Hydrodynamic analysis of an air-oil-water separator under three angular motions

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This study aims to predict the hydrodynamic behaviors and oil separation efficiency inside an air-water-oil separator under the ship motion. A 3D Eulerian computational fluid dynamics (CFD) model was developed to investigate the effect of three angular motions (rolling, yawing and pitching) on the separation efficiency of the air-water-oil separator. The CFD model was combined with the standard k-ε turbulence equation, and a rotation matrix for the angular motions in the moving reference frame for an individual motion and in the dynamic mesh for three simultaneous angular motions. Without exit pressure control, there was backflow in the water outlet, which was not realistic and resulted in a decrease in the separation performance. The backflow in the water outlet did not occur for the angular motions with exit pressure control, and a high oil separation efficiency was obtained. The CFD results indicated the pitching motion influences significantly the performance of separator. In particular, the 4o pitching motion decreased the oil recovery to 93% with a 77% water purity at the water outlet.