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Proper orthogonal decomposition and wavelet methods for noise reduction in particle-based transport calculations ROMAIN NGUYEN VAN YE, LMD-IPSL-CNRS, Normale Supérieure Paris, DIEGO DEL-CASTILLO-NEGRETE, D. SPONG, S. HIRSHMAN, Oak Ridge National Laboratory, M. FARGE, LMD-IPSL-CNRS, Normale Supérieure Paris — A limitation of particle-based transport calculations is the noise due to limited statistical sampling. Thus, a key element for the success of these calculations is the development of efficient denoising methods. Here we discuss denoising techniques based on Proper Orthogonal Decomposition (POD) and Wavelet Decomposition (WD). The goal is the reconstruction of smooth (denoised) particle distribution functions from discrete particle data obtained from Monte Carlo simulations. In 2-D, the POD method is based on low rank truncations of the singular value decomposition of the data. For 3-D we propose the use of a generalized low rank approximation of matrices technique. The WD denoising is based on the thresholding of empirical wavelet coefficients [Donoho et al., 1996]. The methods are illustrated and tested with Monte-Carlo particle simulation data of plasma collisional relaxation including pitch angle and energy scattering. As an application we consider guiding-center transport with collisions in a magnetically confined plasma in toroidal geometry. The proposed noise reduction methods allow to achieve high levels of smoothness in the particle distribution function using significantly less particles in the computations.

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