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Influence of vortex-detaching induced acoustics on freely premixed propagating flames under confinement

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Dynamics of freely propagating flames under confinement are known to be highly non-linear as this kind of flame are very responsive to their own flame intrinsic instabilities[1]. The non-linearities of the problem are aggravated under the presence of small amplitude pressure (acoustic) waves, which can induce constructive interactions notably conditioning the combustion process[2,3].

The resolution of these kind of problems requires dealing with a wide range of scales with temporal dependence with makes numerical simulations computationally expensive. The most extensively used problem closure is settling a domain truncation at the caavity or chamber exit so that all computational resources can be used for the resolution of the inner flow. However, previous works have demonstrated that phenomena happening in the outer flow, such as: vortex detaching, shear layers or pulsating jets due to unsteadiness of the exhaust mass flow rate can definitely have a strong influence on the combustion process inside the chamber, even with a boundary condition that properly models the acoustics.

In this work, flame propagation inside an slender chamber discharging to a stagnant surrounding atmosphere is numerically solved, exploring the different mechanisms that induce the acoustics and evaluating how this acoustic energy is transferred upstream so that the dynamics of the flame propagation are changed.

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