Accepted Manuscript

Title: Discussion of the published manuscript Lazopoulos, K.A., Karaoulanis, D., Lazopoulos, null.κ. (2016) «On fractional modelling of viscoelastic mechanical systems», Mechanics Research Communications, 78, pp. 1-5

Author: Panos Tsopelas

PII: S0093-6413(17)30379-8
DOI: http://dx.doi.org/10.1016/j.mechrescom.2017.07.016
Reference: MRC 3201

To appear in:

Received date: 17-7-2017
Accepted date: 31-7-2017

Please cite this article as: Tsopelas, Panos, Discussion of the published manuscript Lazopoulos, K.A., Karaoulanis, D., Lazopoulos, x391;.x39a;.(2016) laquo;On fractional modelling of viscoelastic mechanical systemsraquo;, Mechanics Research Communications, 78, pp.1-5.Mechanics Research Communications http://dx.doi.org/10.1016/j.mechrescom.2017.07.016

Mechanics Research Communications. Year	Publication Office: **Elsevier UK**
Editor-in-Chief: A. Rosato New Jersey Institute of Technology, Newark, New Jersey, USA Anthony.Rosato@njit.edu	

Discussion of the published manuscript Lazopoulos, K.A., Karaoulanis, D., Lazopoulos, A.K. (2016) «On fractional modelling of viscoelastic mechanical systems», Mechanics Research Communications, 78, pp. 1-5.

Panos TSOPELAS[1]

[1] *Department of Mechanics, Laboratory of Testing and Materials,School of Applied Mathematical and Physical Sciences, NTUA, Theocharis Building, Zografou Campus, 15773, Athens, GREECE*
* tsopelas@central.ntua.gr
Tel.:+30-210772-1150; fax: +30-210772-1302
Accepted: XXXXX.

Abstract

The paper [20] attempts to solve a one dimensional model of the Zener type viscoelastic model (see Fig. 1 of the paper) replacing the classical time derivatives with a new fractional time derivative that was presented earlier by two of the authors (see ref. [1], [9] and [10] cited in the work). In addition, the authors present the classical solution of what is called in the paper "conventional viscoelastic model" and the solution due to Caputo fractional derivative, which is the solution of what the authors call "existing fractional order derivative viscoelastic models". The paper seems to have several problems, typos and mistakes that will be discussed as follows

Keywords: Viscoelasticity, Fractional Derivatives, Fractional Viscoelastic Zener Model, Standard Solid Model.

1. Discussion

Regarding the classic solution in the paper, Eqns. (11), (12) and Figs. 2 and 3 are wrong. The creep compliance $J(t)=\frac{\varepsilon(t)}{\sigma_o}$ cannot start from zero. This is impossible since at zero time there will be an initial strain due to the spring E_2, thus $J(0)\rightarrow\frac{1}{E_2}$. On the other hand, the relaxation modulus $G(t)=\frac{\sigma(t)}{\varepsilon_o}$ cannot go to zero at $t\rightarrow\infty$, as shown in Fig.3 but to the value $G(\infty)=\frac{E_1E_2}{E_1+E_2}$. The numerical results in Fig. 3 start with the value of 10^{17} instead of 1.5 10^9 (N/m) and at infinite time it should approach 0.1415 10^9 (N/m). In normalized values, the G(t) curve should start from 1 and approach asymptotically 0.096. The correct form of Eqns. (11) and (12) can be easily obtained from the governing differential equations considering for the first one, excitation $\sigma(t)=\sigma_o*U(t)$ and for the second excitation $\varepsilon(t)=\varepsilon_o*U(t)$, with U(t) being the unit-step (Heaviside) function. In addition, the correct forms of these equations are reported in reference [15] of the paper (Mainardi's book page 33, Eqn. 2.19b.) These equations should read:

$$J(t)=\frac{1}{E_2}+\frac{1}{E_1}\left(1-e^{-t/\tau_\varepsilon}\right) \tag{32}$$

$$G(t)=\frac{E_2}{E_1E_2}\left(E_1+E_2e^{-t/\tau_\sigma}\right) \tag{33}$$

where, $\tau_\varepsilon=\frac{C}{E_1}$ and $\tau_\sigma=\frac{C}{E_1+E_2}$

The correct Eqns. (32) and (33) are plotted in Fig. 14a and 14b of the present letter, for the values of the parameters E_1=0.16 10^9 N/m, E_2=1.5 10^9 N/m and C=1.6 10^{10} Ns/m reported in the paper under discussion.

Regarding the solution with Caputo fractional time derivatives in the paper, Eqn. (15) and Figs. 4 and 5 have similar type of problems with the classical results. The results in Fig. 32 at page 64 of Mainardi [5], show that J(0) is not zero and G(∞) is also not zero for the fractional Zener model.