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EFFECTS OF SPATIAL DISTORTION ON IMAGE REGISTRATION PERFORMANCE

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It is frequently desired to accurately register or overlay different images of the same scene. Under conditions in which the sensor-to-scene geometry is exactly the same for both images, the registration is accomplished by simply determining the relative translation between the images. However, in many instances there are variations in the sensor-to-scene geometry which cause the images to be spatially distorted relative to one another. This condition requires that a spatial warping be applied to one of the images in addition to determining the relative translation between the images in order to achieve registration.

For many situations in which the relative spatial distortion is small (e.g., temporally differing LANDSAT images), it is assumed that the spatial differences are negligible for small subimages. Registration is accomplished by overlaying corresponding subimages within each of the images via translation only and then applying a spatial warping to one of the images based upon the subimage registrations.

One of the primary parameters that must be determined in such a procedure is the subimage size to be used for registration. The analysis carried out presents a method by which the optimum image size may be chosen based upon a model of the spatial distortion and the premise that the registration processor is designed to overlay spatially congruent images. This is done by determining the effect of the relative spatial distortion upon the output signal-to-noise ratio of the registration processor. It is shown that for spatial distortions which increase with image size (e.g., rotation, scale difference), there is an optimal image size which maximizes the output signal-to-noise ratio. The analysis is also applied to a model of spatial distortions between temporally differing LANDSAT images.