A Review: Interpolation Based Super Resolution Approach for Improving Quality of Single Image

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Abstract : ***Super Resolution technique is use to reconstruct a High Resolution from Low Resolution Image. Image Super Resolution is process of recovering the missing high frequency detail and removing the degradation that arise. In general, SR approaches can be divide into three categories: Interpolation Based, Reconstruction Based and Example Learning Based. Interpolation based methods are used to predict the missing pixel value on the LR image. The super-resolution image reconstruction can be transform to solve linear equations whose size depends on the number of the training data. When the amount of the training data is large, it is time-consuming to solve the regression problem. To solve this problem select part of pair wise values from training database instead of all the training data. Support Vector Regression (SVR) technique is use to generalize unseen data and unknown function. By using this technique, I will try to improve quality of image compare to other technique.***

IndexTerms -

I. INTRODUCTION

Image processing is approach that perform operation on single input image and give enhanced image. Purpose of the image processing is to Visualization, Image Sharpening and Restoration, Image Retrieval, Image Recognition, Image Enhancement etc. Where Image Super Resolution work on resize of image and distort of image. Super Resolution is special technique that produce High-resolution image from low-resolution image. In this report, introduce method of super resolution like Interpolation based, Reconstruction based, learning based. Main goal is to improve pixel value of image using interpolation and vector regression approaches. Interpolation used to produce enhanced and distort image pixel value so that after implementing operation on Low resolution image it produce high-resolution image and compare output image with low-resolution image. Increase value of PSNR, SSIM, FSIM using interpolation and vector regression approaches. [13]

II. CLASSIFICATION OF SUPER RESOLUTION APPROACH

Image super-resolution (SR) reconstruction refers to a special image restoration technique that can produce a latent high-resolution (HR) image with more details from one low-resolution (LR) observation. This technique shows great potential in many practical applications such as criminal investigation, video surveillance, medical imaging, digital entertainment, and high definition television (HDTV).

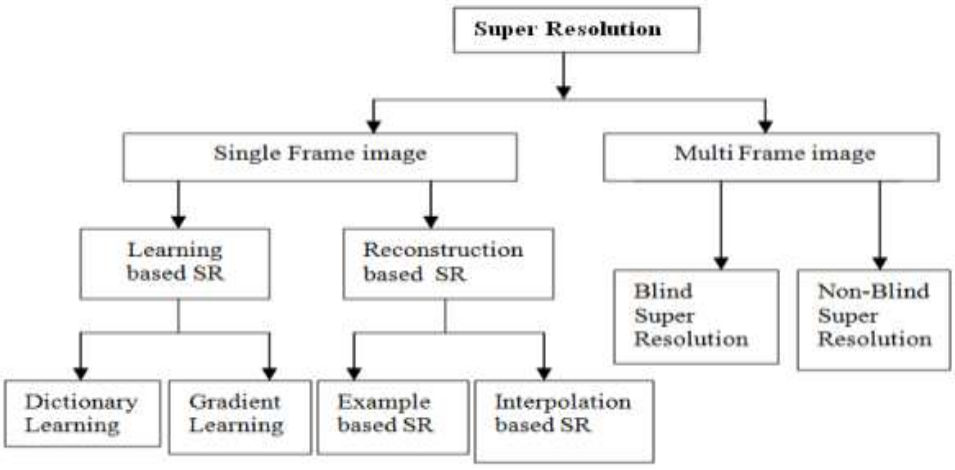

Fig. 1 Techniques for super resolution

A. INTERPOLATION BASED

Interpolation-based methods use interpolation kernels to predict the missing pixel values on the HR image grids. Typical methods include classical bilinear, Bicubic, and nearest neighbour interpolation, and so on. However, due to the isotropic property of applied kernel functions, these methods fail to approximate underlying image structures, leading to blurred results. In recent years, more structure-adaptive interpolation methods have been proposed. So as to adapt different image structures. The interpolation-based methods are fast and easy to implement, but they cannot effectively suppress blurring artifacts in the obtained HR images. [17]

B. RECONSTRUCTION BASED

Reconstruction-based methods are usually incorporate a certain prior knowledge (represented by one or several regularization terms) into the reconstruction process for solving ill-posed SR problem. The popular priors include total variation, bilateral total variation, gradients prior, edge-specific priors, Zernike-moment, non-local similarity, steering kernel prior, and feedback-control framework.

Although reconstruction-based SR approaches are good with the preservation of sharp edges and suppression of unwanted noise, they are still clumsy at generating novel details, leading to water color -like artifacts or over-smooth textures in resultant images. [17]

C. LEARNING BASED

Learning-based methods use a prepared training set to learn the mapping relationship between the LR and HR feature spaces by machine learning technologies. According to how the mappings are established, the existing example learning-based SR methods can be further divided into two subcategories, namely coding-based and regression based methods. [17]

III. BICUBIC INTERPOLATION

Bicubic goes one step beyond bilinear by considering the closest 4x4 neighborhood of known pixels for a total of 16 pixels. Since these are at various distances from the unknown pixel, closer pixels are given a higher weighting in the calculation. Bicubic produces noticeably sharper images than the previous two methods, and is perhaps the ideal combination of processing time and output quality. For this reason it is a standard in many image editing programs, printer driver and in-camera interpolation. [13]

Bicubic interpolation provide best pixel value amongst neighbor pixels and make combination of all pixel to increment pixel values for resize or reconstruction of image.

A. A FAST SINGLE-IMAGE SUPER-RESOLUTION VIA DIRECTIONAL EDGE GUIDED REGULARIZED EXTREME LEARNING REGRESSION BY PAHEDING SIDIKE, EVAN KRIEGER, M. ZAHANGIR ALOM, VIJAYAN K. ASARI1, TAREK TAHA. [1]

Objective of super-resolution (SR) is to increase the spatial resolution of a low-resolution (LR) image by a certain factor using either single or multiple LR input images. It presents a machine learning-based approach to reconstruct a high-resolution (HR) image from a single LR image. In this method, various directional edge responses at each pixel are considered to obtain more complete HF information and then a regularized extreme learning regression model is trained using a set of LR and HR images. Proposed SR technique is much more complicated and can be not easily implemented in any other parallel processing architecture. If it's implemented on other languages than run time in much more than this model. It also cannot detect noise sensitivity in image and also does not perform balancing performance improvements and processing time. The human visual cortex system, which is sensitive to high-frequency (HF) components in an image. Aim of this model is to train a neural network to estimate the missing HF components that contain structural details. Explore directional edge features in terms of high-order filter types and noise sensitivity with a focus on balancing performance improvements and processing time.

B. BIDIRECTIONAL RECURRENT CONVOLUTIONAL NETWORKS FOR MULTI-FRAME SUPER-RESOLUTION BY YAN HUANG, WEI WANG, LIANG WANG. [2]

This model can super resolve videos with complex motions and achieve state-of-the-art performance and achieved better performance and faster speed. Bidirectional recurrent convolutional network for multi-frame. This method cannot provide better performance and faster speed while its compare with other multi-frame SR method. in future we can perform comparison with other multi-frame SR method.

C. COARSE-TO-FINE LEARNING FOR SINGLE-IMAGE SUPER-RESOLUTION BY KAIBING ZHANG, DACHENG TAO, FELLOW, IEEE, XINBO GAO, SENIOR MEMBER, IEEE, XUELONG LI, FELLOW, IEEE, JIE LI [3]

An effective regularization term that seamlessly integrates the properties of local structural regularity, nonlocal self-similarity, and collaborative representation over relevant atoms in a learned HR dictionary, to further improve the visual quality of the initial SR estimation obtained in the coarse stage. in this paper also introduce CNR based algorithm for synthesis and NLSRR based algorithm for quality enhancement. a set of simple effective mapping functions via correlative neighbour regression of grouped low-resolution to high-resolution dictionary atoms, to synthesize an initial SR estimate with particularly low computational cost. A CNR based algorithm for detail synthesis and an NLSRR-based algorithm for quality enhancement.

D. EDGE-DIRECTED SINGLE IMAGE SUPER-RESOLUTION VIA CROSS-RESOLUTION SHARPENING FUNCTION LEARNING BY WEI HAN, JUN CHU, LINGFENG WANG, CHUNHONG PAN [4]

Main objective is to perform a cross resolution sharpening function to recovered high-resolution image from low resolution image. Cross-resolution gradient sharpening function learning to obtain the high-resolution gradient. Cross-resolution learning is to learn a sharpening function from low-resolution, and use it in high-resolution. Edge directed single image super-resolution reconstruction is performed to obtain the sharpened high-resolution image. They propose linear model to perform operation in each edges of low-resolution image but it is not efficient to give better result estimated for high-resolution image. Implement sharpening function which perform better edge detection in low resolution image that gives estimated result for high resolution image.

E. FACE SUPER RESOLUTION BASED ON PARENT PATCH PRIOR FOR VLQ SCENARIOS BY LIANG CHEN, RUIMIN HU, ZHEN HAN, QING LI, ZHENG LU. [5]

When LR images are in Very Low Quality (VLQ), the LR patches are seriously contaminated that even two distinct patches form similar appearance, which means that the consistency assumption is not well held anymore. For solve this problem they use the target patch as well as the surrounding pixels, which represent the target patch. Neighbour embedding face super resolution method. Neighbor Embedding methods are based on the consistency assumption that the neighbours in HR / LR space form similar local geometry. Future work will focus on the exploration of the weight assignment and the expressing ability of data set.

F. IMAGE INTERPOLATION VIA LOW-RANK MATRIX COMPLETION AND RECOVER BY FEILONG CAO, MIAOMIAO CAI, YUANPENG TAN.[6]

Explore the linear relationship among neighbouring pixels to reconstruct a high-resolution image from a low-resolution input image. Lagrange multiplier method, which handle Noisy data and random perturbations robustly. Explore using feasible and effective prior knowledge to guide higher-quality HR image recovery.

G. IMAGE SUPER-RESOLUTION VIA SPARSE REPRESENTATION BY JIANCHAO YANG, STUDENT MEMBER, IEEE, JOHN WRIGHT, MEMBER, IEEE, THOMAS S. HUANG, FELLOW, IEEE, YI MA, SENIOR MEMBER, IEEE [7]

The sparse representation of a low-resolution image patch can be applied with the high-resolution image patch dictionary to generate a high-resolution image patch. a sparse representation for each patch of the low-resolution input, and then use the coefficients of this representation to generate the high-resolution output. Single image super resolution using Sparse Representation is a coupled dictionary

jointly trained from high- and low-resolution image patch pairs. The compatibilities among adjacent patches are enforced both locally and globally.

H. Learning A No-Reference Quality Metric for Single-Image Super-Resolution by Chao Ma, Chih-yuan yang, Xiaokang yang, Ming-Hsuan Yang. [8]

While address the problem of performance evaluation based on visual perception. While most super resolution images are evaluated by full reference metrics. The effectiveness of metrics is not clear and required ground-truth images are not always available in practice. so address these problem conduct the human subject studies using large set of super resolution images and propose a no-reference metrics learned from visual perceptual scores. 1. Full-reference metrics 2. Semi-reference metrics 3. No-reference metrics Full-reference IQA method such as MSE, PSNR, and SSIM indices are widely used in the SR. In addition to the issues on matching visual perception, Full-reference metrics can only be user for assessment when the ground-truth images are available. When ground truth images are not available, SR image can be evaluated by No-reference Methods. It does not perform well when feature of NSSA method is used in image because there are two dimension coefficient and their regressor is based on a simple linear model.

I. Optimized Multiple Linear Mappings for Single Image Super-Resolution by Kaibing Zhanga, JieLib, Zenggang Xiongc, Xiuping Liua, Xinbo Gaob.[9]

An improve MLM-based single image SR method by employee an EM-algorithm to jointly optimize the cluster results and the LR–HR dictionary pairs for regression. Implement method of expectation-maximization algorithm for improve the SR performance. Which start with a set of linear regression obtained by the Multiple Linear Mapping (MLM) based method? The selection of the best mapping function requires to search the whole LR dataset, which limits its potential in real-time application. To overcome limitation have to implement active learning strategy to select more informative dataset.

J. Perceptual Losses for Real-Time Style Transfer and Super-Resolution by Justin Johnson, Alexandre Alahi, Li Fei-Fei. [10]

In this paper they implement optimization based method, which is decrease per-pixel losses during image transformation while LR to HR. Parallel work has shown that high-quality images can be generated by defining and optimizing perceptual loss functions based on high-level features extracted from pretrained networks. They use optimization-based method to implement high-resolution image from low-resolution image. This method cannot useful when colors images are used in LR because the transformation task maybe complex in that image. So colorization and segmentation cannot easily detected in this method. Implement different transformation network which is detect colour in LR image also for find per-pixel losses during LR to HR transformation.

K. Single Image Super Resolution Based on Feature Enhancement by Shiyao Suo, Xiaohai He', Honggang Chen, Shuhua Xiong, Qizhi Teng. [11]

They implement SISR method in two stages. In 1st stage extract interpolated LR image features and HR image features to learn feature enhancement mapping matrices then these metrics are used to enhance the extracted feature. In 2ns stage they learn detail enhancement mapping matrices from enhanced LR image features and HR image patches. Single image super resolution (SISR) method. In this method they restore HR image through the feature enhancement mapping metrics and detail enhancement mapping metrics. Adjusted anchored neighborhood regression (A+) method. Implement subjective and objective assessment of experimental result to prove the superiority of the method over the comparative ones.

L. Single Image Super Resolution Based on Sparse Domain Selection by Wen Lu, Huxing Sun, Rui Wang, Lihuo He, MingJong Jou, ShenSian Syu, JiShiang Li. [12]

The efficient mapping between LR and HR coefficients is established by searching the sparse domain among feature spaces spanned by LR–HR dictionaries. Then this mapping and learning HR dictionary are optimized jointly through minimizing the sparse representation error and sparse domain mapping error. During the reconstruction phase, the learned mapping from the input LR feature is applied to the desired HR feature to achieve accurate and stable SR recovery. Single image super resolution method for utilizing sparse domain selection.

M. Single Image Super-Resolution Using Gaussian Process Regression With Dictionary-Based Sampling And Student-T Likelihood by Haijun Wang, Xinbo Gao Senior Member IEEE, Kaibing Zhang, Jie Li. [13]

A large dataset is available for learning task. The other is that the commonly used Gaussian likelihood in GPR is incompatible with the true observation model for SR reconstruction. a dictionary-based sampling strategy by combining all the neighbourhood samples of each atom into a compact representative training subset so as to reduce the computational complexity. Gaussian Process Regression Super Resolution Method by using dictionary based sampling and student-t likelihood that calls DSGPR method. DSGPR-based SR method cannot fully utilize the structure information in the neighbour pixels of an image patch. For future how to incorporate deep learning into a GPR-framework is also challenging work.

N. J. Jiang, X. Ma, C. Chen, T. Lu, Z. Wang, and J. Ma, "Single Image Super-Resolution via Locally Regularized Anchored Neighbourhood Regression and Nonlocal Means," IEEE Trans. Multimed., vol. 19, no. 1, pp. 15–26, 2017. [14]

The learning-based SISR. It super-resolves the input LR image patch individually by learning the prior knowledge from the LR and HR patch pairs. the nonlocal redundancies and the local geometry structure of the training data into account and develop two assembled priors to regularize the ill-posed SR reconstruction problem. By introducing the nonlocal redundancies, more robust SR estimation can be expected. First collect a training set consisting of a large number of co-occurrence LR and HR images, and then extract pairs of matching patches to form the LR and HR training sets. A compact LR dictionary is trained by sparse coding, and the corresponding HR dictionary is constructed under the assumption that LR and HR features share the same representations. In this paper author introduce the anchored neighbourhood regression (ANR) based SR method as a starting point to propose a novel SISR method by regression functions, namely locally regularized anchored neighbourhood regression based SR with NLM.

O. Q. Dai, S. Yoo, A. Kappeler, and A. K. Katsaggelos, "Sparse representation-based multiple frame video super-resolution," IEEE Trans. Image Process., vol. 26, no. 2, pp. 765–781, 2017.[15]

A novel dictionary learning algorithm utilizing consecutive video frames, rather than still images or individual video frames, which further improves the performance of the video SR algorithms. a batch and a temporally recursive multi-frame SR algorithm, which improve over single frame SR. an approach for video SR, according to which multiple LR observations of an HR video frame are utilized according to both designing coupled dictionaries connecting the sparse representation of LR and HR image frames, as well as

for constructing an HR frame. We borrow two ideas from single frame SR, namely, bi-level coupled dictionary and multiple dictionaries. Two multiple-frame super resolution (SR) algorithms based on dictionary learning and motion estimation. A motion estimation of different video frame is based on fps of frame rate. So it cannot implement same expected result on various frame rate. It gives average frame rate of LR image of video frame. Implement algorithm, which set same frame rate of every video of LR.

IV. LITERATURE SURVEY SUMMARY TABLE

Title	Author	Publication / Year	Methodology	Objective	Limitation	Future work	Tools
A fast single-image super-resolution via directional edge-guided regularized extreme learning regression	Pahedi ng Sidike, Evan Krieger , M. Zahang ir Alom, Vijayan K. Asari1, Tarek Taha	Springer / 2017	the human visual cortex system, which is sensitive to high-frequency (HF) components in an image. aim of this model is to train a neural network to estimate the missing HF components that contain structural details.	Objective of super-resolution (SR) is to increase the spatial resolution of a low-resolution (LR) image by a certain factor using either single or multiple LR input images. it presents a machine learning-based approach to reconstruct a high-resolution (HR) image from a single LR image. in this method, various directional edge responses at each pixel are considered to obtain more complete HF information and then a regularized extreme learning regression model is trained using a set of LR and HR images.	Proposed SR technique is much more complicated and can be not easily implemented in any other parallel processing architecture. If it's implemented on other languages than run time in much more than this model. It also cannot detect noise sensitivity in image and also does not perform balancing perfomance improvements and processing time.	explore direction al edge features in terms of high-order filter types and noise sensitivit y with a focus on balancin g performa nce improve ments and processin g time.	MATLA B
Bidirectio nal Recurrent Convoluti onal Networks for Multi-Frame Super-Resolution	Yan Huang, Wei Wang, Liang Wang	IEEE / 2017	Bidirectional recurrent convolutional network for multi-frame	This model can super resolve videos with complex motions and achieve state-of-the-art performance and achieved better perfomance and faster speed.	This method cannot provide better performance and faster speed while its compare with other multi-frame SR method.	in future we can perform comparis on with other multi-frame SR method.	MATLA B
Coarse-to-Fine Learning for Single-Image Super-Resolution	Kaibin g Zhang, Dachen g Tao, Fellow, IEEE, Xinbo Gao, Senior Membe r, IEEE, Xuelon g Li, Fellow, IEEE, Jie Li	IEEE / 2016	a set of simple effective mapping functions via correlative neighbor regression of grouped low-resolution to high-resolution dictionary atoms, to synthesize an initial SR estimate with particularly low computational cost. A CNR	An effective regularization term that seamlessly integrates the properties of local structural regularity, nonlocal self-similarity, and collaborative representation over relevant atoms in a learned HR dictionary, to further improve the visual quality of the initial SR estimation obtained in the coarse stage. in this paper also introduce CNR based algorithtm for synthesis and NLSRR based			MATLA B

			based algorithm for detail synthesis and an NLSRR-based algorithm for quality enhancement.	algorithm for quality enhancement.			
Edge-directed single image super-resolution via cross-resolution sharpening function learning	Wei Han, Jun Chu, Lingfeng Wang, Chunhong Pan	Springer / 2016	cross-resolution gradient sharpening function learning to obtain the high-resolution gradient. cross-resolution learning is to learn a sharpening function from low-resolution, and use it in high-resolution. edge directed single image super-resolution reconstruction is performed to obtain the sharpened high-resolution image.	Main objective is to perform a cross resolution sharpening function to recovered high resolution image from low resolution image.	They propose linear model to perform operation in each edges of low resolution image but it's not efficient to give better result estimated for high resolution image.	Implement sharpening function which perform better edge detection in low resolution image that gives estimated result for high resolution image.	MATLAB
Face super resolution based on parent patch prior for VLQ scenarios	Liang Chen, Ruimin Hu, Zhen Han, Qing Li, Zheng Lu	Springer / 2016	Neighbour embeding face super resolution method. Neighbour Embeding methods are based on the consistency assumption that the neighbors in HR / LR space form similar local geometry.	when LR images are in Very Low Quality (VLQ), the LR patches are seriously contaminated that even two distinct patches form similar appearance, which means that the consistency assumption is not well held anymore. For solve this problem they use the target patch as well as the surrounding pixels, which represent the target patch.		future work will focus on the exploration of the weight assignment and the expressing ability of data set.	MATLAB
Image Interpolation via Low-rank Matrix Completion and Recover	Feilong Cao, Miaomiao Cai, Yuanpeng Tan	IEEE / 2014	Lagrange multiplier method which handle Noisy data and random perturbations robustly.	explore the linear relationship among neighboring pixels to reconstruct a high-resolution image from a low-resolution input image.		explore using feasible and effective prior knowledge to guide	MATLAB

						higher-quality HR image recovery.	
Image Super-Resolution Via Sparse Representation	Jiancha o Yang, Student Membe r, IEEE, John Wright, Membe r, IEEE, Thoma s S. Huang, Fellow, IEEE, Yi Ma, Senior Membe r, IEEE	IEEE / 2010	Single image super resolution using Sparse Representattion is a coupled dictionaries jointly trained from high- and low-resolution image patch pairs.The compatibilities among adjacent patches are enforced both locally and globally.	the sparse representation of a low-resolution image patch can be applied with the high-resolution image patch dictionary to generate a high-resolution image patch. a sparse representation for each patch of the low-resolution input, and then use the coefficients of this representation to generate the high-resolution output.			MATLA B
Learning a no-reference quality metric for single-image super-resolution	Chao Ma, Chih-yuan yang, Xiaoka ng yang, Ming-Hsuan Yang.	IEEE / 2017	1. Full-reference metrics 2. Semi-reference metrics 3. No-reference metrics Full-reference IQA method such as MSE, PSNR, and SSIM indices are widely used in the SR. In addition to the issues on matching visual perception, Full-reference metrics can only be user for assesment when the ground-truth images are available. When ground truth images are not available, SR image can be evaluated by No-reference Mehtod.	While address the problem of perfomance evaluation based on visual perception. While most super resolution images are ecvaluated by full reference metrics. The effectiveness of metrics is not clear and required ground-truth imagesare not always availabe in practise. so address these problem cunduct the human subject studies using large set of super resolution images and propose a no-reference metrics learned from visual perceptual scores.	It does not perform well when feature of NSSA method is used in image because there are two dimension coefficient and their regressor is based on a simple linear model.		MATLA B

Optimized multiple linear mappings for single image super-resolution	Kaibing Zhanga, JieLib, Zenggang Xiongc, Xiuping Liua, Xinbo Gaob,	ELSEVIER / 2017	Implement method of expectation-maximization algorithm for improve the SR perfomance. Which start with a set of linear regressor obtained by the Multiple Linear Mapping (MLM) based method.	An improve MLM-based single image SR method by employe an EM-algorithm to jointly optimize the cluster results and the LR–HR dictionary pairs for regression.	The selection of the best mapping function requires to search the whole LR dataset, which limits its potential in real-time application.	To overcome limitation have to implement active learning stratrgy to select more imformative dataset.	MATLAB
Perceptual Losses for Real-Time Style Transfer and Super-Resolution	Justin Johnson, Alexandre Alahi, Li Fei-Fei	IEEE / 2016	They use optimization based method to implement high resolution image from low resolution image.	In this paper they implement optimization based method, which is decrease per-pixel losses during image transformation while LR to HR. Parallel work has shown that high-quality images can be generated by defining and optimizing perceptual loss functions based on high-level features extracted from pretrained networks.	This method cannot useful when colores images are used in LR because the transformation task maybe complex in that image. So colorization and segmentation cannot easily detected in this method.	implement different transformation network which is detect color in LR image also for find per-pixel losses during LR to HR transformation.	MATLAB
Single Image Super Resolution Based on Feature Enhancement	Shiyao Suo, Xiaohai He', Honggang Chen, Shuhua Xiong, Qizhi Teng	IEEE / 2017	Single image super resolution (SISR) method. In this method they restore HR image through the feature enhancement mapping metrics and detail enhancement mapping metrics. Adjusted anchored neighbouhood regression (A+) method.	they implement SISR method in two stages. In 1st stage extract interpolated LR image features and HR image features to learn feature enhancement mapping matrices then these methrics are used to enhance the extracted feature. In 2ns stage they learn detail enhancement mapping matrices from enhanced LR image features and HR image patches.		Implement subjective and objective assesment of experimental result to proove the superiority of the method over the comparative ones.	MATLAB

Single image super resolution based on sparse domain selection	Wen Lu, Huxing Sun, Rui Wang, Lihuo He, MingJong Jou, ShenSian Syu, JiShiang Li	ELSEVIER / 2017	Single image super resolution method for utilizing sparse domain selection.	The efficient mapping between LR and HR coefficients is established by searching the sparse domain among feature spaces spanned by LR–HR dictionaries. Then this mapping and learning HR dictionary are optimized jointly through minimizing the sparse representation error and sparse domain mapping error. During the reconstruction phase, the learned mapping from the input LR feature is applied to the desired HR feature to achieve accurate and stable SR recovery.			MATLAB
Single Image Super-resolution Using Gaussian Process Regression with Dictionary-based Sampling and Student-t Likelihood	Haijun Wang, Xinbo Gao Senior Member IEEE, Kaibing Zhang, Jie Li	IEEE / 2016	Gaussian Process Regeression Super Resolution Method by using dictionary based sampling and student-t likelihood that's calles DSGPR method.	A large dataset is available for learning task. The other is that the commonly used Gaussian likelihood in GPR is incompatible with the true observation model for SR reconstruction. a dictionary-based sampling strategy by combining all the neighborhood samples of each atom into a compact representative training subset so as to reduce the computational complexity.	DSGPR-based SR method cannot fully utilize the structure information in the neighbor pixels of an image patch.	For future how to incorporate deep learning into a GPR-framework is also challanging work.	MATLAB
Single Image Super-Resolution via Locally Regularized Anchored Neighborhood Regression and Nonlocal Means	Junjun Jiang Member IEEE, Xiang Ma, Chen Chen, Tao Lu, Zhongyuan Wang Member IEEE, Jiayi Ma Member IEEE	IEEE / 2016	In this paper author introduce the anchored neighborhood regression (ANR) based SR method as a starting point to propose a novel SISR method by regression functions, namely locally regularized anchored neighborhood regression based SR with NLM.	the learning-based SISR. It super-resolves the input LR image patch individually by learning the prior knowledge from the LR and HR patch pairs. the nonlocal redundancies and the local geometry structure of the training data into account and develop two assembled priors to regularize the ill-posed SR reconstruction problem. By introducing the nonlocal redundancies, more robust SR estimation can be expected. first collect a training set consisting of a large number of co-occurrence LR and HR images, and then extract pairs of matching patches to form the LR			MATLAB

				and HR training sets. A compact LR dictionary is trained by sparse coding, and the corresponding HR dictionary is constructed under the assumption that LR and HR features share the same representations.			
Sparse Representation Based Multiple Frame Video Super-Resolution	Qiqin Dai, Seunghwan Yoo, Armin Kappeler, Aggelos K. Katsaggelos, Fellow, IEEE	IEEE / 2016	two multiple-frame super resolution (SR) algorithms based on dictionary learning and motion estimation.	A novel dictionary learning algorithm utilizing consecutive video frames, rather than still images or individual video frames, which further improves the performance of the video SR algorithms. a batch and a temporally recursive multi-frame SR algorithm, which improve over single frame SR. an approach for video SR, according to which multiple LR observations of an HR video frame are utilized according to both designing coupled dictionaries connecting the sparse representation of LR and HR image frames, as well as for econstructing an HR frame. We borrow two ideas from single frame SR, namely, bi-level coupled dictionary and multiple dictionaries.	A motion estimation of different video frame is based on fps of frame rate. So it cannot implement same expected result on various frame rate. It gives average frame rate of LR image of video frame.	Implement algorithm which set same frame rate of every video of LR.	MATLAB

V. CONCLUSIONS

In earlier days, image super resolution is widely used in every area of image processing. Super resolution is used for image reconstruction and image restoration. The issue of high-resolution image when image is being resize or distort at a time pixel value of particular image is changed and so that image blurring occur due to pixel value changes. For solving this issue there are so many algorithm and techniques are available but our main goal is to improve quality of low resolution image to high resolution by using Bicubic interpolation and vector regression techniques to get better result.

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