

Méthodes Multi Échelles :

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The course is finished, but the subject is maybe not. It was just an introduction and a review of classical fluid mechanics with the small parameters point of view : all is ε .

As it is well known that in France *everything ends by songs*, so I propose a song clearly devoted to Fluid Mechanics and Multiple Scales, the Song of Asymptotics (not to be confused with the "song of silence").

The song starts by a clear reference to the random walk, which leads to the diffusion equation which is every were in Mechanics and Physics (chapters on heat equation, and selfsimilar solutions, finite elements). Then clear reference to aerodynamics (boundary layer) and hydrodynamics (KdV, Airy wave theory), two domains with lot of asymptotics. The cannonball refers to the singular problem associated in the chapter of MAE. The high Reynolds flow over bumps (or mountains) with Hilbert transform is clearly mentioned ("blowing velocity"). Note the reference to granular media (porous flows and homogenisation) and the clear reference to the problem of erosion with multiple time scales, at least the time scale of the currents and the time scale of erosion (Exner law). Note reference to electromagnetism and propagation of light (Eikonal and WKB expansion). Note references to acoustics, biomechanics of flying bodies (*∂*'Alembert's paradox) and of man. Note in this song from Bob Dylan references to other Nobel price (for literature 2016) winners (Feynman 1965, Haroche 2009, Parisi/ Hasselmann/ Manabe 2021).

How many roads must a man walk down
 Before you call him a man ?
 Yes, 'n' how many seas must a white dove sail
 Before she sleeps in the sand ?
 Yes, 'n' how many times must the cannonballs fly
 Before they're forever banned ?
 The answer, my friend, is blowin' in the wind
 The answer is blowin' in the wind
 How many years can a mountain exist
 Before it's washed to the sea ?
 Yes, 'n' how many years can some people exist
 Before they're allowed to be free ?
 Yes, 'n' how many times can a man turn his head
 Pretending he just doesn't see ?
 The answer, my friend, is blowin' in the wind
 The answer is blowin' in the wind
 How many times must a man look up
 Before he can see the sky ?

Yes, 'n' how many ears must one man have
Before he can hear people cry?
Yes, 'n' how many deaths will it take till he knows
That too many people have died?
The answer, my friend, is blowin' in the wind
The answer is blowin' in the wind

of course think to the message of this song, note final references to ∂ 'Alembert, "le siècle des lumières", freedom for people through knowledge, and make it yours.

Références

- [1] Bob Dylan (1962)
<http://www.bobdylan.com/us/songs/blowin-wind>
- [2] M. Van Dyke, Perturbation methods in Fluid Mechanics (1975)

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