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Sudden kinks in proper orthogonal decomposition modes of vorticity field for a turbulent flow past a ship topside subject to oscillatory motion[1] XIAOFENG LIU, San Diego State University, ANISH SYDNEY, NAIPEI BI, Naval Surface Warfare Center Carderock Division, SAN DIEGO STATE UNIVERSITY COLLABORATION, NAVAL SURFACE WARFARE CENTER CARDEROCK DIVISION COLLABORATION — Complex flow fields above and around ship deck often exhibit a wide range of temporal and spatial features in fluid motion, which affects not only the ship performance, but also Launch and Recovery (L&R) of air vehicles. To characterize the complex turbulent flow over a ship topside, Time-Resolved Particle Image Velocimetry (TR-PIV) is used in a subsonic wind tunnel test with both stationary and oscillatory modes of the ship model. The tests are conducted at a wind speed of 10.3 m/s and ship oscillations at a frequency of 2.0 Hz with an amplitude of 2.5 degrees. Proper Orthogonal Decomposition (POD) analysis, capable of extracting energetically and dynamically significant features of complex fluid flows, is applied to the time series of the planar velocity and vorticity distributions obtained by the PIV measurements. The POD analyses show that a novel phenomenon featuring significant sudden discontinuities in the vorticity POD mode pattern distributions dubbed as "kinks" is observed for the test model subject to oscillatory motion. In contrast, such kinks are not found in the vorticity POD modes for the test case without the model oscillatory motion, nor the velocity POD modes for both the stationary and the oscillatory tests.

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