traditional methods, this prior information is "encoded" in the basis functions. Other methods, such as the Baysian framework [8], for example, can make more explicit use of these image priors.

In previous work [9], we explored the idea of a least-squares optimal interpolation kernel. We used simulated images, such that the output is freely available, and optimised a finite-support kernel by minimising the mean square error with respect to the kernel weights. The resulting optimal kernel would resample another image with near-optimal results and in later work we demonstrated that one-dimensional optimal kernels optimised on different images are quite similar [10]. It was also shown that a similar kernel can be obtained by using a model image. These results were used in [11], where we optimised a non-separable 2D kernel using an image model. However, this work was completed in light of image super-resolution [12] and the methods were specifically designed to resample non-uniformly sampled data on a uniform grid.

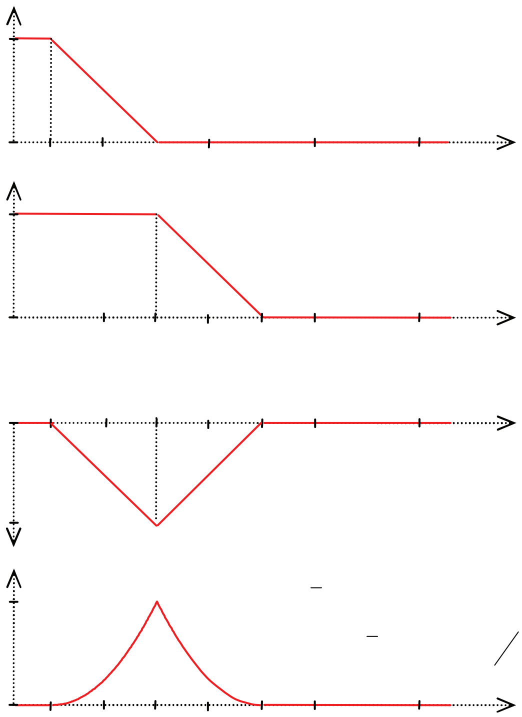
In this paper, we adapt this methodology to derivation of 1D kernels for interpolation of uniform images in a separable fashion, much like a piece-wise polynomial kernel would. The novelty of this method lays in the way the kernel is produced from an image model that can encompass the prior knowledge, making it specific to interpolating image data. We use a step-edge model as an example here, but other image models can be employed in a similar way.

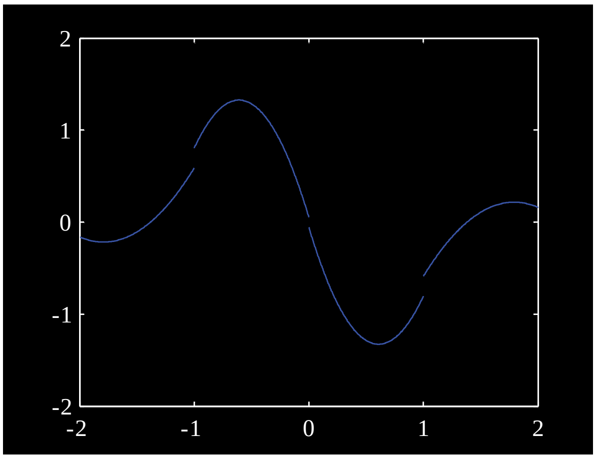
II. Least-Squares Optimal Interpolation

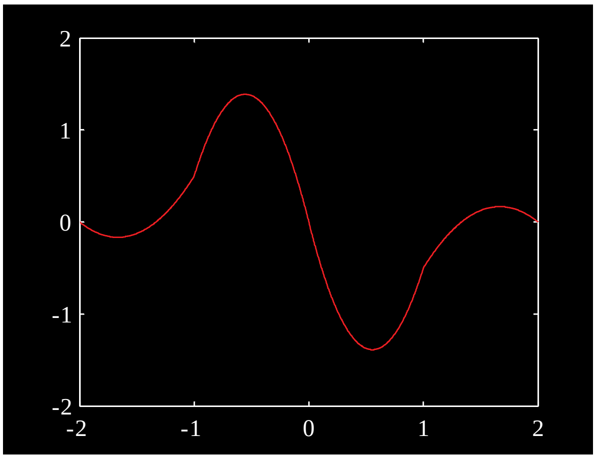
A. *Optimal Interpolation*

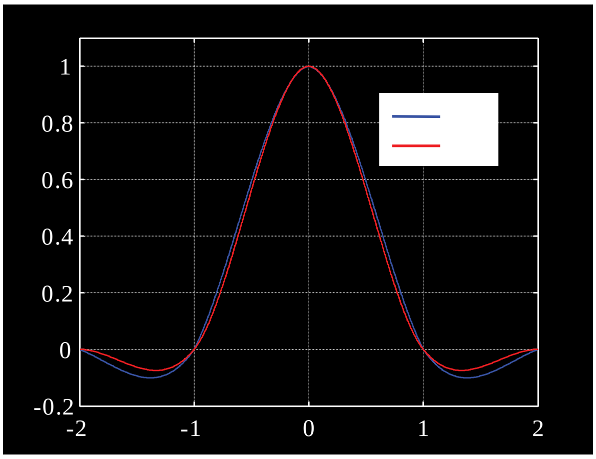
One of the main uses of image interpolation is resampling. If values of the image function are required at locations other than the ones where the image is defined, it is necessary to interpolate the image and resample it at the new locations. A simple case of this procedure is considered here: resampling an image $f[k,l]$ on an offset grid, but with the same sampling rate, as shown in figure 1.

Figure 1 Input an




2
1
0
-1
-2
-2
-1
0
1
2


2
1
0
-1
-2
-2
-1
0
1
2


1
0.8
0.6
0.4
0.2
0
-0.2
-2
-1
0
1
2

http://www.mathworks.com/access/helpdesk/help/techdoc/ref/interp2.html.