Subject: Re: area enclosed by a poylgon on a sphere
Posted by Struan Gray on Tue, 03 Aug 1999 07:00:00 GMT
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Ronn Kling, ronn@rlkling.com writes:

> I need to be able to find the area enclosed by an
> arbitrarily shaped series of lat/lon points on the surface
> of the Earth. I have been told that I can solve this using
> Green's Theorem, but before I gut through the math I was
> hoping that someone would have solved this and be willing to
> share the code. If it is already in IDL that would be
> great, but any language will do.

No code, but an idea which essentially uses Green's Theorem.

1) convert lat/lon to cartesian coords
2) use them to make an IDLgrPolygon object
3) use the IDLgrTessellator object to turn that
into a set of triangles
4) for each triangle work out the solid angle it
subtends from the centre of the earth
5) add up the solid angles and convert to an
area.

Working out the solid angle subtended by an arbitrary triangle of points on the surface of a sphere is left as an exercise for the reader (watch out for triplets of points on the same great circle :-).

Struan

Subject: Re: area enclosed by a poylgon on a sphere
Posted by Craig Markwardt on Tue, 03 Aug 1999 07:00:00 GMT
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Nick Bower <nick.bower@ssec.wisc.edu> writes:
>
>
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>> to share the code. If it is already in IDL that would be great, but any
>> language will do.
>

> What does area in lat's and lon's mean? Since there is no unique
> "square lat/lon" area unit, you'd have to use a projection at some point
> I would guess. Don't have any code then for the area - always used
> ArcView for this type of thing. But maybe it's possible to project,
> pick a point inside a *convex* polygon, connect it with each vertex and
> find the summed area of triangles. You'd end up with an area, but it's
> specific to your spheroid/projection pair. Sorry if it's not what
> you're after, as there's a real chance you won't have a convex shape.

My guess is that he's after the area of the surface defined by the lat/lon points on the sphere (I assume boundary lines joining the points would be great circles). This is equivalent to finding the solid angle enclosed by the points.

There is a relatively simple formula involving a sum of vector cross products which compute the area of any planar polygon, so there must be an analogous form on the surface of a sphere. Unfortunately, it doesn't come to mind immediately.

Craig

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Craig B. Markwardt, Ph.D. EMAIL: craigmnet@cow.physics.wisc.edu
Astrophysics, IDL, Finance, Derivatives | Remove "net" for better response
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Subject: Re: area enclosed by a poylgon on a sphere
Posted by Nick Bower on Tue, 03 Aug 1999 07:00:00 GMT
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nick

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Nick Bower
Space Science and Engineering Center
University of Wisconsin - Madison
http://arm1.ssec.wisc.edu/~nickb

Subject: Re: area enclosed by a poylgon on a sphere
Posted by Struan Gray on Wed, 04 Aug 1999 07:00:00 GMT
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Ronn Kling, ronn@rlkling.com writes:

> I found out how to do this today. For a spherical
> triangle the solid angle subtended is the sum (in
> radians) of the interior angles - Pi.

I'm sure you probably know this, but it's worth pointing out that the 'interior angles' are those measured on the surface of the sphere, and not the angles between chords joining the points. That is, you can't plug the cartesian coordinates of your vertices into the familiar vector formulea for angles and distances. Instead, you have to construct the two great circles which bound each vertex and calculate the complement of the angle between their normal vectors. For small areas on a large sphere it makes no difference, but the case of three points spaced equally around, and just north of, the equator makes the distinction clear: one method gives you zero, the other gives 2*pi.

One of the public IDL libraries (idlastro I *think*) has useful utility routines for great circle calculations.

Struan
