In this dissertation, we address the multiframe super resolution reconstruction problem for wavelet-encoded images and videos. The goal of multiframe super resolution is to obtain one or more high resolution images by fusing a sequence of degraded or aliased low resolution images of the same scene. Since the low resolution images may be unaligned, a registration step is required before super resolution reconstruction. Therefore, we first explore in-band (i.e. in the wavelet-domain) image registration; then, investigate super resolution.

Our motivation for analyzing the image registration and super resolution problems in the wavelet domain is the growing trend in wavelet-encoded imaging, and wavelet-encoding for image/video compression. Due to drawbacks of widely used discrete cosine transform in image and video compression, a considerable amount of literature is devoted to wavelet-based methods. However, since wavelets are shift-variant, existing methods cannot utilize wavelet subbands efficiently. In order to overcome this drawback, we establish and explore the direct relationship between the subbands under a translational shift, for image registration and super resolution. We then employ our devised in-band methodology, in a motion compensated video compression framework, to demonstrate the effective usage of wavelet subbands. Super resolution can also be used as a post-processing step in video compression in order to decrease the size of the video files to be compressed, with downsampling added as a pre-processing step. Therefore, we present a video compression scheme that utilizes super resolution to reconstruct the high frequency information lost during downsampling. In addition, super resolution is a crucial post-processing step for satellite imagery, due to the fact that it is hard to update imaging devices after a satellite is launched. Thus, we also demonstrate the usage of our devised methods in enhancing resolution of pansharpened multi-spectral images.

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The public is welcome to attend.