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Satellite Image Resolution Enhancement Using Double Density Dual-Tree Complex Wavelet Transform and Nonlocal Means

Ritesh. S. Patil[1], Mr. Pravin. S. Patil[2]

P.G. Student SSVP's College of Engineering and Research, Dhule (M.H), India[1]

SSVP's College of Engineering and Research, Dhule (M.H), India[2]

Abstract: A Multi scale decomposition based on double density dual-tree complex wavelet transform and edge preservation is presented for SRE of the satellite images. Resolution enhancement schemes (which are not based on wavelets) suffer from the drawback of losing high frequency contents (which results in blurring). The Discrete Wavelet Transform- based (DWT) RE scheme generates artifacts (due to a DWT shift-variant property). A wavelet-domain approach based on Double Density Dual-Tree Complex Wavelet Transform (DDDTCWT) and nonlocal means is used for RE of the satellite images. A satellite input image is decomposed by DDDTCWT to obtain high-frequency subbands. The high-frequency subband and the low-Resolution (LR) input image are interpolated using the bicubic interpolator. The high frequency subbands are passed through an NLM filter to cater for the artifacts generated by DDDTCWT. The filtered high-frequency subbands and the LR input image are combined using inverse DDDTCWT to obtain a resolution-enhanced image. The simulated results will show that technique used in this process provides better accuracy rather than prior methods.

Keywords: Pre-processing, double density dual-tree complex wavelet transform (DDDTCWT) nonlocal means filter (NLM), Reconstruction, Parameter analysis.

I.INTRODUCTION

Image enhancement problem can be formulated as follows: given an input low quality video and the output high quality video for specific applications. How can we make video more clearer or subjectively better? Digital video has become an integral part of everyday life. As the use of large displays is increasing, the demand for higher quality videos is growing fast in consumer market. New devices have been implemented to capture images and videos with much finer details. To this end more powerful optics and complex image stabilization mechanisms are required. Although many improvements have been made over the capturing devices and cameras, further enhancements are subjected to hardware complexity and restrictions.

In many applications including cell phone and webcam the imaging sensors capture low resolution images due to low cost sensors or physical limitation of the hardware and then a software alternative improves the quality of the captured frames. There are techniques to increase the resolution in an offline manner after that the image or video has been captured. Super-resolution (SR) is among techniques to improve the quality of the images received by the users of consumer applications such as video streaming on the Internet, cell phone devices and video conferencing. Super Resolution makes a high resolution frame out of one or a set of Low Resolution (LR) frames. In fact in low resolution images the high frequency components are missed and SR tries to estimate those missing frequencies in a way that the difference between the original image and the reconstructed SR is minimum [1].