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Fourier power spectrum of ocean data with data missing or irregular sampling

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Fourier power spectrum plays an important role in the dynamical analysis, which associates the energy with different frequencies/scales. Due to a large range of scale interaction in the ocean, power-law behavior of the Fourier power spectrum is emerged spontaneously. This behavior is a signature of the turbulence cascade. However, the collected data, such as ocean current and temperature, are either with missing data or with irregular sampling, which violates the application of the Fast Fourier Transform (FFT). In this work, with the help of the bootstrap procedure and Wiener-Khichine theorem, we propose a systematical way to estimate the Fourier power spectrum without bias from the data missing or irregular sampling. We first validate the new method via a numerical experiment with fractal Brownian motion. It is then applied to ocean current velocity data which was collected form ADCP in the South China Sea to show the efficiency of the new algorithm. It is indicated that the measured scaling exponents for the South China Sea to be -3 and -5/3, respectively for scale below 200 km and scale above 200 km fluctuations, coincidently agreeing with the theoretical prediction of the Kraichnan's 2D turbulence.