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Internal flows of ventilated partial cavity.[1] CHANGCHANG WANG, Beijing Institute of Technology, University of Minneasota, KYUNGDUCK YOON, University of Minneasota, GUOYU WANG, Beijing Institute of Technology, JIARONG HONG, University of Minneasota — Ventilated partial cavitation is an active air lubrication method used in marine engineering for ship hull drag reduction. This work focuses on understanding the internal flow structures and physical processes that lead to the formation of different cavity regimes and transition across these regimes. Both high resolution flow imaging and large eddy simulation (LES) were conducted for two regimes of ventilated partial cavity, i.e. the open cavity (OC) and two-branch cavity (TBC). The results reveal similar flow patterns for OC and TBC, including shear layer near air-water interface, recirculating region, near-cavitator vortex and internal flow circulation vortex. Specifically, OC internal flow exhibits quasi-2D recirculation region and 3D shear layer with intermittent transverse flow across cavity mid-plane, while TBC internal flow shows quasi-2D shear layer and 3D recirculation region where strong circulation exists at cavity mid-plane and counter-rotating vortex pair on both sides of cavity mid-plane. Remarkably, the onset of three dimensionality in recirculation region is responsible for the regime transition from OC to TBC, in the process of which shear layer transitions from convective to absolute instability.

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