E201/ME160 UC Berkeley Ocean Engineering Seminar

SPRING 2024

Biologically Generated Turbulence and the Direction of Spectral Energy Flux

By

Professor Lei Fang

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Friday, February 23rd, 2024, Room: 3110, Etcheverry Hall

2:30- 4:00 PM

Abstract:

It has been proposed that biologically generated turbulence plays an important role in material transport and ocean mixing. Both experimental and numerical studies have reported evidence of the non-negligible mixing by moderate Reynolds number swimmers, such as zooplankton, in quiescent water especially at aggregation scales. However, the interaction between biologically generated agitation and the background flow as a key factor in biologically generated turbulence that could reshape our previous knowledge of biologically generated turbulence, has long been ignored. Here, we show that the geometry between the biologically generated agitation and the background hydrodynamic shear can determine both the intensity and direction of biologically generated turbulent energy flux. Measuring the migration of a centimeter-scale swimmer-as represented by the brine shrimp Artemia salina-in a shear flow and verifying through an analogue experiment with an artificial jet and a programmed rod array revealed that different geometries between the biologically generated agitation and the background shear can result in spectral energy transferring toward larger or smaller scales, which consequently intensifies or attenuates the large scale hydrodynamic shear. Our results suggest that the long ignored geometry between the biologically generated agitation and the background flow field is an important factor that should be taken into consideration in future studies of biologically generated turbulence.

Speaker Biography:

Dr. Lei Fang received a Ph.D. from Stanford University in the Civil and Environmental Engineering Department with a Ph.D. minor in Computational and Mathematical Engineering in 2020. After that, he joined Civil and Environmental Engineering at the University of Pittsburgh as an Assistant Professor. His research focuses on turbulence dynamics and transport and mixing problems with particular emphasis on topics relevant to biology, environment, and health. Current interests include the two-way coupling between swimmers and flows, biologically generated mixing, and the development of new experimental methods.

Hosted by: Prof. Evan Variano, (variano@berkeley.edu)