New fast and oblivious convolution quadrature based on the global inversion of the Laplace transform

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A new generation of fast algorithms with reduced memory requirements and easy to implement for the numerical approximation of Volterra type convolutions is presented. The main ingredient is the global in time inversion of the Laplace transform of the convolution kernel. In several important applications, the Laplace transform of the kernel, also called *transfer operator*, is such that the approximation of the inverse mapping in an interval $[\delta, T]$, with $T \gg \delta$, can be computed with a unique set of quadrature weights and nodes. In order to develop such efficient quadratures we need to use all the information about the problem and thus focus on families of applications, such as fractional integrals and derivatives [1], integral formulations of Shrödinger problems [2] and evolutionary problems governed by sectorial operators [3]. Numerical results supporting the theory will be presented, showing the advantages and the potential of this new approach.

References

[1] L. Banjai, M. López-Fernández, *Efficient high order algorithms for fractional integrals and fractional differential equations*, Numer. Math, 141 (2019), pp. 289–317, .

[2] L. Banjai, M. López-Fernández, *Numerical approximation of the Schrödinger equation with concentrated potential*, J. Comp. Physics, 405 (2020), 109155.

[3] L. Banjai, M. Karkulik, M. López-Fernández, *Global in time hp-quadrature for the inversion of sectorial Laplace transforms*, in preparation.