Centro de Investigação em Matemática e Aplicações
Departamento de Matemática
Programa de Doutoramento em Matemática

Seminário

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On the global structure and asymptotic stability of low-stretch diffusion flames

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Abstract: The present work analyzes cylindrical diffusion flames (Tsuji burner) under low stretch condition, considering fuel injection also from the backward region of the burner. To highlight the fundamental aspects of this flame, some assumptions are imposed, like constant thermodynamic and transport coefficients, unitary Lewis number and no radiative heat loss. It is also considered potential flow model and incompressible Navier–Stokes model. Despite the simplicity of the former model, results from both models show good agreement. Also, an asymptotic analysis describing the problem far from the burner is able to capture the most important mechanisms controlling the flame, then the flame shape is determined and the dependence of the characteristic length scales on Peclet number (based on the burner properties), free stream velocity and stoichiometry is revealed. The results show that the flame width is proportional to the mass stoichiometric coefficient and reciprocal to the Peclet number the 1/4 power and free stream velocity the 3/4 power, and that the flame height is proportional to the square of the mass stoichiometric coefficient and to the square root of the ratio of Peclet number to free stream velocity. In addition, an asymptotic stability analysis reveals low-stretch flame extinction to be caused by reduction in fuel and oxidizer concentrations, which provides the range of the stoichiometric coefficient for stable regime, and at the same time the range of heat released.

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