Bruneau, Ch. H.; Fischer, P.; Peter, Z.; Yger, A.
Comparison of numerical methods for the computation of energy spectra in 2D turbulence. 
I: Direct methods. (English) Zbl 1137.94312

Summary: The widely accepted theory of two-dimensional turbulence predicts a direct enstrophy cascade 
with an energy spectrum that behaves in terms of the frequency range $k$ as $k^{-3}$ and an inverse energy 
cascade with a $k^{-5/3}$ decay. However, the graphic representation of the energy spectrum (even its shape) 
is closely related to the tool which is used to perform the numerical computation. With the same initial 
flow, eventually treated thanks to different tools such as wavelet decompositions or POD representations, 
the energy spectra are computed using direct various methods: FFT, auto-covariance function, auto 
regressive model, and wavelet transform. Numerical results are compared to each other and confronted 
with theoretical predictions. In a forthcoming part II some adaptive methods combined with the above 
direct ones will be developed.

MSC:
94A12 Signal theory (characterization, reconstruction, filtering, etc.)
62M15 Inference from stochastic processes and spectral analysis
76F65 Direct numerical and large eddy simulation of turbulence

Keywords:
time-series analysis; power spectra; auto correlation; wavelets decomposition; auto regressive methods; 
proper orthogonal decomosition; wavelet and cosine packets

Full Text: Link