

**Master *Mathematical Modelling***  
**Ecole Polytechnique and**  
**University Pierre & Marie Curie**

Course given by C. Chalons and F. Coquel

**Practical work subject:** Godunov scheme for the gas dynamics equations

The aim of this project is to implement the exact Godunov scheme for the gas dynamics equations in Eulerian coordinates in one space dimension :

$$\begin{cases} \partial_t \rho + \partial_x(\rho u) = 0, \\ \partial_t(\rho u) + \partial_x(\rho u^2 + p) = 0, \\ \partial_t(\rho E) + \partial_x(\rho E + p)u = 0, \end{cases}$$

with a perfect gas equation of state  $p = (\gamma - 1)\rho\varepsilon$ ,  $\varepsilon = E - \frac{u^2}{2}$ . Compare the numerical results with the exact solutions on Riemann problems, for instance the Sod problem. The book entitled *Riemann solvers and numerical methods for fluid dynamics* by E. Toro can be useful to determine the Riemann solutions at each interface.