Nonlinear Effects in Accelerator Physics: from Scale to Scale via Wavelets, A.N. FEDOROVA, M.G. ZEITLIN, IPME, Russian Academy of Sciences; Z. PARSA, BNL - This is a first part of two talks in which we present applications of powerful methods of wavelet analysis to polynomial approximations for a number of nonlinear accelerator physics problems contained such effects as presence of multiscaling, chaotic and localization phenomena. We give the general multiscale or multiresolution expansion for the solution of the general nonlinear dynamical problem, which contains polynomial nonlinearities and arbitrary variable coefficients (with or without singularities) [1]. We start from variational approach and reduce initial dynamical problem to a number of algebraical problems. After solving reduced problems we have the explicit (in time or in coordinate or both) representation for all dynamical variables in the basis of the well-localized type of functions. The localization is the best both in initial space and corresponding Fourier space representation. We can compare the contribution to the energy spectrum from each level of resolution or from each scale. We consider the analogous representations for constrained problems. Also we consider applications of discrete wavelet analysis technique to maps, which come from discretization of continous problems.

[1] A.N. Fedorova, M.G. Zeitlin, American Institute of Physics, Conf. Proc., Beam Stability and Nonlinear Dynamics, vol. 405, pp.87-102, 1997 or Los Alamos preprint physics/9710035.