In the last decade, airborne laser scanning (ALS) systems have evolved to provide increasingly high-fidelity topographic mapping data. Point clouds and derivative models now rival photogrammetrically derived equivalents. Yet, despite technological advancement and widespread adoption of light detection and ranging (LiDAR) data, sampling guidance and data quality (DQ) assessment remains an open area of research due to the volumetric and irregularly sampled nature of point clouds and the persistent influence of assumptions from early point scanning LiDAR systems on assessment methods. This dissertation makes several contributions to the research area by considering point cloud sampling strategies and DQ assessment from an information potential perspective. First, a method is developed to estimate the quantifiable information content of each point in a cloud based on localized analysis of structure and attribution. This salience measure is leveraged to significantly reduce the population of points in a cloud while minimizing information content loss to demonstrate the importance of structure and attribution to the information potential of the cloud. Next, a method is developed to efficiently perform stratified sampling under constraints that preserve specific reconstruction guarantees. The developed approach leverages the previously established salience findings to provide general guidance for efficient sampling that maximizes the information potential of point clouds and derivative levels of detail (LODs). Third, current point cloud sample spacing and density DQ assessment methods are evaluated to surface potential biases. Alternative methods are developed that efficiently measure both metrics while mitigating the discovered biases. Finally, an initial treatment of additional factors perceived as remaining gaps in the current LiDAR DQ assessment landscape is presented. Several proposed assessments directly follow from the methods developed to support sample spacing and density assessment. Initial direction is provided for addressing the remaining identified factors.

Major: Modeling and Simulation

Educational Career:
Bachelor’s of Computer and Information Science, BS, 2001, University of Florida
Master’s of Digital Arts and Sciences, MS, 2003, University of Florida
Master’s of Modeling and Simulation, MS, 2015, University of Central Florida

Committee in Charge:
Dr. Hassan Foroosh, Chair, Computer Science
Charles Hughes, Computer Science
R. Paul Wiegand, Institute for Simulation and Training
Steven Blask, L3Harris Technologies, Inc.

Approved for distribution by Dr. Hassan Foroosh, Committee Chair, on April 23, 2020.

The public is welcome to attend.