Height Aware 3D Application Documentation

Submitted by:

Arora Engineers, Inc.

Updated: 8/31/2018

Contents

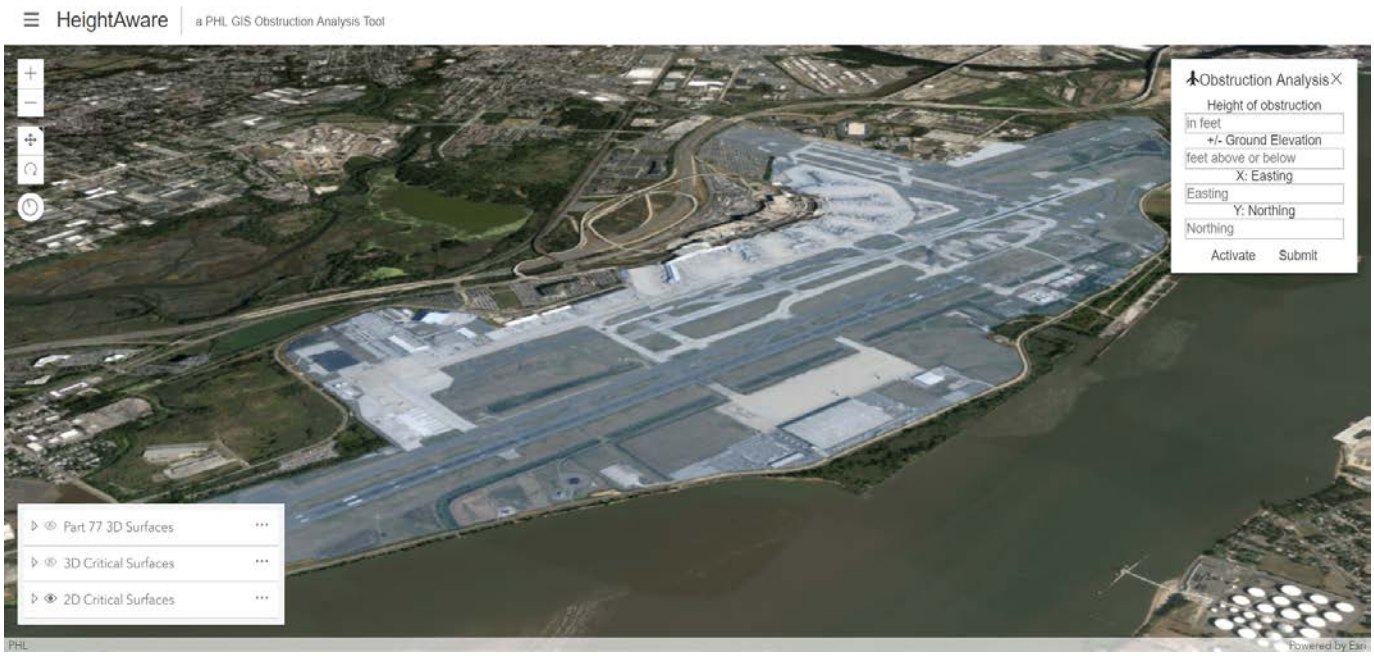

FIGURE 1 THE DEFAULT APPLICATION VIEW AFTER INITIAL LOADING

Background

The PHL HeightAware 3D application is an update to the original Height Aware application which was developed using a single map service and rendered within the application in 2D. This revised application provides much of the same functionality for analyzing proposed obstacles with several enhancements and leverages the esri 4.8 api to render the 3d view. The goal of this application is to provide a streamlined and easy-to-use application for analyzing potential obstructions in 3D. A major feature enhancement of this application is that the extent of the underlying elevation model has been greatly increased to enclose all the surfaces in the application. In figure 2, the original 1ft dem is

placed at the center of the larger USGS dem and symbolized with its own renderer based on the elevation range within its data to make the roads and bridges visible.

Elevation Sources

The original dem was built using 1ft contours generated in 2013. In the original application, estimating obstruction heights outside of this dem extent required that users enter the elevation manually before submitting the request. By leveraging the USGS 10m dems and resampling them to 1ft, this updated application provides estimated ground elevations for the entire airspace. The final dem in this 3D application was created from USGS 10m rasters with the time period of the content specified as 2015 and the published data of 3/29/2017.

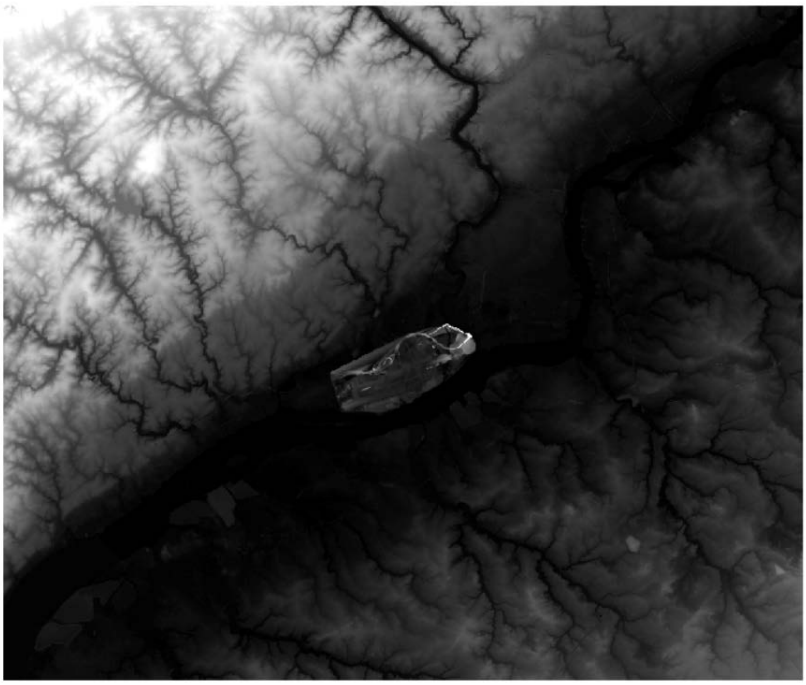

FIGURE 2 THE ORIGINAL 1FT DEM AT THE CENTER OF THE USGS 10 METER DEMS RESAMPLED TO 1FT

FIGURE 3 THE ORIGINAL 1 FT. DEM MERGED WITH THE FINAL USGS RESAMPLED 1FT DEM

In figure 3, the original 1ft dem has been merged with the USGS dems to create the final dem used in the application. The elevations of the bridges in the original dem are seen as light colored to the east of the airport. The USGS dems do not include any bridges or manmade structures.

Included Airspace Surfaces

To provide the airspace GIS data and querying capability for this obstruction analysis application, there are several map services published to an esri GIS Server.

1. CEPCT – This map service is used as the input to the Identify Task which provides the data that populates the Results of the Obstruction Analysis Window after performing an obstruction analysis. This map service is not rendered in the application is only provides data to perform analysis from the server. All of the 3d surfaces are contained in this service as rasters and polygons, and the 2D surfaces are contained as polygons.
2. 3D_Critical_Surfaces – This map service contains 3d polygons representing TERPS, Departure, and OEI surfaces for rendering in the app as Feature Layers. Each Feature Layer is rendered in 3d using the absolute height defined by the z-values in the feature geometry. The metadata for the feature layer is published on the service and contained in the feature attribute table.
3. Surfaces_Part77_3d – This map service contains 3d polygons representing the Transitional, Approach, Horizontal, and Conical surfaces for rendering in the app. Each Feature Layer is rendered in 3d using the absolute height defined by the z-values in the feature geometry. The metadata for the feature layer is published on the service and contained in the feature attribute table.
4. 2D_Critical_Surfaces – This map service contains the Air Operations Area which is loaded by default and rendered as a blue polygon on the ground surface.

Once the individual Feature Layers are created, they are added into these Group Layers in the app;

- Part 77 3D Surfaces
    - Approach
    - Transitional
    - Horizontal
    - Conical
- 3D Critical Surfaces
    - Departure
    - TERPs
    - OEI
- 2D Critical Surfaces
    - Air Operations Area

Included Airport GIS Features

Buildings are currently the only additional GIS layer being added to the Web Scene. The building polygons are rendered on-the-ground and extruded to a height (feet) specified in the STRUCTHGHT field. The color symbology chosen for the buildings is not controlled by the map service the buildings are published in. Instead, it is created in the app code using the feature layer renderer required to extrude the buildings.

** There is a roof feature class which is lacking correct z-values in many areas. There could be a benefit of improving that feature class to coincide with the extruded buildings. Ideally the buildings would be exported to a multipatch feature class and published as a Scene Layer to the DataStore on a Portal. Doing this would allow for detailed editing of the building exterior walls and advanced 3d texture rendering.

App functionality

When the app loads, the default view has the Air Operations Area (AOA) visible as a blue polygon, and the other surfaces are all turned off to be not visible. The Obstruction Analysis Panel (OAP) is open in the upper right. Clicking Activate will enable a graphic layer that is tracking the mouse location on the map. As the user moves the graphic around the map, the location and ground elevation will update in the OAP. Clicking on the map will place an obstruction with the height specified in the OAP. If the height value is not specified at the time an obstruction is placed, a default value of 200 ft. will be used. Modifying the values for the height of the obstruction and the ground elevation then clicking Submit will update the obstacle in the map as well as the results table that appears in the lower right after the obstruction surfaces are analyzed.

The ground elevation, x-coord, and y-coord are queried from the map. Using these values along with the proposed obstruction height, a 3d graphic is added to the map representing the obstacle. These same values are also submitted to the GIS Server using the IdentifyTask, and the results are used to populate the Results of Obstruction Analysis table that appears in the lower right. All surfaces that intersect the x-y location of the obstacle are returned in the results table, but only the surfaces that are penetrated by the proposed obstacle are made visible in the map.

The results from the Obstruction Analysis are calculated using the same mechanism as the original Height Aware application by subtracting the proposed obstacle height from the pixel values in the surface raster(s) provided by the CEPTC map service. If the resulting value is negative, then the Clearance is a negative value and the table cell is colored red.

In the upper left corner of the application, there is a menu button which when clicked opens a popup-menu containing the widgets that provide functionality in the app.

- **Runway Selector** – (not functioning) Provides the user with a way to filter which surfaces are contained in the analysis by runway end.
- **Obstruction Analysis** – Opens the Obstruction Analysis Panel described above
- **Legend** – Provides a small graphic for each feature type along with the layer title to assist with comprehending the surfaces displayed in the app
- **Position** – The Panel for this widget contains information about the position of the user's view in relationship to the ground and the State Plane Coordinate System. The Heading, Tilt, Eastings, Northings, and Camera Height are updated in this panel as the user navigates the app.
- **File Loader** – (not functioning) Provides the user with a way to analyze multiple obstacles by uploading them as a csv file with eastings, northings, and proposed height.
- **Measure 3D** – Opens the widget panel and displays and Active Measure button that, when clicked, will enable measuring distances in both horizontal and vertical directions. This tool will display measurements that follow the 3d features as well as the ground surface. The measured values for these multiple dimensions are all displayed and updated as the user moves the mouse location.

Data Analysis Output

Use Case Scenarios

Maintenance and Recovery Plan

This 3D Web Mapping Application requires ArcGIS Server to host the feature server and the image server. At the time of development only one GIS Server is needed. Adding more GIS Servers to the site would allow for a failover in the

event that the GIS Server needs to be taken offline. The steps for adding a GIS Server to an existing site are available here https://enterprise.arcgis.com/en/server/latest/install/windows/join-existing-site.htm.

The code base is maintained using GitHub which allows the files to be versioned into development and production branches at a minimum. Deploying the application files onto a new web server is as simple as cloning the GitHub repo and running the build script (grunt –force) which transpiles the typescript into javascript. The /src folder containing the index.html file must be registered as an application on IIS.

A web server is required to host the application files (.js, .css, and .html). We use Windows Server's IIS in development and in the cloud "production" site due to the large percentage of projects where it is the web server. It is possible to deploy this application onto any http web server that has ports 80 and 443 opened.