FRACTIONAL CALCULUS AND WAVES IN LINEAR VISCOELASTICITY

by Francesco Mainardi (University of Bologna, Italy)

E-mail: Francesco.Mainardi@bo.infn.it

Imperial College Press, London 2010, pp. xx+ 347.
ISBN: 978-1-84816-329-4 1-84816-329-0
`http://www.worldscibooks.com/mathematics/p614.html`

ERRATA CORRIGENDA (May 2012)

Cuiusvis hominis est errare, nullius nisi insipientis in errore perseverare. Marcus Tullius Cicero (*Oratio Philippica Duodecima*).

Thanks to all those who send corrections or detect typos and omissions! This will prove highly valuable in preparing the next edition/printing.

- **p. 17, Ch. 1**. I. Liouville, I. Hadamard, I.E. Littlewood, I Spanier would read: J. Liouville, J. Hadamard, J.E Littlewood, J. Spanier.

- **p. 31, Ch. 2**. $G(t) \equiv G_g \equiv G_e = 1/m$ would read $G(t) \equiv G_g \equiv G_e = m$.

- **p. 60, Ch. 3**. In the RHS of Eq. (3.11) $s^{1-\nu}$ would be replace by $1/s^{1-\nu}$, namely:

$$\delta(t) \div 1 \Rightarrow \frac{t^{-\nu}}{\Gamma(1-\nu)} \div \frac{1}{s^{1-\nu}}, \qquad (3.11)$$

- **p. 41, Ch. 2.5**. The sentence on the time-spectral function must read as follows: For the sake of convenience we shall omit the suffix to denote any one of the two spectra; we shall refer to $R(\tau)$ as the *time–spectral function* in $\mathbb{R}^+$, with the supplementary normalization condition $\int_0^\infty R(\tau)\, d\tau = 1$ if the integral of $R(\tau)$ in $\mathbb{R}^+$ is convergent.

- **p. 62, Ch. 3**. The R.H.S of Eq. (3.20a) must read as follows:

$$fractional \quad anti-Zener\, model\ :$$

$$\left[1 + a_1 \frac{d^\nu}{dt^\nu}\right] \sigma(t) = \left[b_1 \frac{d^\nu}{dt^\nu} + b_2 \frac{d^{(\nu+1)}}{dt^{(\nu+1)}}\right] \epsilon(t)\,, \qquad (3.20a)$$

- **p. 154, Ch. 6**. Footnote 3: tuentieth would read twentieth

- **p. 163, App. A**. Eq. (A.23) would read:

$$\int_0^\infty \mathrm{e}^{-zt^\mu}\, t^{\nu} - 1\, dt = \frac{1}{\mu}\,\frac{\Gamma(\nu/\mu)}{z^{\nu/\mu}} = \frac{1}{\nu}\,\frac{\Gamma(1+\nu/\mu)}{z^{\nu/\mu}}\,, \qquad (A.23)$$

- **p. 204, App. D**. Eq. (D.5a) would read:

$$\mathcal{E}_\nu(z) = \int_1^\infty \frac{\mathrm{e}^{-zu}}{u^\nu}\, du\,, \quad \nu \in \mathbb{R}. \qquad (D.5a)$$

- **p. 207, App. D**. Eq. (D.18b) would read:

$$\mathcal{L}\{f_2(t); s\} = \frac{1}{s}\log\left(\frac{1}{s}+1\right)\,, \quad \mathcal{R}e\, s > 0\,, \qquad (D.18b)$$

- **p.208, App. D**. Pleas read: After the previous proofs, the proof of (2.19b) is trivial.

- **p. 223, App. E**. In the RHS of Eq. (E.45) β must be replaced by β^n, namely:

$$\mathcal{E}_\alpha(\beta, t) := t^\alpha \sum_{n=0}^{\infty} \frac{\beta^n\, t^{n(\alpha+1)}}{\Gamma[(n+1)(\alpha+1)]}\,, \quad t \geq 0\,. \qquad (E.45)$$

- **p. 226, App. E**. In the LHS of Eq. (E.66) γ must be replaced by $-\gamma$, namely:

$$(1+z)^{-\gamma} = \sum_{n=0}^{\infty} \frac{\Gamma(1-\gamma)}{\Gamma(1-\gamma-n)n!}\, z^n = \sum_{n=0}^{\infty} (-1)^n\, \frac{\Gamma(\gamma+n)}{\Gamma(\gamma)n!}\, z^n\,. \qquad (E.66)$$

- **p. 226, App. E**. Eq. (E.68) would read:

$$e^{\gamma}_{\alpha,\beta}(t;\lambda) := t^{\beta-1}\, E^{\gamma}_{\alpha,\beta}\,(-\lambda t^\alpha) \text{ CM iff } \begin{cases} 0 < \alpha, \beta, \gamma \leq 1 \\ \alpha\,\gamma \leq \beta\,. \end{cases} \qquad (E.68)$$

- **p. 249, App. F**. The sentence in the middle page would read: For the series approach, let us expand the Laplace transform in series of positive powers of s and formally invert term by term.

- **p. 251, App. F**. The sentence on the absolute moments of order δ would read: The *absolute moments* of order $\delta > -1$ of the Wright M-function in $\mathbb{R}^+$ are finite and turn out to be

- **p. 252, App. F**. In the first line of Eq. (F.34) insert in the Fourier integral exp$i\kappa x$, namely:

$$\begin{aligned} \mathcal{F}\left[\tfrac{1}{2}M_\nu(|x|)\right] &:= \frac{1}{2}\int_{-\infty}^{+\infty} \mathrm{e}^{i\kappa x}\, M_\nu(|x|)\, dx \\ &= \int_0^\infty \cos(\kappa x)\, M_\nu(x)\, dx = E_{2\nu}(-\kappa^2)\,. \end{aligned} \qquad (F.34)$$

- **p. 253, App. F**. Eq. (F.36) would read

$$L_\alpha^\theta(x,t) \div \exp\left[-t\psi_\alpha^\theta(\kappa)\right] \Longleftrightarrow L_\alpha^\theta(x,t) = t^{-1/\alpha}\, L_\alpha^\theta(x/t^{1/\alpha})]\,, \qquad (F.36)$$

so the exponent α must be replaced by $1/\alpha$.

- **p. 254, App. F**. The Equation without number after (F.37) would read:

$$\left[L_\alpha^0(x,t/n)\right]^{*n} := L_\alpha^0(x,t/n) * L_\alpha^0(x,t/n) * \ldots * L_\alpha^0(x,t/n)$$

- **p. 259, App. F**. The last reference would read [Mainardi *et al.* (2010)]

- **p.262, Bibliography**. In the references Agrarwal (2000), (2001, (2002), (2003) you would read: Agrawal

- **p.272, Bibliography**. In the reference after Butzer, P.L., Kilbas, A.A., and Trujillo, J.J. (2003), which appears without authors, you would add: Butzer, P.L. and Westphal, U. (1975).

- **p. 279, Bibliography**. The reference Debnath, L. (2003b) would read: Debnath, L. (2003b). Recent developments in fractional calculus and its applications to science and engineering, *Internat. Jour. Math. and Math. Sci.* **54**, 3413–3442.

- **p. 292, Bibliography**. Before Gorenflo, R. and Rutman,R. (1994) add the reference:

Gorenflo, R., Mainardi, F. and Srivastava, H.M. (1998). Special functions in fractional relaxation-oscillation and fractional diffusion-wave phenomena, in Bainov, D. (Editor), *Proceedings VIII International Colloquium on Differential Equations, Plovdiv 1997*, VSP (International Science Publishers), Utrecht, pp. 195–202.

- **p. 303, Bibliography**. The two references to Kiryakova would be updated as follows

Kiryakova, V. (2010a). The special functions of fractional calculus as generalized fractional calculus operators of some basic functions, *Computers and Mathematics with Applications*, **59** No 3, 1128–1141.

Kiryakova, V. (2010b). The multi-index Mittag-Leffler functions as important class of special functions of fractional calculus, *Computers and Mathematics with Applications*,**59** No 5, 1885–1895.

- **p. 311, Bibliography**. This reference is updated:

Mainardi, F., Mura, A. and Pagnini, G. (2010). The M-Wright function in time-fractional diffusion processes: a tutorial survey, *Int. Journal of Differential Equations* Vol. 2010, Article ID 104505, 29 pages. [E-print `http://arxiv.org/abs/1004.2950`]

- **p. 324, Bibliography**. In two references to Rossikhin the year was missed. They would read:

Rossikhin, Yu.A. (1970). *Dynamic problems of linear viscoelasticity connected with the investigation of retardation and relaxation spectra*, PhD Dissertation, Voronezh Polytechnic Institute, Voronezh. [in Russian[

Rossikhin, Yu.A. (2010). Reflections on two parallel ways in the progress of fractional calculus in mechanics of solids, *Appl. Mech. Review* **63**, 010701/1–12.

- **p. 346, Index**. Riemann-Liouville fractional integral, 2,230 in only one line.