Contribution ID: **302** Contribution code: **S09-TMCP-001** Type: **Invited talk**

Fractional calculus in modelling hereditariness and nonlocality in transmission lines

Monday 29 August 2022 14:30 (30 minutes)

Transmission lines are traditionally modelled by considering Heaviside's elementary circuit that contains a resistor and inductor in the series branch, accounting for the energy losses and magnetic effects, while the shunt branch contains a resistor and a capacitor, accounting for the energy losses and capacitive phenomena. Classical telegrapher's equations, modelling the signal propagation in a transmission line, are obtained by assuming the infinitesimal length of the elementary circuit and by passing to a continuum.

The generalization of elementary circuit is two-fold: topological by adding the capacitor in the series branch in order to account for the charge accumulation effects along the line and constitutive in order to account for the memory effects that transmission line may display. The constitutive generalization is performed by changing the constitutive relation describing the capacitive and inductive material properties using the fractional calculus approach accounting for the short-tail memory.

On the other hand, the inclusion of nonlocal material properties of a transmission line is performed by considering the magnetic coupling of inductors in the series branch of Heaviside's elementary circuit, so that the magnetic flux is obtained as a superposition of local and constitutively given nonlocal magnetic flux through the cross-inductivity kernel. Signal propagation is studied in the case of power, exponential, and Gauss type cross-inductivity kernels.

The abstract accounts for the results obtained in collaboration with Stevan Cvetićanin and Milan Rapaić and published in [1, 2, 3].

References

1. S. M. Cvetićanin, D. Zorica, M. R. Rapaić, Generalized time-fractional telegrapher's equation in transmission line modeling, Nonlinear Dynamics, 88 (2017) 1453–1472.
2. S. Cvetićanin, D. Zorica, M. Rapaić, Non-local telegrapher's equation as a transmission line model, Applied Mathematics and Computation, 390 (2021) 125602–1–18.
3. D. Zorica, S. M. Cvetićanin, Transmission line modeling by fractional and topological generalization of the telegrapher's equation, in A. G. Radwan, F. A. Khanday, L. A. Said (Editors), Fractional-Order Modeling of Dynamic Systems with Applications in Optimization, Signal Processing, and Control, Elsevier –Academic Press, 2021, London.

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Session Classification: S09 Theoretical, Mathematical and Computational Physics

Track Classification: Scientific Sections: S09 Theoretical, Mathematical and Computational Physics