Symbolic Computation of Convolution Integrals of Holonomic Functions

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We describe an algorithm for the symbolic computation of convolution integrals of the form

$$\int_0^\infty g(t)f(xt)dt$$

for holonomic functions g and h. Such integrals include such well known integral transforms such as Laplace, Fourier and Hankel transforms. The input holonomic functions are represented in terms of the linear differential equations that they solve along with information about their behaviour at 0 and ∞. The algorithm produces the linear differential equation solved by the convolution integral along with regions where the solution is valid. Thentechniques make use of both algebra and analysis. The algebraic form makes use of Mellin and inverse Mellin transforms while the analysis determines when the algebra is actually valid. The resulting algorithm generalizes the MeijerG method that is the current standard found in such computer algebra systems such as Maple and Mathematica.

This is joint work with Jason Peasgood (Waterloo, Canada) and Bruno Salvy (INRIA, France).