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Dynamic mode decomposition of turbulent cavity flows for self-sustained oscillation JIN LEE, HONG BEOM PARK, HYUNG JIN SUNG, KAIST — Self-sustained oscillations in cavity flows are due to the unsteady separation of boundary layer at the leading edge. The dynamic mode decomposition is employed to analyze the unsteadiness in extracted modes without the explicit knowledge of evolution operator of the data. Two different data of the cavity flow with and without self-sustained oscillations have been analyzed possessing thin and thick incoming boundary layers. The ratios of the cavity depth to the momentum thickness (D/θ) are 40 and 4.5, and the cavity aspect ratio is $L/D = 2$. The dynamic modes extracted from the thick boundary layer show that both of the boundary layer structures and the internal disturbance generated due to the presence of cavity coexist with coincidence in frequency spectrum but with different wavenumber spectrum, whereas the structures of the thin boundary layer show complete coherence among them causing self-sustained oscillations. This result suggests that the hydrodynamic resonance causing self-sustained oscillations occurs when the upcoming boundary layer structures and cavity perturbations coincide not only of frequencies, but also of wavenumbers. The structures of cavity perturbations change with the cavity size and the upcoming momentum thickness. The effects of cavity dimensions and incoming momentum thickness are discussed for oscillations to be self-sustained.

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