Many ecosystem services can be easily mapped from the environment, which will facilitate the improvement of analyses applied on demand. This software will provide the capability to distinguish plants from rocks, or to highlight areas at high risk of landslides. Using existing approaches, performing such analyses computationally analyzed to gain information about the environment they represent. For example, given a LiDAR image of a landscape, it is possible to distinguish plants from rocks, or to highlight areas at high risk of landslides. Using existing approaches, performing such analyses generally requires that the LiDAR image first be captured by the UAV, and then later processed after the UAV has returned to the ground. This workflow is impractical because if any part of the gathered data is incomplete or otherwise unsatisfactory, the flight must be repeated.

### What is LiDAR?
LiDAR is an acronym for Light Detection and Ranging. By shooting an array of lasers hundreds of times a second, it is possible to measure and record distance data. This information can be converted into a cloud of point data that represents an accurate three-dimensional view of the immediate environment.

### Typical Static Data Capture
An Unmanned Aerial Vehicle (UAV) can be equipped with a LiDAR sensor to capture a three-dimensional image of its surroundings. Such an image is composed of many thousands of sample points which may be computationally analyzed to gain information about the environment they represent. For example, given a LiDAR image of a landscape, it is possible to distinguish plants from rocks, or to highlight areas at high risk of landslides. Using existing approaches, performing such analyses generally requires that the LiDAR image first be captured by the UAV, and then later processed after the UAV has returned to the ground. This workflow is impractical because if any part of the gathered data is incomplete or otherwise unsatisfactory, the flight must be repeated.

### Real-Time Capture and Analysis
This project aims to develop software for the real-time reception and analysis of data gathered by a LiDAR-equipped UAV. The user can view and analyze the incoming data as the UAV is in flight, which enables the flight path to be corrected accordingly. The user will be able to see an interactive model of the landscape with selected analyses applied on demand. This software will provide the capability to easily map the environment, which will facilitate the improvement of many ecosystem services.

### Capturing LiDAR Data

### Interfacing with the Velodyne

### Processing Data with Iterative Closest Point
Since the Velodyne is continuously moving, it is necessary to align incoming point clouds to a unified coordinate space. This is accomplished with the Iterative Closest Point (ICP) algorithm, which compares two point clouds in order to produce a transformation that moves the second cloud into the space of the first. Each new point cloud is processed using ICP.

### Retrieving and Processing Data

### Visualizing the Data
Once all of the points exist in a single space, they must be displayed for the user to see. The Open Graphics Library (OpenGL) is used to provide rendering functionality. A 3D navigation interface is available so the user can ‘move around’ in the virtual environment using a mouse and keyboard. The data shown to the left is colored using height measurements, but more sophisticated processes are available.

### Conclusion

### References

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Acknowledgements
This publication was made possible by the NSF Idaho EPSCoR Program and by the National Science Foundation under award number IIA-1301792.