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FIRST STEP OF TRANSFORMATION OPERATORS VIA LOCAL M-DERIVATIVE

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ABSTRACT

In this paper, a transformation operator defined in the fractional derivative approach is presented, which is different from the generally known concept of transformation operator. This construction, which is developed with the local $\mathcal{M}$- derivative defined via the Mittag-Leffler function, offers an alternative approach to classical models. As an alternative to the limitations of classical derivatives, this local $\mathcal{M}$- derivative offers more flexible solutions, especially for fractional order differentiation. In this context, it is shown that the kernel function of the transformation operator defined in the paper corresponds to the solution of the given spectral problem under certain conditions. Mathematical tools such as the partial $\mathcal{M}$- derivative concept based on the local $\mathcal{M}$- derivative and integration by parts formula were used in the study. These mathematical tools contribute to the solution of both theoretical and applied problems and offer a more comprehensive approach compared to classical derivative methods. The theoretical results obtained are supported with visuals to provide a more tangible understanding of the results. As a result, this study shows how fractional derivatives can be used more flexibly and effectively as an alternative to traditional mathematical methods [1-5].

***K*eywords** Spectral theory · Local $\mathcal{M}$-derivative · Transformation operator

References

[1] A. Ansari, On finite fractional Sturm–Liouville transforms, Integr. Transf. Spec. Funct. 26 (1) (2015) 51–64.

[2] Bas, E., Acay, B. (2020). The direct spectral problem via local derivative including truncated Mittag-Leffler function, Applied Mathematics and Computation 367, 124787

[3] Levitan, B.M. and Sargjan, I.S. (1975). Introduction to Spectral Theory. Soc., Pro.

[4] Podlubny I., Fractional Differential Equations, Mathematics in Science and Engineering, 198, 41-119, 1999.

[5] Sousa J.V.C., Oliveira E.C., A new truncated M-fractional derivative type unifying some fractional derivative types with classical properties, International Journal of Analysis and Applications, 16 (1), 83-96, 2017.

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