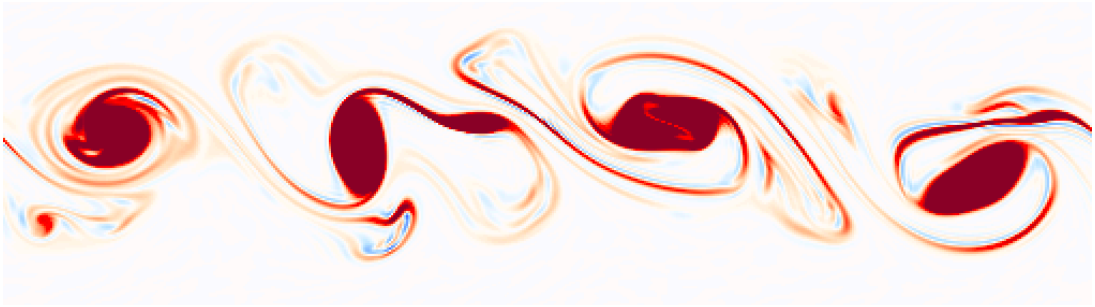
Activity – Instabilities

Introduction

During this activity, we will use the **fluid2d** code to run cases of horizontal shear and KH instability.



Get and run the script

Information on how to download and install fluid2d can be found here: http://mespages.univ-brest.fr/~roullet/OC/howto.html

Install on IUEM computers:

- git clone https://github.com/pvthinker/Fluid2d.git
- cd Fluid2d
- module load anaconda3/4.4.0
- ./install.sh
- source ~/.fluid2d/activate.sh

Run the experiment:

- cd myexp/KelvinHelmholtz
- python kelvin_helmholtz.py

KH instability

a) Run the Kelvin-Helmoltz instability case
b) Look at the exponential growth (on v or banom)
c) Check the evolution of Kinetic, Potential and total Energy.

d) Modify the stratification N (or the velocity shear S) to increase the Richardson number $Ri = N^2/S^2$ above the critical value $Ri = 0.25$. What happens?
e) Estimate the growth rate σ as a function of Ri *(Pick values for example like : Ri = 0.01, 0.1, 0.2, 0.25)*

Shear Instability

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1. Piecewise linear profile

a) Implement a profile with a filament of constant vorticity (width = $a = 0.05$)
b) Run the experiment and compare the wavelength of the most unstable mode (k_a) with a
c) What happens if you do not add noise to the background? *(you need to comment line "vor += noise*1e-2")*
d) Redo the experiment for several values of a and plot k_a as a function of a *(you can increase the size of the domain in the x direction to fit more wavelengths in the domain)*

2. Rayleigh-Fjortoft's theorem

a) Try to implement profiles satisfying or not the Rayleigh's inflection point and Fjortoft's theorem. Comment on the stability.

3. Bickley Jet

a) Implement a Bickley jet profile *(see profile in https://www.jgula.fr/Fluid/PoulinFlierl03.pdf)*
b) Check the stability of the flow