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MULTIRESOLUTION SIFT VIDEO STABILIZATION SCHEME FOR ENHANCED FEATURE TRACKING AND REGISTRATION

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Abstract. Video stabilization techniques are becoming an integral component of target tracking as increased applications in the medical and military sectors utilize moving sensors, requiring advanced real time video stabilization in order to process the data. Target tracking when the camera is stationary is a relatively mature field but the moving sensor poses uniquely challenging problems because relative to the camera, everything in the scene appears to be moving. This paper presents a robust and efficient multiresolution video stabilization algorithm based on the Scale Invariant Feature Transform (SIFT) algorithm. The algorithm utilizes the Haar wavelet transformation of registered images, reducing the memory consumption while maintaining accuracy of the feature points. Important comparisons will be made between the algorithms with and without the multiresolution approach by quantitatively contrasting trade-offs in speed and accuracy. In addition, the SIFT feature tracker will be compared to Kanade-Lucas-Tomasi (KLT) algorithm, a widely used feature based tracker component in stabilization algorithms. The deficiencies of KLT and advantages of SIFT when confronted with limited features and 3D structures will be demonstrated.

Keywords. Multiresolution, Video Stabilization, Feature tracking, Registration, Haar wavelet transform

1 Problem Formulation

The moving sensor paradigm has proven to be uniquely different as compared to the stationary sensor because in addition to not knowing what the coordinates, rotation, and translation of the camera are with respect to the target, the motion of the targets must be distinguished from the global motion of the scene. This motion could result from uneven terrain, high frequency vibrations from the engine, uneven air currents, or instability of the pan-tilt camera system and presents the most challenging aspect of analyzing data from moving sensors. The movement of the camera makes the stationary background appear to move and thus even if all of the objects are stationary, the external movement makes the objects appear in different locations with different camera coordinates [4][14].