4B07: DECOUPLING HEAT RELEASE FROM ACOUSTIC FORCING IN ROUND JET DIFFUSION FLAMES.

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You discuss instability as being due to inflection points in the velocity profile and you also noted the crossing points with the density as being important. Is this really correct? I am under the impression that it is the inflection points in the density weighted velocity gradient ($\rho\ du/dy$) that determines stability modes [1].

Reference:

[1] M.J. Day, W.C. Reynolds, N.N. Mansour, *Physics of Fluids* 10 (4) (1998) 993–1007.

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In the paper [28], the authors identify peaks in the density-weighted velocity gradient, $\rho\ du/dy$, of a compressible reacting mixing layer to be qualitative indicators of the positions and strengths of instability modes. Their Fig. 4 and 5, in which two outer modes can be seen to follow the positions of peaks of $\rho\ du/dy$, demonstrate that this works well at a convective Mach number, M_c, equal to 2. Their Fig. 3, however, shows that these two outer modes are much weaker than the central Kelvin-Helmholtz mode at $M_c = 1$ and that, at $M_c = 0$, only the central Kelvin-Helmholtz mode remains.

The experimental results presented in our paper are at low Mach number ($M_c << 1$) and the numerical results are calculated with a low Mach number code. At low Mach number, only the central Kelvin-Helmholtz mode is expected, one in each shear layer ([17] in the paper). In this situation J.W. Nichols et al ([9] in the paper), has found that the integral $I = -\int \partial u_x/\partial r\ \partial\rho/\partial r\ r dr$ is proportional to the log of the absolute growth rate (the growth rate of the mode with zero group velocity). Therefore, a high value of I which corresponds to the gradient of the density profile being in the opposite direction to the gradient of the velocity profile, indicates strong absolute instability. This is an algebraic formulation of the generally observed result that a co-flow shear layer is more unstable when the slow stream has greater density. Therefore our assertion is correct, at least for the central Kelvin-Helmholtz modes in the low Mach number cases that we examine. As an aside ([28] in the paper), shows this generally observed result is also true for the outer modes, which are observed at higher Mach number. As a further aside, I is proportional to the baroclinic torque generated by the interaction of the pressure perturbations with the mean density gradient. If this torque is artificially removed, this effect of the density profile disappears ([29] in the paper).