International Cartographic Association
Association Cartographique Internationale

Reference frame and map projection for irregular shaped celestial bodies

Krisztián Kerkovits [a,*], Tünde Takáts [a]

[a] *Department of Cartography and Geoinformatics, ELTE Eötvös Loránd University, Budapest, Hungary, Krisztián Kerkovits - kerkovits@map.elte.hu*

* Corresponding author

Keywords: map projection, planetary cartography, comet 67/P Churyumov-Gerasimenko, small celestial body

Abstract:

Recent advancements of technology resulted in greater knowledge of the Solar System and the need for mapping small celestial bodies significantly increased. However, creating a good map of such small objects is a big challenge for the cartographer: they are usually irregular shaped, the usual reference frames like the ellipsoid of revolution is inappropriate for their approximation.

A method is presented to develop best-fitting irregular surfaces of revolution that can approximate any irregular celestial body. (Fig. 1.) Then a simple equal-area map projection is calculated to map this reference frame onto a plane. The shape of the resulting map in this projection resembles the shape of the original celestial body.

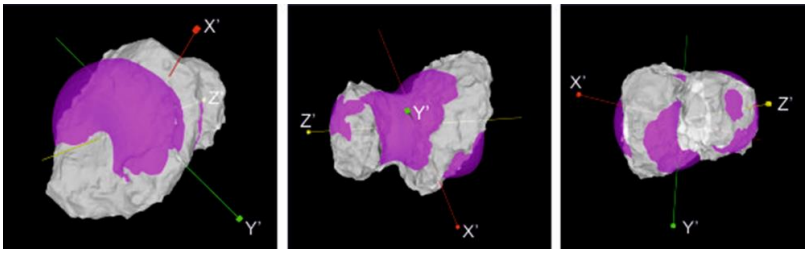

Figure 1. Best-fitting surface of revolution for comet 67/P Churyumov-Gerasimenko

The usefulness of the method is demonstrated on the example of the comet 67P/Churyumov-Gerasimenko. This comet has a highly irregular shape, which is hard to map. Previously used map projections for this comet include the simple cylindrical, which greatly distorts the surface and cannot depict the depressions of the object. Other maps used the combination of two triaxial ellipsoids as the reference frame, and the gained mapping had low distortion but at the expense of showing the tiny surface divided into 11 maps in different complicated map projections (Nyrtsov et. al., 2018). On the other hand, our mapping displays the comet in one single map with moderate distortion and the shape of the map frame suggests the original shape of the celestial body (Fig. 2. and 3.).

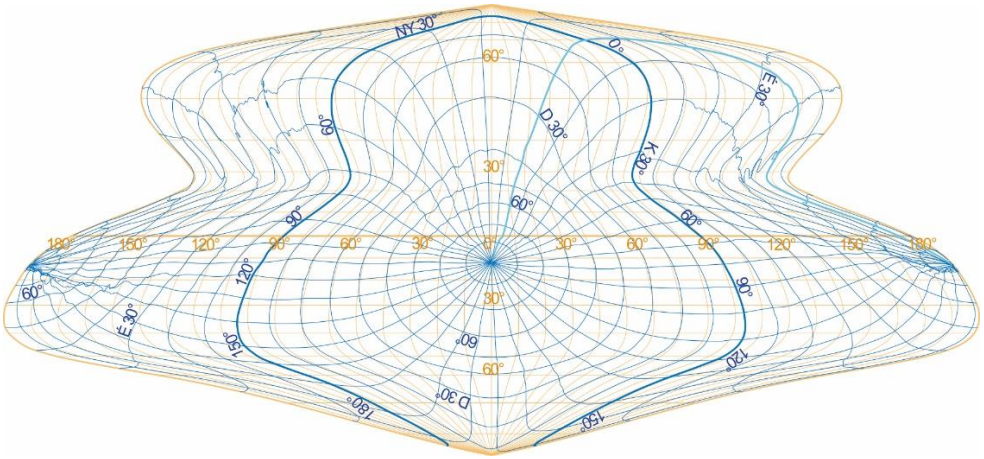

Figure 2. Map of comet 67/P Churyumov-Gerasimenko in our map projection. Blue: original spherical graticule; orange: planetocentric graticule on the general surface of revolution.

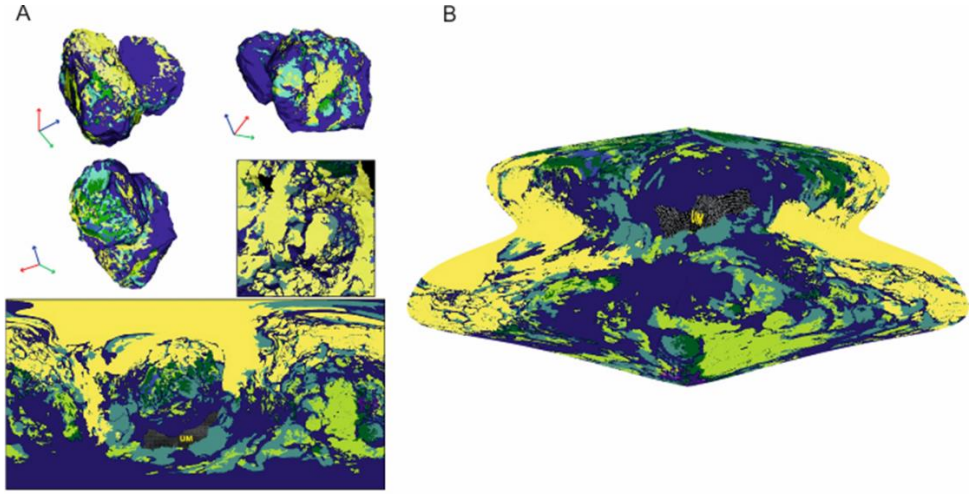

Figure 3. Part A: A geomorphological map of the comet (Birch et al., 2017); part B: the same map reprojected into our map projection

Acknowledgements

This study was funded by EFOP-3.6.3-VEKOP-16-2017-00001: Talent Management in Autonomous Vehicle Control Technologies – The Project is supported by the Hungarian Government and co-financed by the European Social Fund.

References

Birch, S. et al., 2017. Geomorphology of comet 67P/Churyumov–Gerasimenko. In: *Monthly Notices of the Royal Astronomical Society*, Vol. 469, pp. 50–67.

[Nyrtsov et. al.] М.В. Ныpцов, М.Э. Флейс, Д.Д. Николаева, А.В. Орендарчук, 2008. Картографирование небесных тел со сдвоенной фигурой в проекциях трёхосного эллипсоида на примере бинарного ядра кометы 67P/Чурюмова–Герасименко [Mapping of celestial bodies with bi-lobate shape in triaxial ellipsoid projections on example of binary nucleus of comet 67P/Churyumov-Gerasimenko]. In: *Геодезия и аэрофотосъемка* No. 5., pp. 514–523.