Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

Spectral Proper Orthogonal Decomposition of Flow Around a Disk in Homogeneous and Stratified Fluids[1] SHEEL NIDHAN, University of California San Diego, KARU CHONGSIRIPINYO, Chulalongkorn University, SUTANU SARKAR, OLIVER SCHMIDT, University of California San Diego —
The eduction of coherent structures and quantification of their role is a cornerstone of research in turbulent flows. Proper orthogonal decomposition (POD) introduced by Lumley to turbulent flows is a technique which can be used to identify the coherent structures that optimally capture the fluctuation kinetic energy of the flow. In this study, a space-time variant of POD, namely spectral POD (SPOD) is used to study the dynamics of the wake behind a disk at $Re = 50,000$. Two cases, a stratified flow with $Fr = U/ND = 2$ that evolves into a regime of strongly stratified turbulence (SST) and an unstratified case with $Fr = \infty$, are analyzed. Preliminary results for $Fr = \infty$ show that the wake fluctuation energy is dominated by azimuthal modes, $m = 0, 1$ and 2. As the wake evolves downstream beyond $x/D \approx 60$, $m = 2$ (at Strouhal number, $St = 0$) becomes dominant while the $m = 1$ mode (at $St = 0.136$) dominates in the near wake. At $Fr = 2$, the energy captured in the most energetic POD mode increases downstream, indicating the increasing importance of coherent modes in the stratified wake as it evolves downstream. In further analysis of modal dynamics, the Reynolds stresses carried by the dominant modes and the intermodal energy transfer among these modes will be quantified.

[1]Office of Naval Research

Sheel Nidhan
University of California San Diego

Date submitted: 31 Jul 2019 Electronic form version 1.4