Some challenging issues in the linear algebra of contour integral methods for PDEs

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We generalize ideas in the recent literature [1] and develop new ones [2] in order to propose a general class of contour integral methods for linear convection–diffusion PDEs and in particular for those arising in finance. These methods aim to provide a numerical approximation of the solution by computing its inverse Laplace transform. The choice of the integration contour is determined by the computation of a few suitably weighted pseudo-spectral level sets of the leading operator of the equation, defined as:

$$\sigma_{\epsilon,t}(A) = \left\{ z \in \mathbb{C} \ : \ e^{-\Re(z)t}\sigma_{\min}(A - zI) \leq \epsilon \right\}. \tag{2}$$

A fast and reliable approximation of these weighted pseudo-spectral level sets is fundamental for the use of contour integral methods. We propose a new fast pseudospectral roaming method and we show results of its application in some illustrative parabolic problems.

Joint work with N. Guglielmi *and* M. López Fernández

References

[1] N. Guglielmi, M. López Fernández and G. Nino, *Numerical inverse Laplace transform for convection-diffusion equations*, Mathematics of Computation, 89 (2020), pp. 1161-1191.

[2] N. Guglielmi, M. López Fernández and M. Manucci, *Pseudospectral roaming contour integral methods for convection-diffusion equations*, Journal of Scientific Computing, 89 (2021), pp. 1-31.