

Cockcroft Institute Seminar

Density Estimation Techniques for Charge Particle Beams

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Abstract

I present two alternative techniques for density estimation of particle distribution in a 2D code by Bassi, which simulates coherent synchrotron radiation (CSR). In the original implementation of Bassi's Monte Carlo code, the particle distribution sampled by N point-charge macroparticles is first approximated by the cosine expansion, then evaluated on the finite grid and stored for computation of retarded potentials. Both alternative techniques are grid-based, so the first step is to directly deposit macroparticles onto a finite grid. The first technique is based on the fast cosine transform on the grid, which yields a density estimation which is just as accurate as the original cosine implementation, but two orders of magnitude faster. The second and more interesting technique is to use fast wavelet transforms to judiciously denoise density estimates, thus yielding an approximation which is both appreciably more accurate and about two orders of magnitude faster. Applications to study microbunching instability are presented.