Urban Tree Structure Parameter Retrieval from Aerial Stereo Imaging, LiDAR, InSAR and Polarimetric InSAR

Sean Hartling1, Abduwasit Ghulam1, Benjamin Bira1, Bethany Marshall1, Joshua Carron2, Guzelay Sataer1

1Center for Sustainability, Saint Louis University, 2Department of Parks, Recreation and Forestry, City of St. Louis

Vegetation has aesthetic, environmental, human health and economic benefits in urban ecosystems. Measurements of urban forest inventory are important for the management of urban ecosystems. An optimal strategy for the mapping and monitoring of urban forest structure would include detailed measurements of the biophysical properties that characterize the structure and health of urban trees. Traditional ground surveys are costly, time intensive and require considerable human resources. Remote sensing and Geographic Information Systems (GIS) provide cost effective solutions to large-scale detection and predictive monitoring of urban vegetation. While certain sensors are more effective than others at estimating specific variables, we aim to combine information from multiple sensors (LiDAR, stereo imaging, interferometric synthetic aperture radar (InSAR), and polarimetric InSAR (PolInSAR) ) to derive a more holistic assessment of urban tree structure (canopy height, crown diameter, biomass). In this study, the performance of these sensors for providing urban tree structure was evaluated with 200 individual samples collected in Forest Park, St. Louis, MO. We then statistically combine structural information from all sensors to improve accuracy of our structural assessments. Initial results indicate that LiDAR achieved the most accurate estimates for all structural attributes. WorldView-2 stereo imagery performs well at extracting canopy height and is a suitable supplement for areas where LiDAR data is unavailable or sparse. We will show the impact to which InSAR/PolInSAR data improves LiDAR/stereo estimates of overall tree structure. While we find only marginal contribution to canopy height accuracy, we demonstrate the ability of InSAR/PolInSAR to improve other tree structure parameters such as biomass. The results demonstrate the high potential of these remote sensing data sources for assessing urban tree structure.