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Puffing flame instability - Part I: Numerical investigation and analysis[1] SHYAM MENON, GUILLAUME BLANQUART, Mechanical Engineering, California Institute of Technology, PHILIPP BOETTCHER, JOSEPH SHEPHERD, Graduate Aerospace Laboratories, California Institute of Technology — Experimental and computational work has been carried out to understand hot-surface ignition and the subsequent flame propagation in low pressure environments. In the experiments, a "puffing" instability is observed at rich hydrocarbon fuel-air mixture ratios. The generation and transport of these flame "puffs," characterized by vortex rings, is investigated in this work by combining results from numerical simulations and experiments. Analysis of the sources of vorticity shows that baroclinic torque is the major contributor to vorticity generation. Misalignment of buoyancy induced pressure gradients in the flow field with density gradients at the flame front leads to the formation of vortex rings. Circulation of these individual vortex rings is calculated and correlated to the formation time scale of a flame "puff." The effect of different parameters such as gravity, flame speed, and density ratio on the "puffing" frequency is investigated and a correlation of the puffing frequency with these parameters is proposed.

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