COMMENTARY ON "A STUDY INTO SATELLITE COVERAGE AND ORBITAL EQUATIONS" BY BIELICH, MATESI AND LE

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ℓ 40 "The orbit itself will be a Sun-synchronous orbit" —This implies a small t-varying correction to Ω (longitude of ascending node) that probably was not yet implemented.

ℓ 42 "An equi-rectangular model" i.e., for longitude ψ, latitude ϕ.

ℓ 47 "Swath angle for inclination or altitude" —Probably only directly-overhead view was considered.

$\ell\ell$ 50–54 The 4 items compose several inverse problems. The software provided with this Report completely solve the forward problem, so can be wrapped in an inverse-problem solver in various ways.

$\ell\ell$ 66, 76–77 Actually $r_1 = r_2$, just using different parameters.

ℓ 100 Note eq. 6 is just the positive half of an un-rotated ellipse.

ℓ 117 It's neglected that $e = |\boldsymbol{e}|$ where the unit vector $\boldsymbol{e}/e$ points toward the periapsis (perigee).

ℓ 119 I believe true anomaly is θ everywhere else herein.

ℓ 124 "David from Ball" actually wrote 82° in his 2019/10/20 e-mail.

ℓ 125 "h [*sic*] is the orbital momentum vector" refers to angular momentum vector $\boldsymbol{h}$, so $\boldsymbol{\nu} = \boldsymbol{h}/|\boldsymbol{h}|$ is the unit normal vector of the orbital plane.

ℓ 129 "Which is what we do" —Actually it seems the eccentric anomaly E was used.

ℓ 141 The θ in Fig. 6 is not the θ before that stood for the satellite true anomaly.

ℓ 148 I.e., Cartopy-dependent lines can probably be commented out or replaced with a simpler mapping function.

$\ell\ell$ 152, 172–174 "The one-dimensional displacement for the three Earth centered Earth fixed models" i.e., the 3D trajectory in one model presented as a 3D curve ($\boldsymbol{q}$, left) or in its 3 Cartesian components (q_1, q_2, q_3, right).

ℓ 154 "Figure 4 is the interpolation of points straddling the equator" —Actually, the interpolation only happens at the equator and a better use of Fig. 4 is to understand that the 3 satellites started at 3 different locations (ψ, ϕ), approximately $(0, 1.5)$, $(-2, 1)$, $(-1.5, -1)$, which is probably not realistic but can be easily corrected in the Python notebook.

ℓ 159 "Don't underestimate coverage" i.e., don't omit dividing by the sine of the angle in Fig. 6.

ℓ 162 "One with 5 satellites for 1/4 of a day" —Note in Fig. 8 that some satellites eventually track (almost) exactly after other ones. This can be controled in the Python notebook.

ℓ 162 "With a better input for the parameter argument of perigee, the spacing on the satellites could be better" —Actually for small e, the argument of perigee makes almost no difference. All that's required is to schedule the satellite launch times in the Python notebook.

$\ell\ell$ 174–175 "The third, polar, component . . . retains a constant magnitude" i.e., constant maximum and minimum component q_3 parallel to the pole axis, because ν_3 is constant.

ℓ 179 "The longitude of the ascending node precessing once per day" —I actually did not see this implemented in the code. The variable q_1 and q_2 extrema are due to the slow rotation of the orbital plane in terms of (ν_1, ν_2).

$\ell\ell$ 181–182 "Conversely, the second component of the ECEF position will then have it's smallest magnitude" i.e., the 3D orthogonal unit basis vectors $\boldsymbol{\lambda} = (-\nu_2, \nu_1, 0)/\sqrt{\nu_1^2 + \nu_2^2}$, $\boldsymbol{\mu} = \boldsymbol{\nu} \times \boldsymbol{\lambda}$ enable the orbit to be expressed by Cartesian coordinates $r \cos\theta = \boldsymbol{\lambda} \cdot \boldsymbol{q}$ and $r \sin\theta = \boldsymbol{\mu} \cdot \boldsymbol{q}$ in the orbital plane, each of which attains its extrema when the other is zero.

ℓ 184 "The y-axis runs . . . " i.e., the latitude ϕ-axis.

ℓ 185 "The x-axis runs . . . " i.e., the longitude ψ-axis.

$\ell\ell$ 190–193 "For each satellite, two passes are in the same north/south direction . . . at a complimentary angle". They mean the 2 satellites (2 marker colors) each display 3 eastward equator-crossings, 2 of which being opposite the 3rd in regard to north-south direction. The curve colors don't seem to be meaningful.

ℓ 198 "Calculated using the sine function" i.e., swath/coverage = sine of the angle.

ℓ 201 "Paths of five satellites", actually 5 in Fig. 8 and 3 in Fig. 9.

$\ell\ell$ 217–218 "The argument of perigee . . . the deterministic value which displaces a satellite in an orbit" is incorrect for small e, as noted above. It's just a simple launch scheduling question that the students didn't realize at the project end.

$\ell\ell$ 227–228 "Overall this tool will provide a good answer to the question Ball Aerospace asks", actually the tool will estimate coverage over time correctly for a given number of satellites. The issue of scheduling and co-locating launches was neglected but is a minor adjustment.

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