Nonlocal means denoise

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1 Motivations

Denoising images is a common need and has been done through averaging the pixels in the direct vicinity for the most part. Through doing so fine details are the image itself are often degraded or removed entirely. This caused the desire for a denoising algorithm that wouldn't alter the original image or remove details if possible. Therefore the NL-means algorithm wished to solve which of these in which it could.

2 Approach

2.1 The Algorithm

The NL-means operates by comparing the mean of the neighborhood of the current point x with the gaussian neighborhoods of several other points in the image, and replacing the point x with the most similiar neighborhood's mean. The guassian kernel is used due to its relevance to denoising, but it doesn't solve the issue of removing detail so a block would then be passed through an enisotropic filter to diminish its negative effects.

2.2 The Steps

For every pixel i, the weighted average of all the pixels in the image will be calculated, this will be done as follows. For every other pixel j with respects to pixel i, the weight will be calculated. This weight will then be multiplied by the value of pixel j and summed for every j.

To compute the weights for each pixel j relative to i requires 3 primary parts. The first would be to find the euclidean distance betweem the vectors of the grey levels of the neighborhoods of each i and j, centered at i or j respectively and with $s\sigma^2$ added to the result.

Then the normalizing constant for the weight must be generated, $Z(i)$, which is denoted as $Z(i) = \sum_j e^{-\frac{\|v(N_i)-v(N_j)\|_{2,a}^2}{h^2}}$ computed for every pixel j and summed. This constant is then divided into each weight's calculation.

compare and find weights for every other pixel j –for each j find the weighted euclidean distance between the two neighborhoods.

more similiar neighborhoods have higher weights

a weight is the gaussian to the euclidead distance divided by the normalizing constant which is the sum of

3 Results and critique