02B.Overview

Wednesday, August 24, 2022

Today: Overview

- Admin
  - Finish Initial Assignments
  - Schedule
- Choices
- Forces: why does it look like that
- Start Vis Techniques

Admin

Your Name Table Tents. Every person, every class.
Reading assignment - First three pages: Introduction, Overview 1 (Phenomena, why does it look like that?) and 2 (Visualization Techniques)
Camera Festival 10 minutes? If you have your camera, show it to somebody who doesn't. Show what you like or don't like about it.
Schedule:

Overview 1: Topics will be presented iteratively.

Previsualization: Have a goal, think about what you want it to look like.
Make CHOICES:

1. Flow phenomenon: Water boiling? Faucet dripping?
2. Visualization technique: Add dye? See light distorted by air/water surface?
3. Lighting: Continuous? Strobe? Sheet?
4. Image acquisition: Still? Video? Stereo? Time lapse? High speed?
5. Post processing, final output. Edit, at least crop the image and set contrast.

Choice 1 - Flow phenomenon: Why does it look like that?

What are the forces? = a framework for interpretation of the image
Minute paper. In groups (3 or so; random breakout rooms in zoom, clusters in person) list all the forces that can act on a fluid. Write them down, then we'll harvest from the class.

Gravity
Buoyancy
Pressure
Other fluids
Convection
Temperature
Viscosity
Combustion
Surface tension
Electrostatics
Magnetism
paddles

Previous Minute paper results:

- Viscous
- Shear
- Gravitational
- Buoyancy
- Electromagnetic
- Electrostatic
- Inertial
- Centripetal/centrifugal
- Pressure
- Body forces: gravity, buoyancy, EM
- Viscosity, shear, friction
- Thermal diffusivity
- Interaction with other fluids
- Surface tension
- Intermolecular
- Air resistance (drag)
- Cohesion
- Adhesion (capillary action)
- Normal force
- Stress
- Strain
- Thermodynamic
- Heat
- Convection
- Osmosis
- Solar radiation
- Composition of fluids
- Densities of fluids
- Chemical reactions
- Impact paddles
- Wind
- Mass
- Acceleration
- Temperature
- Phase change
- Strong, weak nuclear forces
- Cavitation
- Vortex structures
- vortex stretching
- concentration gradient

Good, inclusive list. Not all are forces, but all can 'drive' a flow via a set of physics or mechanism.
Heat, for example.
Force - Any action applied to an object which would cause the object to move, change the way it is currently moving, or change its shape. A **force** can also be thought of as a push (compressive **force**) or pull (tensile **force**) acting on an object.
Engineering Terms
www.pre-engineering.com › resources › engineeringterms

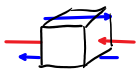
All *forces* can be categorized like this: 2 types of forces

Body

Acts directly on every molecule equally
a) Gravity
b) Electromagnetics

Surface

Acts on the surface of a volume of fluid

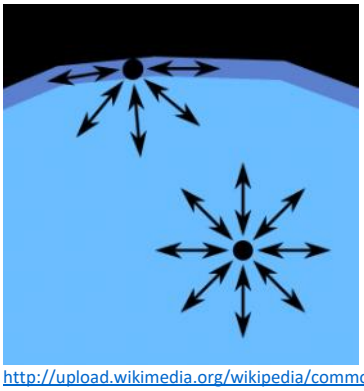


Pressure: always perpendicular to surface (red)
Shear: always parallel to surface (blue)

Any surface force can be decomposed into a shear plus pressure
Note: these are actually STRESSES = Force acting on an area.

The only force that is not so easily categorized

is SURFACE TENSION



It's the result of intermolecular forces, so it affects every molecule, like a body force

But it is only obvious at interfaces between fluids, kind of like a surface force.

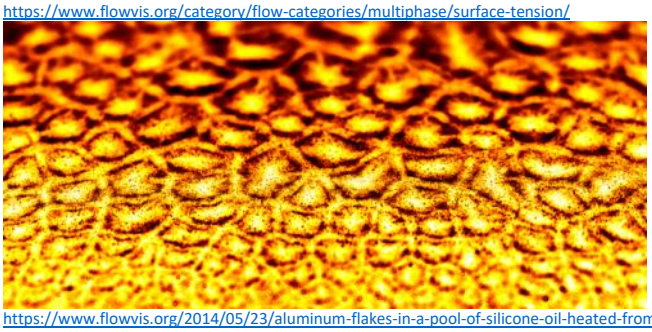
immiscible

http://upload.wikimedia.org/wikipedia/commons/thumb/f/f9/Wassermolek%C3%BCleInTr%C3%B6pfchen.svg/300px-Wassermolek%C3%BCleInTr%C3%B6pfchen.svg.png

Marangoni Convection

When the chemical composition or temperature of a liquid varies from one location to another, the surface tension will vary. Fluid will be dragged from the low-surface-tension area into the higher: Marangoni convection.

The classic food dye/milk/detergent experiment shows this effect. There are a lot of other experiments to try!
https://www.flowvis.org/category/flow-categories/multiphase/surface-tension/



Millie Blackstun, with
Athena Ross, Vigneshwaran Selvaraju, and Amanda Kennedy, using equipment from Scott Kittleman, ATOC.
2014 Team First assignment

From <https://www.flowvis.org/media/2014/2014TeamFirst/Reports/Melissa_Blackstun.pdf>

https://www.flowvis.org/2014/05/23/aluminum-flakes-in-a-pool-of-silicone-oil-heated-from-below-displays-the-benard-marangoni-convection-instability-the-resemblance-to-the-sun-was-achieved-with-post-processing-of-color/

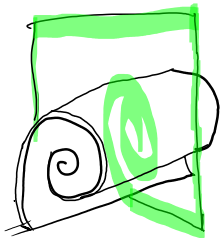
Conclusion: Whenever you are observing fluids, think about the forces that may be acting, ***that make it look like that.*** Yes, put in your reports. +other physics

2. Visualization Techniques

a. Seeded Boundary techniques
b. Index of refraction (light bending)
c. Particle tracking

a. Seeded Boundary techniques:

One fluid is seeded with dye or particles which scatter or absorb light. The other fluid is transparent, not scattering or absorbing light. The boundary can be seen.



Stage fog illuminated by a sheet of laser light forms a suddenly started laminar planar jet at Re = 330. Tanner Ladtkow, Geneva Wilkesanders, Tim Read, Andrea Fabri. Team Project 3, 2006

India ink falling through water shows the Rayleigh-Taylor instability. Gordon Browning. Get Wet Fall 07.

Back-lit. Dark ink absorbs light.

http://www.colorado.edu/MCEN/flowvis/galleries/2009/Team-1/FV_popup1-21.htm

Lucy Dean, Joseph Duggan, Tim Jarrell, Melissa Lucht

White gas (naptha) pool flame.
Team 1 Spring 2009

Light emission shows hot soot region
Black body radiation: Red to yellow to white

Blue = specific emission from C_2 or CH radicals