Analysis, Modeling, and Rendering of Urban Flood Events

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ABSTRACT

911 control centers wish to know the extent of flood given verbal eyewitness reports of depths at specific sites. First responders, given a flood extent map, might wish to know if a high-water vehicle can navigate a specific route. Before an event, FEMA needs accurate elevations in for issuing FIRMs (Flood Insurance Rate Maps). Many of these needs can be addressed via prior-collected data from a ranging sensor, LiDAR, in which an increasing number of municipalities are investing.

Working with organizations such as regional council of governments, FEMA, and the Army Corps of Engineers, we are integrating LiDAR with other data sources to obtain data products of higher value and accuracy. Specifically, we are determining terrain and building structure properties that lead to a better understanding of the potential risks of wind and flood damage as well as provide post-event assessment. This entails solving several problems in both the science domain and the application domain. In the application domain there are issues relevant to determining accurate breaklines, accurate roof topologies, and building heights and footprints. We address all of these.


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@inproceedings{buckles08,
     author     = {B.~P. Buckles and Laura Steinberg and Xiaohui Yuan and
                   Xiaoping Liu and Liangmei Hu and Yassine Mohammed
                   Belkhouche and Bradley Cromwell},
     title      = {Analysis, Modeling, and Rendering of Urban Flood Events},
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     month      = {May 18-21},
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```

A WAVELET-BASED NOISE-AWARE METHOD FOR FUSING NOISY IMAGERY

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ABSTRACT
Fusion of images in the presence of noise is a challenging problem. Conventional fusion methods focus on aggregating prominent image features, which usually result in noise enhancement. To address this problem, we developed a waveletbased, noise-aware fusion method that distinguishes signal and noise coefficients on-the-fly and fuses them with weighted averaging and majority voting respectively. Our method retains coefficients that reconstruct salient features, whereas noise components are discarded. The performance is evaluated in terms of noise removal and feature retention. The comparisons with five state-of-the-art fusion methods and a combination with denoising method demonstrated that our method significantly outperformed the existing techniques with noisy inputs.

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. @inproceedings{yuan07,
     author     = {Xiaohui Yuan and Bill P. Buckles},
     title      = {A Wavelet-based Noise-aware Method
                   for Fusing Noisy
                   Imagery},
     booktitle  = {Proc. {IEEE} Intern. Conf. on Image
                   Processing},
     address    = {San Antonio, TX},
     month      = {Sept. 16-19},
     year       = 2007
}
```

A PREPROCESSING METHOD FOR AUTOMATIC BREAKLINES DETECTION

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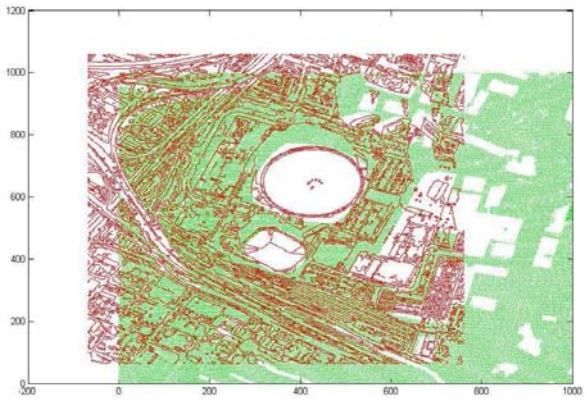
Bill P. Buckles
Xiaohui Yuan
Laura Steinberg

In the recent years, digital terrain models (DTMs) have been used in many applications such as hydrology for flood modeling, forest fire prediction and placements of antennas. Developing an accurate DTM that reflects the exact behavior of the terrain surface is a very complicated task. Different methods have been developed for DTM generation from LIDAR cloud points using interpolation methods. These methods include inverse distance weighting, kriging, as well as rectangular or triangular based methods.

In some areas where the surface behavior (slope) changes rapidly, interpolation methods incur large errors. Different situations can be identified. For example, in the case of step edges, interpol ation has to be done separately on the upper and lower surfaces. The same situation appears in case of buildings, bridges and other elevated structures. For this reason, introducing a line that separates the two sets of points is necessary. such lines are called breaklines. After the detection of all the breaklines, interpolation methods can be used for each set of points independently. Since the manual determination of breaklines is time and labor consuming, developing an automatic method becomes very important.

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@inproceedings{belkhouche08,
     author     = {M. Yassine
                   Belkhouche and Bill P. Buckles and Xiaohui Yuan and Laura
                   Steinberg},
     title      = {A Preprocessing Method for Automatic Breaklines
                   Detection},
     booktitle  = {{IEEE} International Geoscience \& Remote Sensing
                   Symposium},
     address    = {Boston},
     month      = {July 5-10},
     year       = 2008
}
```

AN ADAPTIVE METHOD FOR THE CONSTRUCTION OF DIGITAL TERRAIN MODEL FROM LIDAR DATA

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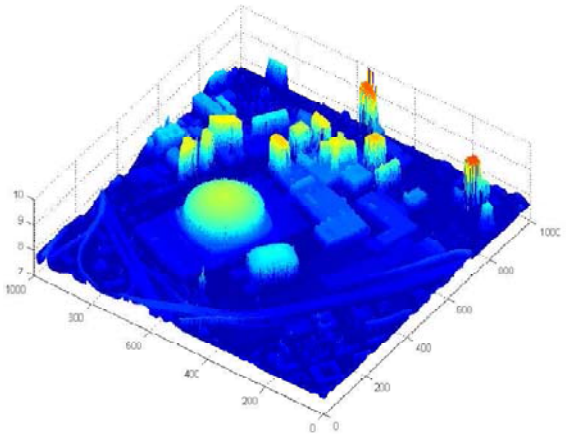
Liangmei Hu
Bill Buckles
Laura Steinberg
Vaibhav Sarma

LiDAR (Light Detection And Ranging) is an active sensor now approved by FEMA for construction of digital terrain models (DTMs). A LiDAR acquisition device measures the distance to the target by calculating the time spent in signal reflection. Together with a Global Positioning System and a Inertial Navigation System, a three-dimensional (3-D) land surface topology is obtained via an airborne LiDAR. The applications of LiDAR began slowly but are gaining momentum as the instruments and support for them improve [1, 2]. Given elevations, urban landscapes can be accurately visualized in 3-D, damage from natural disasters can be assessed (based on pre- and post-disaster data) or predicted (given the water level), line-of-sight analysis for proposed transportatio n corridors can be performed, and fine-scale air contaminant models which rely on accurate depictions of the cityscape can be improved. An important step in many of these applications is to separate bare earth measurements and construct a DTM [3, 4]. In this paper, we present an adaptive method to remove above-ground LiDAR measurements and generate DTMs. LiDAR returns from New Orleans are used to test our algorithms.



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@inproceedings{yuan08,
     author     = {Xiaohui Yuan and
                   Liangmei Hu and Bill
                   P. Buckles and Laura
                   Steinberg and Vaibhav Sarma},
     title      = {An Adaptive Method for the Construction of Digital Terrain
                   Models from LiDAR Data},
     booktitle  = {{IEEE} International Geoscience \& Remote Sensing
                   Symposium},
     address    = {Boston},
     month      = {July 5-10},
     year       = 2008
}
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