P5.5 ANALYTIC CONSTRUCTION OF INSTANTANEOUS FIELD OF VIEW ELLIPSOIDS ON AN ARBITRARY EARTH PROJECTION

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1. INTRODUCTION

The ability to draw realistic fields of view (fov) in an arbitrary earth projection has a number of uses. It can be used with coastlines to assess the geolocation and pointing accuracy of an instrument. In conjunction with surface type atlases, it can help in estimating surface emissivity and land fraction. It can also be used to easily co-locate disparate instruments from different platforms. This paper outlines a method for performing this function. The mathematical derivation is not given here, but will be published in the open literature.

2. DESCRIPTION OF THE TECHNIQUE

The fov of most nadir scanning satellite instrument normally is circular at nadir and increases in size both along and cross track as the scan angle increases. Notable exceptions to this are the AVHRR and the HIRS-4, which have square fovs. The cross track distortion is due to the fact that the fov edge closer to nadir is also farther away from the horizon, which causes a stretching of the fov. In fact the distance from the fov center to the edge farthest from nadir is larger than the distance from the fov center to the edge closest to nadir. The along track distortion is simply due to the fact that fov angle is fixed, but the distance from the satellite to the viewing location on the earth increases as the scan moves away from nadir. The technique used to produce the figures shown here assumes a spherical earth, that topography can be neglected, that the field of view can be represented by an ellipse, that the satellite attitude is nominal, that the satellite height and sub point are known, and that the location of the centers of the individual fields of view are known. The ellipse semi-major and semi-minor axes are computed from known satellite height and scan angles via plane trigonometry. The rotation of the ellipse with respect to latitude parallels is computed from the sub-satellite point and the fov location via spherical trigonometry. Finally, the ellipsoid is approximated by a polygon of an arbitrary number of sides using the equation of an ellipse in polar coordinates.

As an example of the application of this technique, Figure 1 shows the scan patterns of the AMSU-A and the AMSU-B near the equator in cylindrical coordinates. Note that the 3x3 AMSU-B pattern does not quite match the AMSU-A near the edge of scan. Figure 2 shows the same instruments near the north pole using a polar stereographic coordinate system. Figure 3 shows a 40 km fov of a hypothetical sounder in geosynchronous orbit at 100 West both as viewed from the satellite, and in cylindrical coordinates.

The figures below demonstrate the flexibility of the technique described here. The fact that the instrument fov is described in earth coordinates makes it easy to visualize their appearance in alternative coordinate systems. A future paper will investigate the utility of applying this tool to integration of sub-fov properties from a Geographic Information System.

3. ACKNOWLEDGMENTS

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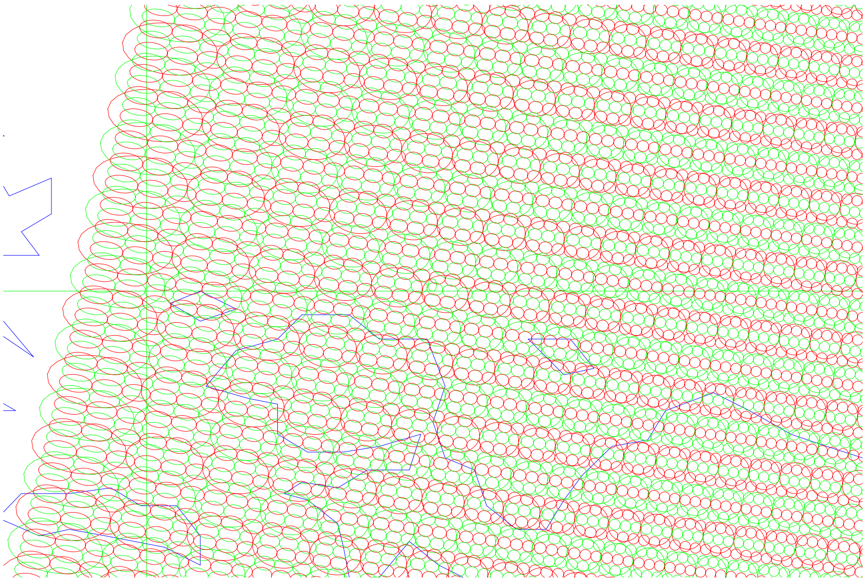

Figure 1: NOAA-17 AMSU-A and AMSU-B scan pattern in cylindrical coordinates. Coastline is North New Guinea. Scan lines alternate red and green.

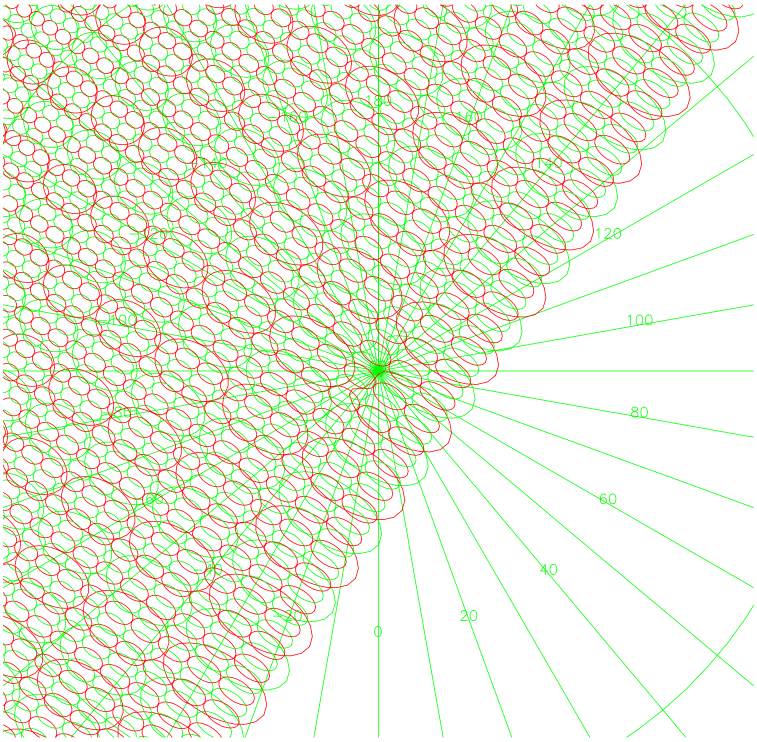

Figure 2: NOAA-17 AMSU-A and AMSU-B scan patterns near the north pole in polar stereographic coordinate. Scan lines alternate red and green.

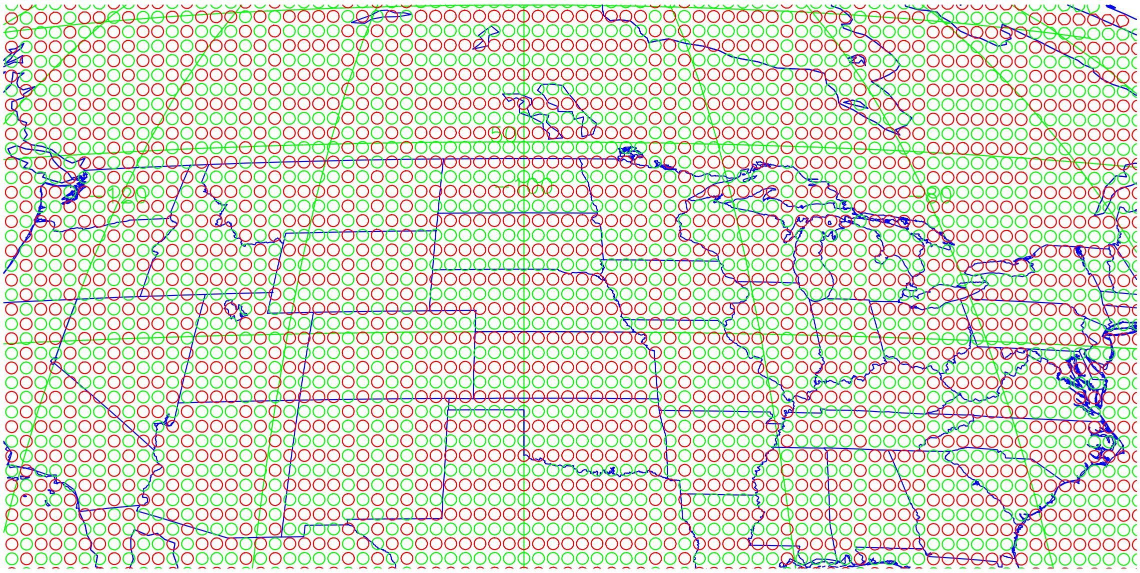

Figure 3a. Hypothetical 40 km nadir resolution geosynchronous sounder scan pattern as viewed by the satellite. Here the colors have no meaning.

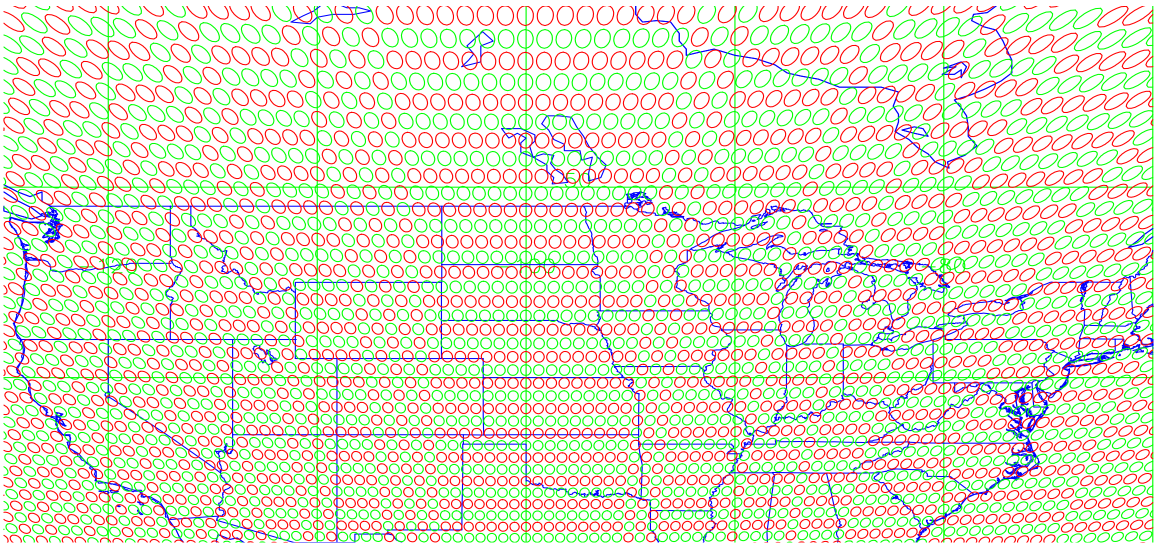

Figure 3b. Hypothetical 40 km nadir resolution geosynchronous sounder scan pattern in a cylindrical coordinate system. Here the colors have no meaning.