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Wavelet-based density estimation for noise reduction in plasma simulations using particles R. NGUYEN VAN YEN, Ecole Normale Superieure, Paris, D. DEL-CASTILLO-NEGRETE, Oak Ridge National Laboratory, K. SCHNEIDER, Universite Aix-Marseille, M. FARGE, Ecole Normale Superieure, Paris, G. CHEN, Oak ridge national laboratory — A limitation of particle methods is the inherent noise caused by limited statistical sampling with finite number of particles. Thus, a key issue for the success of these methods is the development of noise reduction techniques in the reconstruction of the particle distribution function from discrete particle data. Here we propose and study a method based on wavelets, previously introduced in the statistical literature to estimate probability densities given a finite number of independent measurements. Its application to plasma simulations can be viewed as a natural extension of the finite size particles (FSP) approach, with the advantage of estimating more accurately distribution functions that have localized sharp features. Furthermore, the moments of the particle distribution function can be preserved with a good accuracy, and there is no constraint on the dimensionality of the system. It is shown that the computational cost of the denoising stage is of the same order as one time step of a FSP simulation. The wavelet method is compared with the recently introduced proper orthogonal decomposition approach in Ref. [D. del-Castillo-Negrete, et al., Phys. Plasma, **15** 092308 (2008)].

D. del-Castillo-Negrete
Oak Ridge National Laboratory

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