Comparaison des approches **EEM** et **LES/DNS** pour une flamme mince plissée 2D

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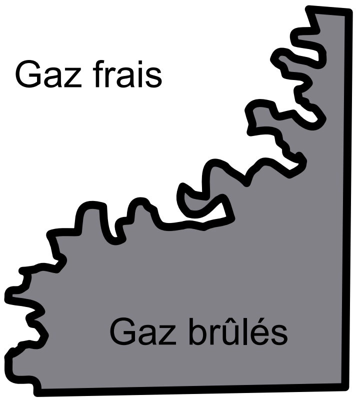
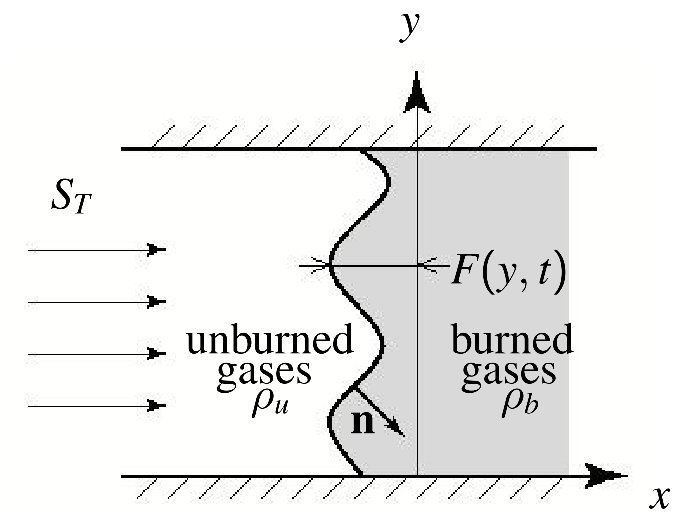




Euler equations

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho \mathbf{u}) = 0$$

$$\rho \frac{\partial \mathbf{u}}{\partial t} + \rho \mathbf{u} \cdot \nabla \mathbf{u} = -\nabla p + \rho \mathbf{g}$$

Jump conditions across the flame

$$[\![\rho \mathbf{n} \cdot (\mathbf{u} - \mathbf{D})]\!]_-^+ = 0$$

$$[\![\mathbf{n} \times \mathbf{u}]\!]_-^+ = 0$$

$$[\![p + \rho\left(\mathbf{n} \cdot (\mathbf{u} - \mathbf{D})\right)^2]\!]_-^+ = 0$$

A kinematic relation

$$\mathbf{n} \cdot \mathbf{u}_u - \mathbf{n} \cdot \mathbf{D} = S_n = S_L(1 - \mathcal{L}\mathcal{C})$$

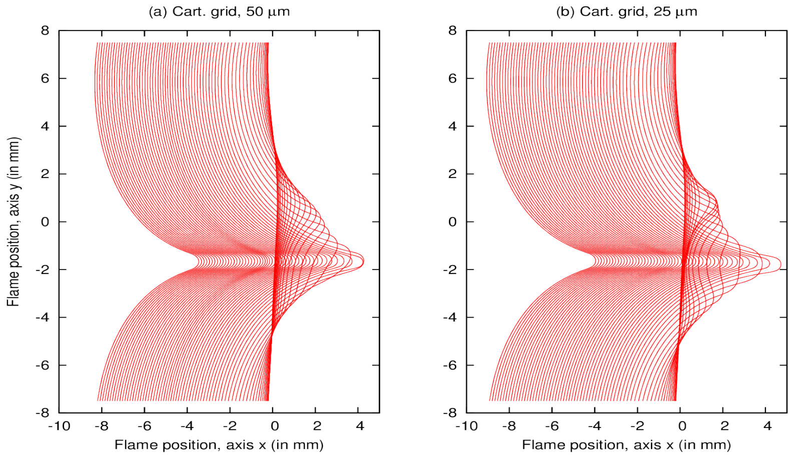
2D-planar fronts: Michelson-Sivashinsky structure

$$\frac{1}{S_L} F_t + \underbrace{\frac{a(\alpha)}{2}(F_y)^2}_{\text{Huygens}} + \underbrace{\frac{1 - a(\alpha)}{2}\langle (F_y)^2 \rangle}_{\text{CT}} = \Omega(\alpha) \left(\underbrace{I(F,y)}_{\text{LD}} + \underbrace{\frac{F_{yy}}{k_n}}_{\text{curv}} \right)$$

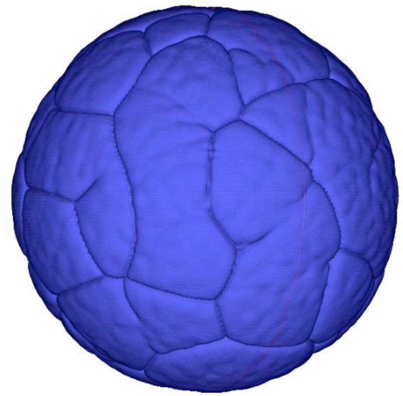
Résultats : 2D plan / 3D plan / 3D Sphériques

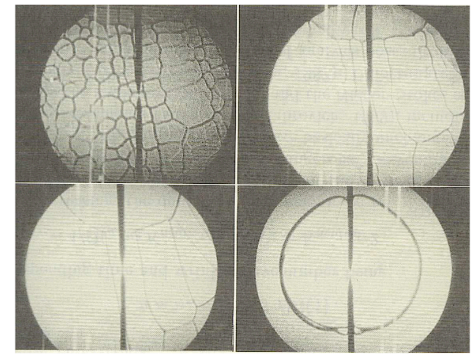
$$\frac{\partial F}{\partial t} - \frac{a(\alpha)}{2} S_L \frac{|\nabla_S F|^2}{r_F^2} = \Omega(\alpha) S_L \left(\frac{H(F)}{r_F} - \frac{C(F)}{k_n r_F^2} \right) + CT \; + u'$$

δ-correlated forcing



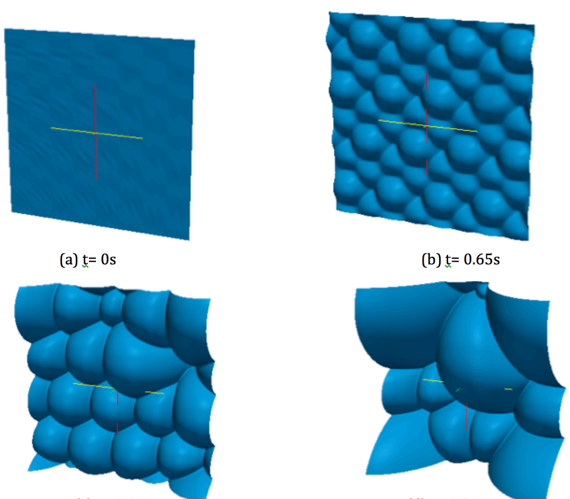
Evolution du front de flamme selon la taille de maille de t=0 à t=67 ms Maillage cartésien, initialisation en sin.cos (code Yales2, chimie complexe)





Groff, 1982.

« Soccer-Ball » Flame (cf. Zel'dovich)



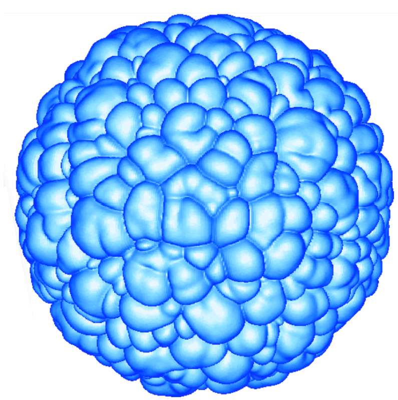
(a) t= 0s

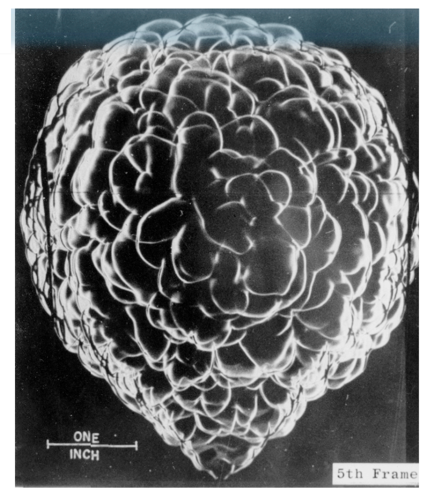
(b) t= 0.65s

(c) t= 1.94s

(d) t= 3.24s

Flamme en 3D
Plane-en-moyenne





Cauliflower Flame