
RAJ RAO NADAKUDITI, University of Michigan
Numerical computation of convolutions in free probability

We develop a numerical approach for computing the additive, multiplicative and compressive convolution operations from free probability theory. We utilize the regularity properties of free convolution to identify (pairs of) 'admissible' measures whose convolution results in a so-called 'invertible measure' which is either a smoothly-decaying measure supported on the entire real line (such as the Gaussian) or square-root decaying measure supported on a compact interval (such as the semi-circle). This class of measures is important because these measures along with their Cauchy transforms can be accurately represented via a Fourier or Chebyshev series expansion, respectively. Thus knowledge of the functional inverse of their Cauchy transform suffices for numerically recovering the invertible measure via a non-standard yet well-behaved Vandermonde system of equations. We describe explicit algorithms for computing the inverse Cauchy transform alluded to and recovering the associated measure with spectral accuracy.