Comment on angeo-2021-63

Ciaran Beggan (Referee)

Referee comment on "The Lehtinen–Pirjola method modified for efficient modelling of geomagnetically induced currents in multiple voltage levels of a power network" by Risto J. Pirjola et al., Ann. Geophys. Discuss., https://doi.org/10.5194/angeo-2021-63-RC1, 2021

This paper provides a new method for computing GIC by simplifying the manner in which grounding resistances are treated in the traditional Lethinen and Pirjola (1985) paper. The authors revisit the derivations of the LP85 paper and from there explain their suggested change for removing virtual nodes from the equations, which are usually given a very large (e.g. 10,000 Ohm) value to represent an infinite resistance to ground. This is a useful update and easy to implement. The main advantage would be if you were to start afresh though existing codes could also be modified. The authors test the new implementation agains the Horton et al (2012) paper and reproduce the results given in the original Horton et al paper. This is a very pleasing demonstration of the method and a very useful check for others attempting to develop their own code.

Comments:

1) The use of LU decomposition is quite specific. It was not clear if the authors directly compute the inverse of $[Y^e + Y^n]$ using Matlab's pinv() function. This would not be the correct way to solve it as Matlab usually finds the best way to resolve the inversion if the A\b form (i.e. the backslash function) was used. Can I ask how the values in Table 8 were arrived at? If you are computing the inverse directly, that is not really a fair comparison of potential compute time or the savings from LP versus LPm.

2) I have found in the standard LP method that when grounding resistance is high (10,000 Ohm) the current in virtual nodes is usually near zero to within 5 decimal places. So altough this modified LPm method is mathemtically better, it is not usually an issue with regards to computing the 'wrong' value, as any GIC below 0.001 A can be considered to be zero in reality.

3) Line 225: Yn should be Y^n (twice)

4) In the contributions, I assume AM is SM?