

## ***Interactive comment on “A simple method for solving the Bussian equation for electrical conduction in rocks” by P. W. J. Glover et al.***

**Anonymous Referee #2**

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### General Comments.

This paper by PWJ Glover and coauthors reports a new method to solve the Bussian equation, which gives the effective (complex) electrical conductivity/dielectric permittivity of a medium consisting of a conductive matrix filled by a conductive fluid. This equation is obviously fundamental in rock physics, and often used for instance to determine the fluid content of a rock (by an inverse approach). As the authors said, classical solving of the direct problem (the Bussian equation) in the complex plane is not straightforward at all and rather complicated. Here, they propose a smart manner to solve this equation by using the conformal mapping technique. This is obviously of interest for rock physicists, and thus deserves publication.

### Scientific Comments.

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I have very few scientific comments, as the paper is logical, self-consistent and well-written.

1) page 4, line 5: I am not sure that the cementation exponent is sufficient to fully describe the geometry of the porous medium!

2) page 6, line 22: the fact that  $\sigma_{\text{eff}}$ ,  $\epsilon_{\text{eff}}$  or  $\kappa_{\text{eff}}$  appear on both the left-hand and right-hand sides of the equations does not imply the non-linearity (we can imagine a linear system with each term on both side)! The non linearity is due to the combination of simple and powered terms...

3) page 7, lines 9 to 12: the sentence is not clear. It needs to be reformulated. I think also that a paragraph describing the principle of the conformal mapping technique would help the reader, and will equilibrate with the paragraph where the bisection method is described.

4) Figure 4 is not so commented as figures 2 and 3. Are there here convergence/divergence problems for the imaginary part (as before for the real part)? If yes, please detail.

### Technical Comments.

5) page 2, line 12: I am not sure that the probability given here (from Student test) is speaking. Rather use the classical adjustment coefficient  $r^2$  to quantify the fitting here.

6) page 5: maybe add some references for the different methods listed.

7) The construction of section 4 is a little bit confusing. I think that the paragraphs [page 8 line 8 - page 9 line 6] has to be placed at the beginning, and followed by the paragraphs [page 7 line 16 - page 8 line 7]-[page 9 line 7 - ...]. Or remove from the first paragraph the reference to the figures.

8) page 11, line 17: please give the type of processor (e.g. intel Core quadro), and the

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exploitation system. Maybe this information should be provided to the reader before the details about the performances.

9) Table 1: Columns 3 and 4 can be merged since they are identical (for instance, "from the classical bisection method and conformal mapping technique").

10) Figure 2: There is a problem with the curves. Maybe plot the bisection results with continuous lines of different colors, and superimpose the conformal mapping results with dotted black lines.

Typos and associates.

11) Add the symbol "TM" after each "Maple", "(R)" after Matlab and Mathematica

12) page 2, line 26: "and its special case": not clear. Are some words missing here?

13) page 3, line 20: "of void" rather than "of free space"

14) page 6, line 12:  $\sigma^* = \sigma' + i \sigma''$

15) page 6, lines 17-18: remove the definition of  $\epsilon_0$ , since it appears earlier in the text

16) page 7, line 5: "soluble"? you mean "solvable"...

17) page 7, line 10: " $C \setminus ]-\infty, 0]$ ", not " $C \setminus (-\infty, 0]$ "

18) page 8, line 4: " $\phi = 0.2$  ;"

18) page 8, line 5: " $10^{-3}$  S/m ;  $10^{-5}$  S/m"

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Interactive comment on Solid Earth Discuss., 2, 213, 2010.