A new electric streamer for the characterization of river embankments

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Erratum to: "Elasticity and Permeability of Porous Fibre-Reinforced Materials Under Large Deformations"

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1. Introduction

We would like to correct a few points in our previously published paper (Federico and Grillo, 2012): an equation reported incorrectly, which however does not affect the subsequent calculations (Section 2), a formally incorrectly chosen argument of certain constitutive functions (Section 3), and a few plain mistypings (Section 4).

2. Transformation of the probability density

In our paper (Federico and Grillo, 2012), three lines after Eq. (5.27), we stated

> Note also that, since the reorientation of the fibres is driven by the deformation gradient $\boldsymbol{F}$, the *current* probability distribution $\psi_{curr} : \mathbb{S}^2_x \to \mathbb{R}^+_0$ for the orientation of the fibres at the spatial point $x = \chi(X, t)$, is entirely determined in terms of the referential probability ψ and $\boldsymbol{F}$ [...]

This means that, since the current normalised direction $\boldsymbol{m}$ is obtained from the referential direction $\boldsymbol{M}$ as $\boldsymbol{m} = \|\boldsymbol{F}\boldsymbol{M}\|^{-1}\boldsymbol{F}\boldsymbol{M}$, the current probability $\psi_{curr} : \mathbb{S}^2_x \to \mathbb{R}^+_0$ is expressible in terms of the referential probability $\psi : \mathbb{S}^2_X \to \mathbb{R}^+_0$. In our paper (Federico and Grillo, 2012), following the statement above, we reported Eq. (5.28):

$$\psi_{curr}(\boldsymbol{m}) = \psi_{curr}(\|\boldsymbol{F}\boldsymbol{M}\|^{-1}\boldsymbol{F}\boldsymbol{M}) = \psi(\boldsymbol{M}). \qquad (5.28)$$

However, Eq. (5.28) as reported above is incorrect. Indeed, what is preserved is *not* the value of the probability but, rather, the fraction of fibres contained in an infinitesimal referential solid angle $\mathrm{d}S$, which is mapped by the deformation into the infinitesimal current solid angle $\mathrm{d}s$. Therefore, always based on $\boldsymbol{m} = \|\boldsymbol{F}\boldsymbol{M}\|^{-1}\boldsymbol{F}\boldsymbol{M}$, the correct form of Eq. (5.28) is

$$\psi_{curr}(\boldsymbol{m})\,\mathrm{d}s = \psi(\boldsymbol{M})\,\mathrm{d}S. \qquad (5.28\text{ corr.})$$

We remark that the remainder of the procedure for the evaluation of the permeability is correct, since it in fact does follow Eq. (5.28 corr.), as is clear from Eq. (5.27) in Federico and Grillo (2012).

3. Spatial constitutive functions

In Eqs. (5.26), (5.27), (5.29) and. (5.30), we expressed the constitutive functions $\hat{\boldsymbol{k}}_{\mathrm{REV}}$, $\hat{\boldsymbol{k}}$ and $\hat{z}$ as depending on the right Cauchy-Green deformation $\boldsymbol{C} =$

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$F^T.F$. However, these constitutive functions depend on the deformation gradient F, i.e.,

$$\begin{aligned} \boldsymbol{k}_{\mathrm{REV}}(\boldsymbol{A}) &= \hat{\boldsymbol{k}}_{\mathrm{REV}}(\boldsymbol{F}, \boldsymbol{A}) \\ &= J^{-2}\boldsymbol{k}_0.[(J-\phi_{1\mathrm{R}})\phi_{1\mathrm{R}}[\boldsymbol{C}:\boldsymbol{A}]^{-1}\boldsymbol{F}\boldsymbol{A}\boldsymbol{F}^T \\ &\quad + (J-\phi_{1\mathrm{R}})^2\boldsymbol{g}^{-1}], \end{aligned} \tag{5.26 corr.}$$

$$\boldsymbol{k} = \hat{\boldsymbol{k}}(\boldsymbol{F}) = \int_{\mathbb{S}^2_X} \psi(\boldsymbol{M})\hat{\boldsymbol{k}}_{\mathrm{REV}}(\boldsymbol{F}, \boldsymbol{A}(\boldsymbol{M}))\,\mathrm{d}S, \tag{5.27 corr.}$$

$$\boldsymbol{k} = \hat{\boldsymbol{k}}(\boldsymbol{F}) = J^{-2}\boldsymbol{k}_0.[(J-\phi_{1\mathrm{R}})\phi_{1\mathrm{R}}\hat{\boldsymbol{z}}(\boldsymbol{F}) + (J-\phi_{1\mathrm{R}})^2\boldsymbol{g}^{-1}], \tag{5.29 corr.}$$

$$\hat{\boldsymbol{z}}(\boldsymbol{F}) = \boldsymbol{F}\left[\int_{\mathbb{S}^2_X} \psi(\boldsymbol{M})[\boldsymbol{C}:\boldsymbol{A}(\boldsymbol{M})]^{-1}\boldsymbol{A}(\boldsymbol{M})\,\mathrm{d}S\right]\boldsymbol{F}^T. \tag{5.30 corr.}$$

Consequently, in the text immediately following Eq. (5.26), the wording "explicitly dependent on the deformation $\boldsymbol{C}$" should read "explicitly dependent on the deformation $\boldsymbol{F}$". Also, in Eqs. (5.31) and (5.32), reporting the calculations in the absence of deformation, the constitutive functions $\hat{\boldsymbol{k}}$ and $\hat{\boldsymbol{z}}$ should not be evaluated at the material metric tensor $\boldsymbol{G}$ (the value attained by the right Cauchy-Green deformation $\boldsymbol{C}$ in the undeformed configuration), but at the shifter $\mathbf{1}$ (the value attained by the deformation gradient $\boldsymbol{F}$ in the absence of deformation). Therefore, Eqs. (5.31) and (5.32) should read

$$\hat{\boldsymbol{z}}(\mathbf{1}) = \mathbf{1}\left[\int_{\mathbb{S}^2_X} \psi(\boldsymbol{M})\boldsymbol{A}(\boldsymbol{M})\,\mathrm{d}S\right]\mathbf{1}^T = \mathbf{1}\boldsymbol{A}_{avg}\mathbf{1}^T = \boldsymbol{a}_{avg}, \tag{5.31 corr.}$$

$$\hat{\boldsymbol{k}}(\mathbf{1}) = \boldsymbol{k}_0.[(1-\phi_{1\mathrm{R}})\phi_{1\mathrm{R}}\boldsymbol{a}_{avg} + (1-\phi_{1\mathrm{R}})^2\boldsymbol{g}^{-1}]. \tag{5.32 corr.}$$

4. Various mistypings

We take this chance to correct some mistypings. Due to an incautious copy-and-paste operation on our part, Eq. (5.12) erroneously reports a coefficient $\phi_{1\mathrm{R}}$ before the integral sing. The correct equation is

$$V_e(\boldsymbol{C}) = \int_{\mathbb{S}^2_X} \psi(\boldsymbol{M})\, V_1(\boldsymbol{C}, \boldsymbol{A}(\boldsymbol{M}))\,\mathrm{d}S, \tag{5.12 corr.}$$

Two more obvious mistypings are in Eqs. (4.2b), (4.3), (4.6b) and (4.7), in which $\partial V^2/\partial J^2$ should have been, naturally, $\partial^2 V/\partial J^2$, and in Eq. (4.5c), where $\partial U^2/\partial J^2(1) = 0$ should have been $\partial^2 U/\partial J^2(1) = 0$.

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References

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