Hands on RAMSES

Computational MHD

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Outline

- The compound wave problem in 1D
- The Orszag-Tang vortex problem in 2D

Solution in Fromang, Hennebelle & Teyssier, 2006, A&A, 457, 371

The compound wave problem

Box size = 3

Outflow boundary conditions and γ = 5/3

Left and right state (ρ, *u, v, w, P, A, B, C*) with interface at *x*=1.5

Left state: (1, 0, 0, 0, 1, 1, 1, 0)

Right state: (0.2, 0, 0, 0, 0.2, 1, cos α, sin α)

Choose as final time *t*=0.4

Try first α = π with 256 grid points.

Identify the compound wave (Alfven + Slow)

Try then α = 3 with 256 grid points.

Do you still see the compound wave ?

Use AMR for α = 3 up to l_{max}=20.

What do you see ?

The Orszag-Tang vortex

Box size = [0, 1]x[0, 1]

Periodic boundary conditions and γ = 5/3

Uniform density and pressure $P_0 = 5/(12\pi)$ and $\rho_0 = \gamma P_0$

$\boldsymbol{B}$ = (-B_0 sin 2πx, B_0 sin 4πy) with B_0 = 1/sqrt(4π)

$\boldsymbol{v}$ = (-sin 2πy, sin 2πx)

Final time t=0.5

Patch condinit.f90 to set up the initial conditions.

Make sure that div B = 0 initially (use the vector potential).

Use 128 grid points in each direction.

Compare various 1D and 2D Riemann solvers (LLF, HLL, HLLD, Roe)

Use AMR up to l_{max}=9 with various refinement strategy.