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METHOD OF INTEGRAL TRANSFORMS IN THE THEORY OF INTEGRAL AND DIFFERENTIAL EQUATIONS OF FRACTIONAL ORDER

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Our report is devoted to solution in closed form of integral equations and ordinary and partial differential equations of fractional order by using the Laplace, Fourier and Mellin integral transforms. We give a survey of results in this field.

First we present a general approach, based on Laplace, Mellin and Fourier transforms, to deduce solution in closed form of non-homogeneous integral and ordinary differential equations of fractional order with constant coefficients. The equations under consideration involve the Liouville, Caputo, Hadamard and Riesz fractional integrals and derivatives, and their particular solutions are expressed in terms of convolutions involving fractional analogues of the Green function.

Next we give application of the direct and inverse Laplace transforms to obtain general solutions of the one-dimensional homogeneous and non-homogeneous ordinary differential equations with Liouville and Caputo fractional derivatives. We also apply the one-dimensional Laplace and Mellin transforms to solve in closed form of certain classes of ordinary differential equations with Liouville fractional derivatives and nonconstant coefficients. The results obtained are used to deduce explicit solutions of Cauchy and Cauchy-type problems for ordinary differential equations of fractional order, and, in particular, for the corresponding Cauchy problems for ordinary differential equations.

Last part of the report deals with using multi-dimensional Laplace and Fourier transforms to solve boundary value problems for homogeneous and non-homogeneous partial differential equations of fractional order. We present the results on explicit solutions of Cauchy-type and Cauchy problems for homogeneous and inhomogeneous partial differential equations with Riemann-Liouville and Caputo partial fractional derivatives generalizing the classical heat and wave equations as well as evolution equation.

Explicit solutions of the above ordinary and partial differential equations and of the corresponding Cauchy-type and Cauchy problems are given in terms of the so-called H-function and its special cases expressed via the Wright and generalized Wright functions; see [1, Chapter 1], [2, Section 18.1], [3, Section 4.1] and [4].

References

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