

MODIFIED DEMOSAICKING AND DENOISING TECHNIQUE FOR RGB IMAGE LEVEL SETS BY USING BAYER FILTER

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Abstract— Vector-valued images such as RGB color images or multimodal medical images show a strong inter channel correlation, which is not exploited by most image processing tools. Here propose a new notion of treating vector-valued images which is based on the angle between the spatial gradients of their channels. Through minimizing a cost functional that penalizes large angles, images with parallel level sets can be obtained. It illustrates the properties of this cost functional by several examples in denoising and de-mosaicking of RGB color images. They show that parallel level sets are a suitable concept for color image enhancement. De-mosaicking with parallel Level sets gives visually perfect results for low noise levels.

I. INTRODUCTION

Image processing is any form of signal processing for which the input is an image, such as a photograph or video frame and the output of image processing may be either an image or a set of characteristics or parameters related to the image. Most image-processing techniques involve treating the image as a two dimensional signal and applying standard signal-processing techniques to it. Image processing usually refers to digital image processing, but optical and analog image processing also are possible. The acquisition of images (producing the input image in the first place is referred to as imaging.

Most image processing tools are designed for scalar-valued images or when applied to vector valued images they process these independently channel by channel, which fails to exploit the information expressed in the correlation between channels. One prominent example of using information between channels is color total variation. This extension of the scalar-valued version leads to a non-linear diffusion scheme where the diffusivity depends on all channels.

In grayscale images intuitively image demosaicing can be best understood as an extension of image interpolation. If denote full-resolution color image by $S = (R, G, B)$ and its Bayer pattern by $zS = (zR, zG, zB)$, demosaicing includes two inter-related interpolation problems: quincunx interpolation (reconstruct the missing half amount of G pixels) and rectangular interpolation (reconstruct the missing three-quarters of R/B pixels). Although each problem can be solved by the standard image interpolation techniques (e.g., bilinear/bicubic interpolation, edge-directed interpolation), the real challenge in demosaicing lies in joint exploitation of both intra and inter-channel dependencies such that smaller reconstruction errors can be achieved. Here propose a new notion of treating vector-valued images which is based on the angle between the spatial gradients of their channels. Through minimizing a cost functional that penalizes large angles, images with parallel level sets can be obtained. After formally introducing this idea and the corresponding cost functional discuss their Gateaux derivatives that lead to a diffusion-like gradients descent scheme. It illustrates the properties of this cost functional by several examples in denoising and demosaicking of RGB color images.

II. RELATED WORK

Multi-Modality Imaging Of Structure and Function Combining Spectral-Domain Optical Coherence and Multiphoton Microscopy used Integration of acquisition speed, sensitivity, and simplicity has been incorporated for the images using a spectral domain OCM (Optical Coherence and Multiphoton microscopy) system. Spectral-domain OCM and MPM for the detection of structure and function respectively. It has been recently shown that the spectral-domain configuration provides significant advantages in terms of acquisition speed, sensitivity, and simplicity in the acquisition module; benefits that are incorporated into our integrated microscope. Confocal microscopy are limited primarily to the limited number of excitation wavelengths available with common lasers (referred to as laser lines), which occur over very narrow bands and are expensive to produce in the ultraviolet region.

Computation of Geometric Partial Differential Equations and Mean Curvature Flow Proposed a Mean curvature computation for the geometric partial differential equations. Then constructed a finite difference scheme that is both monotone and consistent, and obtained the first convergence result for an approximation of an error analysis for this scheme. Injected microbes and nutrients are cheap; easy to handle in the field and independent of oil prices. Economically attractive for mature oil fields before abandonment. Increases oil production. The oxygen deployed in aerobic MEOR can act as corrosive agent on non-resistant topside equipment and down-hole piping. Anaerobic MEOR requires large amounts of sugar limiting its applicability in offshore platforms due to logistical problem.

A Review of Statistical Approaches to Level Set Segmentation: Integrating Color, Texture, Motion and Shape Presented a survey of a specific class of region-based level set segmentation methods and clarify how they can all be derived from a common statistical framework. Segmentation algorithm, sank algorithm is used. Level-set method, especially for medical imagery, is its natural ability to incorporate information on object shape, texture, and color distribution into the segmentation process. Level-set methods for image segmentation are that they are slow and memory-intensive. The level-set function is typically discredited on the entire image grid to hold floating-point values (Figure 1E and Movie Dense S1.mov) although only the position of the zero level curves is of primary interest. Intensity Gradient Based Registration and Fusion of Multi-Modal Images Proposed an Investigated an alternative distance measure which is based on normalized gradients. The Generic algorithm is used. The advantages of this proposed work is Speed: down-sampled images and Convergence: smoother cost function. The main disadvantages of this paper are to fuse the multimodal medical images, the characteristics of the images should also be considered. Illustrates an example of the original CT and MR images.

Image Quality Assessment: From Error Visibility to Structural Similarity Proposed the use of the structural similarity as an alternative motivating principle for the design of image quality measures. The Optimize algorithm is used. A great deal of effort has gone into the development of quality assessment methods that take advantage of known characteristics of the human visual system (HVS). The raster image will have to be completely reproduced, but the vector data, "roads," can be easily updated by adding the missing road segment. In addition, vector data allows much more analysis capability, especially for "networks" such as roads, power, rail, telecommunications, etc.

A Database of Human Segmented Natural Images and Its Application to Evaluating Segmentation Algorithms and Measuring Ecological Statistics Proposed a database containing 'ground truth' segmentations produced by humans for images of a wide variety of natural scan. Evaluating the performance of segmentation algorithms and measuring probability distributions. Anyone with Internet access can segment images. The process produces an explicit partition of the pixels into groups. Difficult to fully represent the original data.

Demosaicking: Color Filter Array Interpolation In Single-Chip Digital Cameras Proposed different models have been proposed. In and Markov Random Field (MRF) models were used. Alternating projections algorithm is used. Immediate image review and deletion is possible; lighting and composition can be assessed immediately, which ultimately conserves storage space. High volume of images to medium ratio; allowing for extensive photography sessions without changing film rolls. To most users a single memory card is sufficient for the lifetime of the camera whereas film roles are a re-incurring cost of film cameras. High ISO image noise may manifest as multicolored speckles in digital images, rather than the less-objectionable "grain" of high-ISO film.

Color TV: Total Variation Methods for Restoration of Vector-Valued Images proposed a new definition of the total variation norm for vector-valued functions that can be applied to restore color and other vector-valued images. The total variation identifies several slightly different concepts, related to the (local or global) structure of the co domain of a function or a measure. But the catch is limited by mechanical constraints related to the implementation of the encode and the exoskeleton. In effect then use the method of optical positioning to place the animation in décor.

A Review of Image Denoising Algorithms with a New One Proposed a general mathematical and experimental methodology to compare and classify classical image denoising algorithms and, second, to propose a nonlocal means (NL-means) algorithm addressing the preservation of structure in a digital image. The mathematical analysis is based on the analysis of the "method noise," defined as the difference between a digital image and its denoised version. The NL-means algorithm is proven to be asymptotically optimal under a generic statistical image model. Denoising algorithm is used. The most powerful evaluation method seems, however, to be the visualization of the method noise on natural images. The limitations in image accuracy are categorized as blur and noise.

Color Plane Interpolation Using Alternating Projections Proposed a new demosaicing technique for the inter-channel correlation effectively in an alternating-projections scheme. It have compared this technique with six state-of-the-art demosaicing techniques, and it outperforms all of them, both visually and in terms of mean square error. Alternating projections algorithm is used. High contrast ratio (over 15,000:1) excellent color, fairly wide color gamut and low black level. No native resolution; the only current display technology capable of true multisyncing (displaying many different resolutions and refresh rates without the need for scaling. Large size and weight, especially for bigger screens (a 20-inch (51 cm) unit weighs about 50 lb (23 kg). Geometric distortion caused by variable beam travel distances.

III. PROPOSED APPROACH

Image demosaicing is a problem of interpolating full-resolution color images from so-called color-filter-array (CFA) samples. Among various CFA patterns, Bayer pattern has been the most popular choice and demosaicing of Bayer pattern has attracted renewed interest in recent years partially due to the increased availability of source codes/executables in response to the principle of “reproducible research”.

Here propose a new notion of treating vector-valued images which is based on the angle between the spatial gradients of their channels. Through minimizing a cost functional that penalizes large angles, images with parallel level sets can be obtained. After formally introducing this idea and the corresponding cost functional discuss their Gateaux derivatives that lead to a diffusion-like gradients descent scheme. It illustrate the properties of this cost functional by several examples in denoising and demosaicking of RGB color images. They show that parallel level sets are a suitable concept for color image enhancement. Demosaicking with parallel level sets gives visually perfect results for low noise levels. Furthermore, the proposed functional yields sharper images than the other approaches in comparison.

A. Advantages

- Supporting Larger Dimensions images (Larger matrix and greater pixel-colored images)
- Supporting different forms of images.
- Without affecting image dimensions the compression of images can be done.
- Pattern recognition done for the input images.
- Increased PSNR (peak signal noise ratio)
- Proposed functional yields sharper images than any approaches for the image enhancement.

IV. ALGORITHM DESCRIPTION

A. Bayer filter Algorithm

The goal of our Bayer filter algorithm is to perform the *Image enhancement* using the level sets.

B. Algorithm Work flow

1. New level set formulation, called distance regularized level set evolution (**DRLSE**), and proposed by Chunming Li et al's in the paper "Distance Regularized Level Set Evolution and its Application to Image Segmentation". The main advantages of **DRLSE** over conventional level set formulations include the following:
 - It completely eliminates the need for dreinitialization;
 - It allows the use of large time steps to significantly speed up curve evolution, while ensuring numerical accuracy;
 - Very easy to implement and computationally more efficient than conventional level set formulations.
2. Getting the noisy Bayer data.
3. Denoising and interpolation.
4. Denoising is to estimate the original pixels from the noisy measurements, while interpolation is to estimate the missing sample from its local neighbors using partial differential equation (PDE).
Demosaicking technique
5. Interpolation of R, G, B pixel position using Bayer pattern RR, BB, GR and GB have been decoded and arranged.
Separating noise free RGB pixel images for the Bayer filter applied images.
6. Full size noise free images by using Median Filter To remove salt and pepper noise.

7. Separating the level sets with noise free data the dimension output parameters are same to channels of the input image.

V. PROJECT DESCRIPTION

1. Getting the input from the level set and Denoising the Bayer data (Input image)
2. Interpolation of R, G, B pixel position (Demosaicking Technique-CFA method)
3. Separating noise free RGB pixel images.(Bayer filter is applied)
4. Full size noise free images and Separating the level sets with noise free data.

A. Getting the Input from the Level Set

- Level set method

The figure on the right illustrates several important ideas about the level set method. In the upper-left corner see a shape; that is, a bounded region with a well-behaved boundary. Below it, the red surface is the graph of a level set function φ determining this shape, and the flat blue region represents the xy -plane. The boundary of the shape is then the zero level set of φ , while the shape itself is the set of points in the plane for which φ is positive (interior of the shape) or zero (at the boundary).

In the top row see the shape changing its topology by splitting in two. It would be quite hard to describe this transformation numerically by parameterizing the boundary of the shape and following its evolution. One would need an algorithm able to detect the moment the shape splits in two, and then construct parameterizations for the two newly obtained curves. On the other hand, if look at the bottom row see that the level set function merely translated downward. This is an example of when it can be much easier to work with a shape through its level set function than with the shape directly, where using the shape directly would need to consider and handle all the possible deformations the shape might undergo.

Thus, in two dimensions, the level set method amounts to representing a [closed curve](#) Γ (such as the shape boundary in our example) using an auxiliary function φ , called the level set function. Γ is represented as the zero [level set](#) of φ by

$$\Gamma = \{(x, y) | \varphi(x, y) = 0\},$$

And the level set method manipulates Γ *implicitly*, through the function φ . This function φ is assumed to take positive values inside the region delimited by the curve Γ and negative values outside.

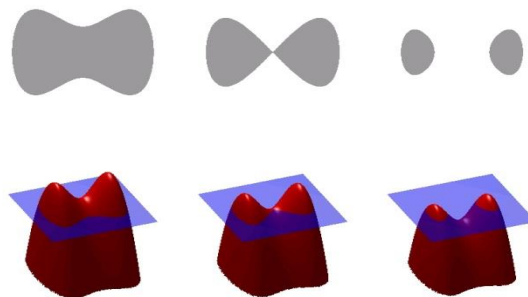


Fig.1 Level set Method

Matlab code implements a new level set formulation, called distance regularized level set evolution (DRLSE), proposed by Chunming Li et al's in the paper "Distance Regularized Level Set Evolution and its Application to Image Segmentation",

The main advantages of DRLSE over conventional level set formulations include the following: 1) it completely eliminates the need for dreinitialization; 2) it allows the use of large time steps to significantly speed up curve evolution, while ensuring numerical accuracy; 3) Very easy to implement and computationally more efficient than conventional level set formulations.

• Getting the Noisy Bayer Data

Decimated Discrete Wavelet Transform Denoising generate MATLAB® code to reproduce GUI-based 2-D decimated wavelet denoising at the command line. You must perform this operation in the Wavelet 2-D –De-noising tool. You must first denoise your image before you can enable the File > Generate Matlab Code (Denoising Process) operation.

1. Enter wavemenu at the MATLAB command prompt and Select Wavelet 2-D.
2. Load the Noisy SinSin example indexed image. Using the default bi orthogonal wavelet and level 3 decomposition, click **De-noise**.
3. In the Select thresholding method drop-down menu, select the default Fixed form threshold and softoptions. Use the default Unscaled white noise.
4. Select **De-noise**.
5. Generate the MATLAB code with **File > Generate Matlab Code (Denoising Process)**.

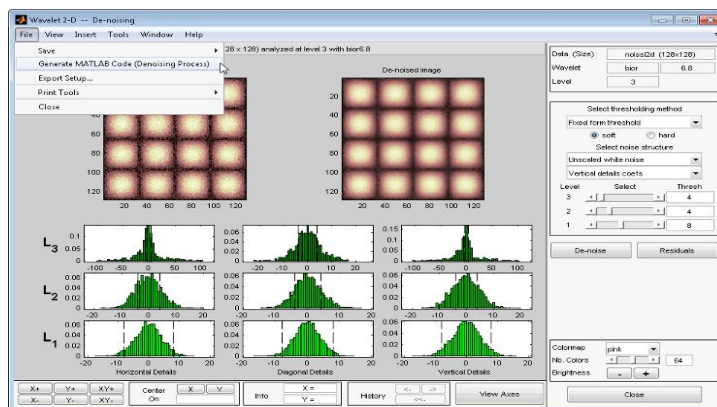


Fig2 Decimated Discrete Wavelet Transform Denoising

• Denoising the Bayer data (Input image)

Usually denoising and interpolation are treated as two different problems and they are performed separately. However, this may not be able to yield satisfying result because the denoising process may destroy the edge structure and introduce artifacts, which can be further amplified in the interpolation stage. With the prevalence of inexpensive and relatively low resolution digital imaging devices (e.g. webcam, camera phone), demands for high-quality image denoising and interpolation algorithms are being increased. Hence new interpolation schemes for noisy images need to be developed for better suppressing the noise-caused artifacts and preserving the edge structures. Instead of performing denoising and interpolation separately, it is possible to perform interpolation and denoising jointly to reduce the artifacts introduced in the denoising process. Actually, both denoising and interpolation can be viewed as an estimation problem.

Denoising is to estimate the original pixels from the noisy measurements, while interpolation is to estimate the missing sample from its local neighbors. The idea of joint denoising and interpolation has been exploited in HIRAKAWA et al proposed an algorithm of joint denoising and color demosaicking (which is a special case of interpolation) to reconstruct the full color image from the color filter array image. The total least square technique was used to estimate the noiseless and missing color components. In ZHANG et al developed a directional estimation and wavelet based denoising scheme for joint denoising and color demosaicking.

The directional information also plays a key role in interpolation. The traditional linear interpolation methods, such as bi-linear and bi-cubic interpolation, are simple and fast but they do not work well in edge preservation due to the ignorance of local directional information. Most of the later developed interpolation techniques aim at maintaining the edge sharpness. Jensen and Anastassiou detected edges and fitted them by some predefined templates to improve the visual perception of enlarged images. The image interpolator by Carrato and Tenze first replicates the pixels and then corrects them by using some preset 3x3 edge patterns and optimizing the parameters in the operator.

B. Interpolation of R, G, B pixel position (Demosaicking Technique)

Once the four color channels RR, BB, GR and GB have been decoded and arranged in a Bayer pattern, a demosaicing algorithm is performed. In this work have chosen a basic demosaicing algorithm consisting of the following stages.

1) The green color component is interpolated using edge preserving filtering . It consists of filtering the Bayer pattern horizontally and vertically, then choosing the direction of interpolation corresponding to the smaller estimated gradient to avoid interpolation across edges, horizontal or vertical. In case of equal gradients, the average of the horizontal and vertical interpolators is taken. This method of interpolation was chosen due to its high performance at relatively low complexity. Other more complex techniques can be used here for the reconstruction of the green.

2) The interpolated green component G is used in the reconstruction of the red and blue colors. The linear combinations $CRG = a_1R + a_2 G$, $CBG = d_1B + d_2 G$ (4) are calculated at the known pixels of the red and the blue colors, respectively. There are different choices of a_1 , a_2 , d_1 and d_2 that are better than the common choice: $a_1 = d_1 = 1$, $a_2 = d_2 = -1$. In this work have taken the choice that provides minimal gradient energy of CRG and CBG (summed up for the whole image), the coefficients corresponding to this choice are

$$a_1 = 1, \quad a_2 = -\frac{\sum_i \sum_j (\nabla R)_{ij}^T (\nabla \hat{G})_{ij}}{\sum_i \sum_j \left\| (\nabla \hat{G})_{ij} \right\|^2}, \quad (5)$$

R and G at pixel (i, j), respectively. The solution for d_1 and d_2 is similar, with B replacing R everywhere. (5). Then the red-green combination is interpolated at the locations of the known blue samples, and the blue-green combination is interpolated at the locations of the known red samples using a local polynomial approximation (LPA) filter. Better performance can be achieved by this filter compared to basic bilinear interpolation.

C. Separating noise free RGB pixel images. (Bayer filter is applied)

That is the main reason that automatic thresholds are not always robust. If you have to find something that can range from anywhere of 0% of an image to 100% of an image, using thresholds that force you to pick automatically, or clusters that force you to pick a certain number of clusters, are not robust. They will fail if you don't have the proper number of pixels in the image belonging to those classes. For most or all of my color classification applications I use fixed values to determine the class. I used a training set to determine where the classes will be and then once I decide on them, they are fixed for all images. That way I can get area fractions for all color classes no matter if they are present or 100% or somewhere in between. If you had one cluster and told it to find 4 clusters, it would find 4 clusters but it will chop your image up into 4 clusters when if you had 3 other "real" colors there, it would find them all accurately, whereas in the first case it was calling the cluster 4 clusters when it should actually only be one cluster.

D. Full size noise free images

Median filtering is a common image enhancement technique for removing salt and pepper noise. Because this filtering is less sensitive than linear techniques to extreme changes in pixel values, it can remove salt and pepper noise without significantly reducing the sharpness of an image. In this topic, you use the Median Filter block to remove salt and pepper noise from an intensity image. **ex_vision_remove_noise.**

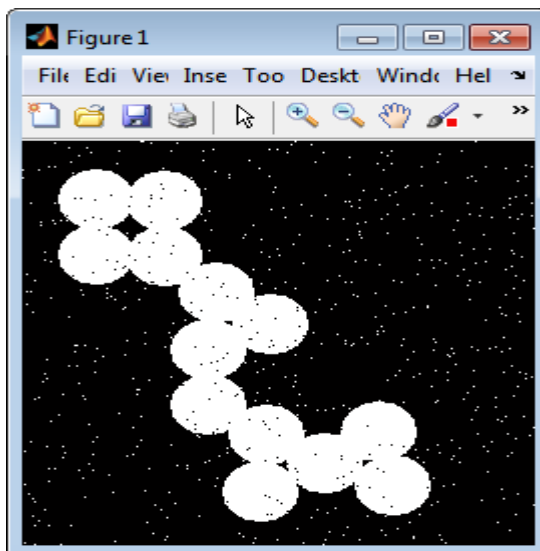


Fig.3 The intensity image contains noise that you want your model to eliminate.

1. Define an intensity image in the MATLAB® workspace and add noise to it by typing the following at the MATLAB command prompt:
2. `I= double(imread('circles.png')); I= imnoise(I,'salt & pepper', 0.02);` I is a 256-by-256 matrix of 8-bit unsigned integer values. The model provided with this example already includes this code in file>Model Properties>Model Properties>InitFcn, and executes it prior to simulation.
3. To view the image this matrix represents, at the MATLAB command prompt, type
4. `imshow(I)`

- Separating the level sets with noise free data

NoiseLevel estimates noise level of input single noisy image. `[nlevel th num] = NoiseLevel (img, patchsize, decim, conf, itr)`
Output parameters nlevel: estimated noise levels. th: threshold to extract weak texture patches at the last iteration. num: number of extracted weak texture patches at the last iteration.

If you put large number, the calculation will be accelerated. (default: 0) conf (optional): confidence interval to determine the threshold for the weak texture. In this algorithm, this value is usually set the value very close to one. (default: 0.99) itr (optional): number of iteration. default: 3))

Example

```
img=double(imread('img.png'));
nlevel = NoiseLevel(img);
```

VI. CONCLUSION

The advantages in using the region-based approaches over image gradient-based methods include the following: Robustness against local gradient variations. Feasibility of segmentation of color and multi-spectral images even in the absence of gradient-defined boundaries. Lower sensitivity to contour initialization and noise. Better ability to capture concavities of objects. In such models, foreground and background regions are modeled statistically and energy functional is minimized to best separate foreground and background regions. A novel image primitive - the diffusion curve method is applied on the principle that images can be defined via their discontinuities, and concentrates image features along contours. The diffusion curve can be defined in vector graphics, as well as in raster graphics, to increase user control during the process of art creation. The vectorial diffusion curve primitive augments the expressive powers of vector images by capturing complex spatial appearance behaviors. Diffusion curves represent a simple and easy-to-manipulate support for complex content representation and edition. In raster images, diffusion curves define a higher level structural organization of the pixel image. This structure is used to create simplified or

exaggerated representations of photographs in a way consistent with the original image content. Finally, a fully automatic vectorization method is presented, that converts raster diffusion curve to vector diffusion curve.

References

- [1] Bayer B E, 1976 "Color imaging array," *U.S. Patent* 3971065.
- [2] Blomgren P and Chan T F, 1998 "Color TV: Total variation methods for restoration of vector-valued images," *IEEE Trans. Image Process.*, vol. 7, no. 3, pp. 304_309.
- [3] Buades A, Coll B and Morel J M, 2005 "A Review of Image de-noising algorithms, with a new one" *Multiscale model.Simul.*, Vol. 4, No. 2, pp. 490–530.
- [4] Chung K H and Chan Y H, 2006 "Color demosaicing using variance of color differences," *IEEE Trans. Sig. Proc.*, vol. 15, pp. 2944–2955.
- [5] Cremers D, Rousson M and Deriche R, 2006 "A review of statistical approaches to level set segmentation: Integrating Color, texture, motion and shape," *Int. J. Computer. Vis.*, vol. 72, no. 2, pp. 195_215.
- [6] Deckelnick K, Dziuk G, and Elliott C M, 2005 "Computation of geometric partial differential equations and mean curvature flow," *Acta Numer.*, vol. 14, pp. 139_232.
- [7] Gallardo L A, 2003 "Characterization of heterogeneous near-surface materials by joint 2D inversion of DC resistivity and seismic data," *Geophys. Res. Lett.*, vol. 30, no. 13, p. 1658.
- [8] Gershikov E and Porat M, 2007 "On color transforms and bit allocation for optimal subband image compression," *Signal Processing: Image Communication*, vol. 22, pp. 1–18.
- [9] Gunturk B K, Altunbasak Y and Mersereau R M, 2002 "Color plane interpolation using alternating projections," *IEEE Trans. Image Proc.*, vol. 11, pp. 997–1013.
- [10] Gunturk B K, Glotzbach J, Altunbasak Y, Schafer R W and Mersereau R M, 2005 "Demosaicking: Color Filter array interpolation in Single-Chip Digital Cameras," *IEEE Signal Process. Mag.*, vol. 22, no. 1, pp. 44_54.
- [11] Haber E and Modersitzki J, 2006 "Intensity gradient based registration and fusion of multi-modal images," in *Medical Image Computing and Computer-Assisted Intervention*. New York, NY, USA: Springer-Verlag, Jan. 2006, pp. 726_733.
- [12] Katkovnik V, Bilcu R, Alenius S, and Egiazarian K, 2007 "Spatially adaptive color filter array interpolation for noiseless and noisy data," *Int. Journal of Imag. Sys. And Techn.*, vol. 17, pp. 105–122.
- [13] Kirshner H and Porat M, 2007 "On the approximation of l2 inner products from sampled data," *IEEE Trans. Signal Proc.*, vol. 55, no. 5, pp. 2136–2144.
- [14] Kotera H and Kanamori K, 1990 "A novel coding algorithm for representing full color images by a single color image," *J. Imag. Technology*, vol. 16, pp. 142–152.
- [15] Li X, 2005 "Demosaicing by successive approximation," *IEEE Trans. Image Proc.*, vol. 14, pp. 370–379.
- [16] Lian N X, Chang L, Tan Y P, and Zagorodnov V, 2007 "Adaptive filtering for color filter array demosaicking," *IEEE Trans. Image Proc.*, vol. 16, pp. 2515–2525.