

MEASUREMENT OF IMPERVIOUS SURFACES FOR STORMWATER MANAGEMENT APPLICATIONS USING DIGITAL AERIAL IMAGERY, TOPOGRAPHIC LIDAR, AND LIDAR INTENSITY RETURNS

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ABSTRACT

Many municipal governments are implementing a parcel stratified utility tax based on the aerial coverage of impervious surfaces in an effort to recover the costs associated with stormwater management. Other environmental concerns, such as urban heat islands and poor air quality, add to the rationale for vegetated, pervious surfaces and for the measurement and restraint of expansive impervious surfaces within cities. Low spatial resolution image sensors, even those exhibiting hyperspectral sensitivity, will not allow the production of detailed planimetric landcover maps suitable for measurement justification to taxpayers. High spatial resolution imagery exhibits complex urban patterns, often confounded by shadows, surface occlusion, and spectral confusion between functionally different materials (such as sand and concrete). Such complexities usually require expert manual interpretation. This paper presents the results of a NASA Affiliated Research Center commercial technology transfer project that investigates the combined use of digital aerial imagery, topographic LiDAR, and LiDAR intensity returns for automatically mapping land cover (especially impervious surfaces) on Hilton Head Island, SC. The study uses area array CCD imagery at a nominal spatial resolution of 0.3×0.3 meters and LiDAR data (with near infrared intensity) at a nominal post spacing of 0.8 meters. An innovative approach is presented whereby an expert system adapts to optimal scales of spatial aggregation and optimal combinations of input databases within each unsupervised spectral cluster. Recommendations are given based on a comparison between the adaptive system and traditional methods of high spatial resolution land cover extraction.