Subject: Re: Azimuth and Offset XYZ position correction Posted by James Kuyper on Thu, 23 Mar 2006 23:42:46 GMT

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Dave wrote:

> Hi All,

>

- > Quick question for anyone out there. I am looking to write a script and
- > I'm wondering if anyone out there has done it already. I have a known
- > precise position, say X and Y (UTM coordinate) in meters. From that
- > precise position I am using a laser range finder to calculate a
- > distance measurement from my original XY location. Along with this
- > distance measure I obtain the exact azimuth.

>

- > What I would like to do is calculate the precise XY location at the end
- > of the laser measurement.

You don't mention the elevation angle of the laser finder. Without that information, the best we can do is assume that it's 0. I would imagine that the distances you measure are much smaller than the radius of the earth, which would allow the use of certain approximations, but I'm going to use a method that will give accurate results for any distance measured along a great circle on the surface of the earth all the way up to half the circumference of the Earth. First, set up the utm map projection:

utm = MAP_PROJ_INIT('UTM', CENTER_LONGITUDE=clon, \$ CENTER LATITUDE=clat, ZONE=z);

;If you don't know what the zone is for your UTM projection, you probably aren't using

;one, and you can drop that argument. Next, convert your known position to longitude ;and latitude:

Ionlat = MAP PROJ INVERSE(known, MAP STRUCTURE=utm);

;Next, set up an azimuthal equidistant projection centered at your known position:

azeg = MAP PROJ INIT('Azimuthal Equidistant', CENTER_LONGITUDE=Ionlat[0], \$ CENTER LATITUDE=Ionlat[1]):

;The next step depends upon how you define azimuth - there is a standard convention; ;unfortunately, there are many different mutually incompatible conventions. 0 degrees ;can represent either due North, or due East. A positive azimuth can

represent either a

;clockwise or a counterclockwise rotation, as seen from above. I will assume that due

;North is 0 degrees, and that due East is +90 degrees. Then calculate appropriate :offsets:

dx = distance*sin(azimuth*!DTOR)

dy = distance*cos(azimuth*!DTOR)

;Now convert those offsets to a latitude and a longitude.

newlonlat = MAP_PROJ_INVERSE(dx, dy, MAP_STRUCTURE=azeq);

;And finally, back to UTM XY coordinates:

newxy = MAP_PROJ_FORWARD(newlonlat, MAP_STRUCTURE=utm)

There are other ways to do this, and some are more efficient, but this one hides all of the spherical trig inside the map projection code, allowing you to concentrate on other issues.

There should be a standard function to do this; it's sort-of the inverse of map_2points(). However, I couldn't find one using the built-in help.

Subject: Re: Azimuth and Offset XYZ position correction Posted by Dave[2] on Fri, 24 Mar 2006 00:42:46 GMT View Forum Message <> Reply to Message

Oops, your right I forgot the angle, we do have that information as an output. The scanner we use collects data at 250 measurements/second and scanes 270 degrees vertical and 360 horizontal.

Hypothetically speaking, if I was to feed ~5 million data points into the methodology you described, what are the chances of it choking? Or speed issues?

All in all though....great approach!!!

Dave

kuyper@wizard.net wrote:

- > Dave wrote:
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- >>
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- >> I'm wondering if anyone out there has done it already. I have a known

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    CENTER_LATITUDE=Ionlat[1]);
>
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Subject: Re: Azimuth and Offset XYZ position correction Posted by James Kuyper on Fri, 24 Mar 2006 14:12:08 GMT View Forum Message <> Reply to Message

Dave wrote:

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- > Oops, your right I forgot the angle, we do have that information as an
- > output. The scanner we use collects data at 250 measurements/second and
- > scanes 270 degrees vertical and 360 horizontal.

>

- > Hypothetically speaking, if I was to feed ~5 million data points into
- > the methodology you described, what are the chances of it choking? Or
- > speed issues?

The key step in that process was the map projections. I just tried it with 5 million randomly generated lat/lon pairs, and MAP_PROJ_FORWARD() took about 5 seconds to process them. Is that fast enough for your application?

Subject: Re: Azimuth and Offset XYZ position correction Posted by Dave[2] on Fri, 24 Mar 2006 21:07:17 GMT View Forum Message <> Reply to Message

Plenty fast enough....next step is to try and get the elevation angle incorporated.

Thanks again,

Dave

kuyper@wizard.net wrote:

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- >> output. The scanner we use collects data at 250 measurements/second and
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- > application?

Subject: Re: Azimuth and Offset XYZ position correction Posted by James Kuyper on Fri, 24 Mar 2006 23:08:48 GMT View Forum Message <> Reply to Message

Dave wrote:

- > Plenty fast enough....next step is to try and get the elevation angle
- > incorporated.

That's no big deal, if the distances you're measuring are small compared to the radius of the earth (which seems pretty likely for line-of-sight laser ranging to positions on the surface of the earth). Just multiply the dx and dy formulas I gave you by cos(elevation*!DTOR). Of course, you have to add distance*sin(elevation*!DTOR) to the altitude of your known site to get the altitude of the other site.