

## **IMAGE SUPER RESOLUTION APPLICATION**

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### **ABSTRACT**

This research paper explores the practical application of image super resolution techniques in addressing the ever-growing demands for enhanced visual quality across various domains. Focusing on real-world scenarios, we delve into the implementation of state of the art algorithms to elevate the resolution of images, providing a detailed analysis of their effectiveness. Paper highlights the significance of image super resolution application in fields such as medical imagery, digital media, satellite imagery, digital media, showcasing tangible improvements in clarity and detail. Through combination of algorithmic insights and application-specific evaluations, this study contributes to the understanding of how image super resolution can be a transformative tool for refining visual data in diverse contexts.

### **1. INTRODUCTION**

Image super resolution is one of the very basic technique in order to increase the resolution of images. The need for resolution enhancement cannot be ignored in many application [1]. It could be single image based or multiple image based system. In today's time modern image processing techniques require good visual quality of image so SR is beneficial in this regard. In this paper further section explore the major applications of SR image processing .

Image super resolution application leverage advanced algorithms, often employing artificial intelligence and deep learning techniques, to enhance the resolution and quality of images and upscale them while preserving or improving their visual details, making them clearer and sharper. Users can often adjust setting to control the level of enhancement and apply the algorithms to various types of images to achieve better visual results.

Sure, an image super resolution application uses sophisticated algorithms, often based on machine learning, to enhance the quality of images. It works by analysing the existing data in an image to generate additional pixels ,thus increasing the images resolution while maintaining or improving its visual quality. How to extract 3D models of the human structure with high resolution images while reducing the level of radiation still remains a challenge [2][3] . These applications allow users to input low resolution versions, making the images clearer, sharper and more detailed. Users can typically adjust settings to control degrees of enhancement based on their preferences. We present an exhaustive summary of the current applications using SR techniques, such as the recent google skybox satellite application [4] and unmanned aerial vehicle surveillance sequences [5].

### **2. APPLICATIONS**

#### **1 .SR in satellite Image processing**

In the field of satellite imaging it is often desired to have the higher resolution of images. In order to execute this task SR plays very significant place satellite image processing area includes the image rectification, restoration, enhancement and also information extraction. Super resolved image increases the number of pixels which enhances the display of the digital image it is visual interpretation increases. It could help in removal of distortion and geographical information can be further enhanced.

Super resolution in satellite image processing typically involves the following aspects .

- Interpolation Techniques
- Frequency Domain
- Multiple Image Fusion
- Deep Learning Approaches
- Iterative Back Projection Algorithms
- Sparse Representation Techniques
- Sensor Specific Techniques
- Evaluation Metrics

Applications of super resolution in satellite image processing include improved identification of objects, enhanced cover classification and better tracking of changes over time.



**Figure 1:** SR for satellite image

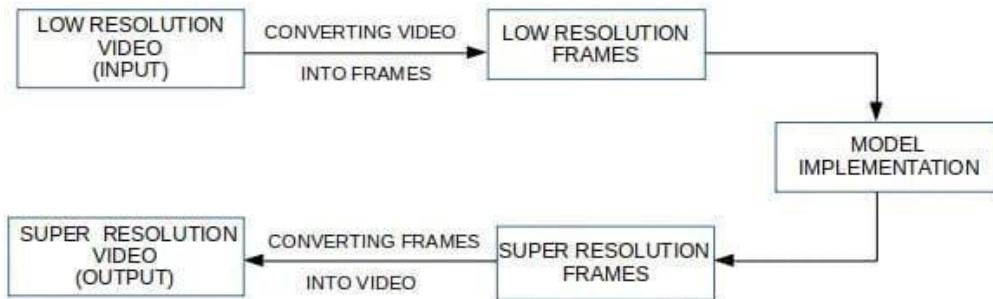
It could also include learning based techniques which are useful in Landmap construction [6][7]. That above figure proposed the mapping of satellite images with super resolution using Hopfield neural networks. They have used neural based methods of spatial fields. It is one the application in mapping using satellite imaging.

One of the other SR application is associated with the multi angle remote sensing imaging [8]. Multi angle information of the area might be having the similar information that but not exactly same. However with the application of SR it could be used for getting more information from images.

Other area of satellite image includes the classification different types areas which could also be enhanced with SR. SR mapping can include the spectral information offered by the sensors. SR mapping for extraction of urban tree crown objects from VHR satellite has done work in this area, has proposed the improvement with contextual classification approach in SR mapping and have applied it in identification and extraction of tree crown objects .

## 2. Regular video information Enhancement

Video super resolution(VSR) is reconstructing high-resolution videos from low- resolution once. Recently, the VSR methods based on deep neural networks have made great progress. However, there is rarely systematical review on these methods. In this survey, we comprehensively investigate 37 state of the art VSR methods based on deep learning it is well known that the leverage of information contained in video frames is important for video super resolution.[1] article has considered.



**Figure 2:** Architecture diagram of the video enhancement using single image super resolution model

The Figure 2 shows the Architecture diagram for the implemented video enhancement using a single image super resolution model

The application of SR technique has entered our daily life. LR video images can be converted into high definition images using SR technique. Hitachi Ltd. Achieved the conversion of standard definition tv(SDTV) to high definition television(HDTV) using SR technology for videos, which makes SR a particularly interesting and relevant research topic[9] .

## 3. Medical diagnosis

Super resolution application in medical diagnosis involve using advanced image processing techniques to enhance the quality and detail of medical images, aiding in more accurate reliable diagnosis.

Here are some specific applications

- **Magnetic Resonance Imaging (MRI)**  
Soft tissue visualization, this technique applied to MRI image enhance the visualization of soft tissues, making it easier to identify abnormalities in organs and tissues. Ultrasound Imaging Fetal imaging higher resolution ultrasound images can provide clearer views of fetal anatomy during pregnancy, aiding in the early detection of potential developmental issues. Radio imaging is shown in this explanation X-ray and CT scan images, assisting radiologists in detecting subtle abnormalities, fractures, or tumors with greater precision
- **Ophthalmology**  
Retinal Imaging techniques applied to retinal images can contribute to early detection of retinal diseases and provide more detailed information for ophthalmologists.
- **Dental Imaging**  
Tooth and jaw structure SR can enhance the quality of dental X-rays, aiding dentists in diagnosing dental issues such as cavities or structural abnormalities with greater accuracy.
- **Neuro Imaging Brain Imaging**  
It improves the resolution of brain scans, assisting in the identification of subtle structural changes associated with neurological disorders.
- **Emergency Medicine**  
Trauma Assessment can enhance the clarity of imaging for trauma assessments helping in healthcare professionals make quicker and more accurate decisions.



**Figure 3:SR in medical Imaging 4.SR in Microscopy Image processing**

Aiming at the unique SR reconstruction algorithms in the field of medical images, based on subdivided medical fields such as magnetic resonance images, computed tomography images and ultrasound images [10].

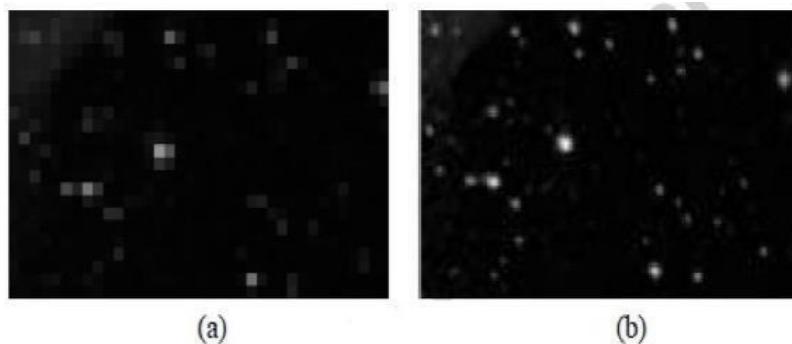
Super resolution in microscopy image processing refers to the enhancement of image resolution beyond the inherent limits of the imaging system. Various techniques, such as deconvolution algorithms or single-molecule localization microscopy (SMLM), can be employed to achieve higher spatial resolution and reveal finer details in microscopic images. These methods play a crucial role in advancing biological and medical research by providing clearer insights into cellular structures and processes. Super resolution is also playing an important role in microscopic image processing. In this area, much advancement has been done as per literature. In order to visualize the biological structures including cells and tissues, SR is very useful. Super-resolution Fluorescence microscopy is one of the very significant fields in microscopic imaging. [4]

In the past time, Fluorescence microscope is one of the essential tools for examination of the pathways, biological molecules, living cells, tissues, and even whole subjects. It is more useful as compared to electron microscopy. Other techniques like MRI or OCT (optical coherence tomography) can give resolution in 10s of centimetres and micrometers.

However, with super resolution fluorescence range can be further increased [10][11].

##### **5. Astronomical Observation**

The physical resolution of astronomical imaging devices is limited by system parameters, also providing a chance for SR techniques to play a role. Astronomical systems can typically collect a series of images for SR by improving the resolution of the exploration of outer space. A specific example is shown in Figure 4 showing an example of astronomical images. The exploration of outer space. A specific example is shown in Figure 4 showing an example of astronomical



**Figure 4:** Observation of stars

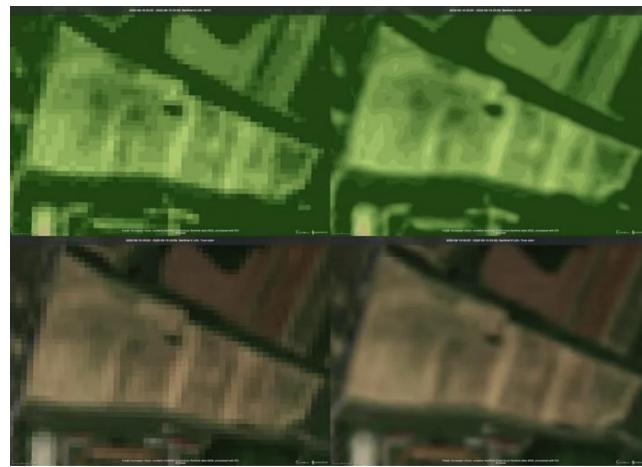
#### 6. Earth-observation remote sensing

The application of SR technique has entered our daily life. LR video images can be converted into high definition images using SR technique. Hitachi Ltd. Achieved the conversion of standard definition tv(SDTV) to high definition television(HDTV) using SR technology for videos, which makes SR a particularly interesting and relevant research topic[9]. Super resolution in Earth observation remotesensing refers to techniques that enhance the spatialresolution of images captured by satellites or othersensors. This improvement allows for more detailed and clearer imagery. Various methods, such as interpolation algorithms and machine learningbased approaches, are employed to achieve super resolution and enhance the quality of the observed data. This is particularly beneficial like land cover mapping, environmental monitoring, and disasters response, where high resolution imaginary is crucial . Super resolution technique in Earth observation remote sensing aim to enhance the spatial details of image beyond the native resolution of the sensors. Some common approaches include following.

- Interpolation Methods
- Frequency Domain Methods
- Machine Learning approaches
- Multi-Sensor

#### 7. Other Application of super resolution

Beyond all super resolution application as we mentioned in the above part of this paper. It also having application in various areas such as object detection, automotive industry, real time processing, scanning, surveillance, military and in forensics[10][12] digital photography, Video streaming, Art and Design, virtual reality, Machine learning training data, Archival and Restoration, facial recognition, printed media, industrial quality control, education and training, gaming graphics, social media, scientific imaging etc.



**Figure 5:** Image of Earth Observation

### 3. CONCLUSION

The application of image super resolution stands at the forefronts of technological advancements, offering a transformative impact across manydomains. Image super resolution plays important role in many fields and brings the very advanced and more useful application. It provides major contribution in the sector of HealthCare and Space science brings significant results. Image super resolution bring good application and good changesboth technology as well as Society by providing its number of application.

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