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Framework for unsteady flow analysis in a circular cavity using Dynamic Mode Decomposition PAULO YU, VIBHAV DURGESH, University of Idaho — Flows in a circular cavity display complex fluid behavior which contain large-scale flow structures and are impacted by different unsteady inflow conditions. Therefore, the objective of this study is to develop a framework for extraction of fluid dynamics in a circular cavity to identify large-scale structures, highlight their temporal features, and quantify flow behavior for a given flow scenario. To achieve this objective, velocity field measurements using Particle Image Velocimetry (PIV) were performed near the center plane of an idealized rigid closed-cavity model. The velocity field data were then sequenced and phase-averaged to a single flow cycle. Dynamic Mode Decomposition (DMD) was then used to the sequenced and phase-averaged data to obtain dynamic modes, DMD energies, and associated frequencies and decay rates which are related to the large-scale structures and temporal behavior in the circular cavity flow. A velocity field approximation which contained significant dynamic modes was used to highlight important temporal flow features and obtain information related to the flow evolution in the cavity. The combination of phase-averaging and DMD for this given flow scenario was able to capture the large-scale flow dynamics and their associated temporal behavior.

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