International Journal of Mining Science (IJMS)
Volume 6, Issue 3, 2020, PP 1-3
ISSN 2454-9460 (Online)
DOI: ***http://doi.org/10.20431/2454-9460.0603001***
www.arcjournals.org

Direct Spherical Azimuth Angles Determination

Sebahattin Bektas

19Mayıs University, Faculty of Engineering, Geomatics Department, Samsun

****Corresponding Author:*** ***Sebahattin Bektas,*** *19Mayıs University, Faculty of Engineering, Geomatics Department, Samsun*

Abstract: *In this paper, we will see that the determination of direct bearing angles. As it is known, in bearing angles are often computed used formulas with arctan function. The arctan function gives an angle values between -90^o and + 90^o. However, the bearing angle is by definition 0^o to 360^o. Consequently, it is inevitable to examine the process of obtaining the azimuth angle.*

Classic formulas only work correctly if the edge is in the 1st quarter. If the edge is located in the other quarters, the angles of the bearing should be examined. In this work we proposed a new formulas for direct bearing angles on globe (sphere). Using the formula that we propose will save execution time in codes with intensive geodesic calculations.

Keywords: *Azimuth Angles, Sphere, Geographical coordinates*

1. Introduction

For example, First Geodetic Basic problem; $P_1(\varphi_1, \lambda_1)$ the geographic coordinates of a point P1 are given in latitude longitude values , $S_{12}$the geodetic curve length from point P1 to point P2 , A_{12} theazimuth angle (bearingangle) of the length and desired$P_2(\varphi_2, \lambda_2)$ the geographic coordinates of a point P2. The azimuth $A_{21}$is desirable which is corresponding A_{12} azimuth angle. Because there is approximately 180 degrees difference between A_{12} and A_{21}. Thus, the region of A_{21} is easily predicted. If the two points are on the same meridian oron the same parallel circle the difference between A_{12} and A_{21} is exactly 180^o degrees [5],[6].

However, in the 2nd Geodetic basic problem; the geographic coordinates latitude and longitude values of the two points are given ; $P_1(\varphi_1, \lambda_1)$,P2$(\varphi_2, \lambda_2)$and required the geodesic curve length between the two points is S_{12} and the corresponding azimuths A_{12} and A_{21} between the two points. The azimuth calculation is not as easy as in the 1st Geodetic basic problem assignment. If the A_{12} azimuth is calculated incorrectly, the A_{21} azimuth will also be incorrect by itself.

In this proposed method, formulas are given for how to obtain the azimuth angle directly without any examination. The given method can calculate azimuth without reducing the sphere and ellipsoid surface.

2. Material and Methods

Calculation of between the two points S_{12} and the corresponding azimuths A_{12} and A_{21} from known P1,P2 points geographical coordinates is also called as geodetic 2nd basic problem solution (see Fig.1). Problem is solved classically with below formulas[1], [2], [4]

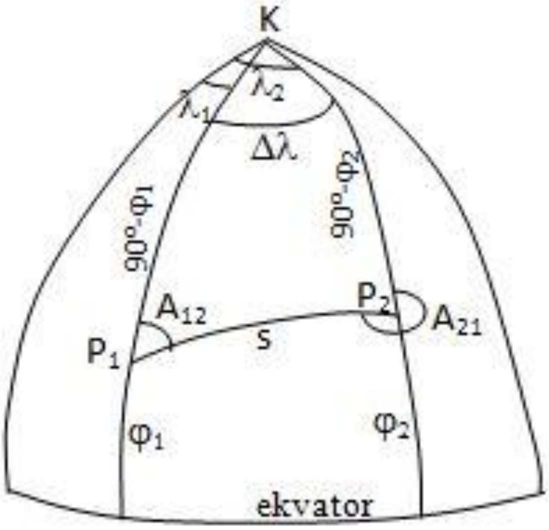

Figure1.

Classic Method;

$$\sigma = \arccos(\sin\varphi_1 \sin\varphi_2 + \cos\varphi_1 \cos\varphi_2 \cos\Delta\lambda$$

$$A_{12} = \arctan\left(\frac{\sin\Delta\lambda}{\tan\varphi_2 \cos\varphi_1 - \sin\varphi_1 \cos\Delta\lambda}\right)$$

$$A_{21} = \arctan\left(\frac{\sin\Delta\lambda}{\cos\Delta\lambda \sin\varphi_2 - \cos\varphi_2 \tan\varphi_1}\right) + \pi$$

Here σ is the angular equivalent of the edge. If you want to find the metric of the edge

$S=\sigma/\rho.R$ $\rho=180^o/\Pi$ R: radius of the earth

It is important to remember that these classic formulas only work correctly if the edge is in the 1st quarter. If the edge is located in the other quarters, the angles of the bearing angle should be examined. For correct angles, the necessary additions should be made according to the Table-1 below.

Table1. *Fixed value to add for bearing angles*

Quadrant	fixed value to add for A_{12}	fixed value to add for A_{21}
1.Quadrant	-	-
2.Quadrant	$+180^o$	$+180^o$
3.Quadrant	$+180^o$	-180^o
4.Quadrant	$+360^o$	-

Proposed Method

For direct determination of azimuth by geographic coordinates, we give below formulas. In this proposed method, formulas are given how to obtain the azimuth angle directly without any examination. The proposed method can calculate direct azimuth angles on the sphere and ellipsoid surface [3].

$$I=\sin\Delta\lambda$$

$$II=\tan\phi_2\cos\phi_1 - \sin\phi_1\cos\Delta\lambda$$

$$A_{12} = 2.\arctan\left(\frac{I}{II - \sqrt{I^2 + II^2}}\right) + 180^o$$

$$III=\tan\phi_1\cos\phi_2 - \sin\phi_2\cos\Delta\lambda$$

$$A_{21} = 2.\arctan\left(\frac{I}{-III + \sqrt{I^2 + III^2}}\right) + 180^o$$

Numerical Example

To compare direct formula and classical formula results, From the point P1 to the point P2 which is located in different quarters each time, the second basic problem solutions were made and the bearing angles calculations were made.

$P_1(\varphi_1, \lambda_1)$ the geographic coordinates of a point P1 are given in latitude longitude values:

$\varphi_1 = 30^o$, $\lambda_1 = 30^o$ R=6370000m

Required: s, A_{12} , A_{21}

If we use the above classic method formula and proposed method formula for the solution, for results please see Table-2

Table2. *Direct formula and classical formula results*

				Classic Formula		Proposed (Direct) Formula	
Quadrant	φ_2	λ_2	S	A_{12}	A_{21}	A_{12}	A_{21}
1	32	31	241911.948	22.94320	203.45833	22.94320	203.45833
2	29	32	223183.087	-60.61890	120.36606	119.38110	300.36606
3	28	29	242683.026	23.86428	203.37939	203.86428	23.37939
4	32	29	241911.948	-22.94320	156.54167	337.05680	156.54167

3. Result and Discussion

In this proposed method, formulas are given for how to obtain the azimuth angle directly without any examination. The given method can calculate azimuth without reducing the sphere and ellipsoid surface.

The numerical example that we have given shows the accuracy of the method we propose. The advantage of the method is that no examination is required. In computer calculations, *if...end* blocks are not used when direct formulas are used. The *if...end* blocks reduce the execution speed in computer calculations. For future studies, researchers are advised to try to find more simple direct formulas.

4. Conclusion

In this proposed method, formulas are given for how to obtain the azimuth angle directly without any examination. The given method can calculate azimuth without reducing the sphere and ellipsoid surface. Using the formula that we propose will save execution time in codes with intensive geodesic calculations

References

[1] Bektaş, S. (2001) :" MatematikJeodezi ", Kamer MatbaaYayıncılık,Samsun
[2] Bektaş, S. (2004) : "Jeodezik Hesap-DüzlemdeveKüreYüzeyinde Jeodezik Hesaplamalar", OMÜ yayınları,Yayın no:120,Samsun
[3] Bektaş, S. (2016) :" Pratik Jeodezi",2.Baskı, OMÜ yayınları, Yayın no:120,Samsun
[4] Yaşayan,A.,Hekimoğlu,Ş. (1982): "KüreselTrigonometri", KTÜ yayınları, Yayın no : 143/122, Trabzon
[5] Grossmann, W. (1964) :"GeodaticheRechnungen und Abbildungen in der Landesvermessung", Verlag Konrad Wittwer, Stutgart 1964
[6] Hristow,W.K.(1943):"Die Gauss-Krüger'schenKoordinaten auf dem Ellipsoid",Berlin

Citation: *Sebahattin Bektas, (2020)"Direct Spherical Azimuth Angles Determination"*, *International Journal of Mining Science (IJMS), 6(3), pp. 1-3. DOI: http://doi.org/10.20431/2454-9460.060 3001*