02.Overview

Tuesday, January 18, 2011

Today:

Admin

Finish First Assignments

Start Overview: Choices in imaging

Put signed Use Agreement, Syllabus Agreement, on piles up front.

ITLL orientations: For after-hours access and computer login, attend a 1/2 hr tour. Find out what resources are here, agree to not spill drinks on the keyboards.

Lecture notes will be posted on the Flow Vis site. Feel free to nag me.

First Assignments

http://www.colorado.edu/MCEN/flowvis/course/initialassignments.pdf

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 (source of worst image problems)
4. Image acquisition: Still? Video? Stereo? Time lapse? High speed?
5. Post processing, final output. Edit, at least crop the image and set contrast.

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) list all the forces that can act on a fluid. Write on a scrap of paper.

Gravity
Buoyancy
Intermolecular
Pressure
Temperature
Kinetic energy/potential energy
Surface tension
Magnetism
Viscous force
Centripetal
Coriolis
drag

Minute paper results:

Viscous
Shear
Gravitational
Buoyancy
Magnetic
Inertial
Centripedal/centrifugal
Pressure
Body forces: gravity, buoyancy, EM
Viscosity, shear, friction
Thermal diffusivity
Interaction with other fluids
Surface tension

Air resistance
Cohesion
Adhesion (capillary action)
Normal force
Stress
Strain
Thermodynamic
Electro-magnetic
Compressible
Heat
Convection
Osmosis
Solar radiation

Composition of fluids
Densities of fluids
Chemical reactions
Impact
Wind
Mass
Acceleration
Temperature
Phase change
Strong, weak nuclear forces
Cavitation
Vortex structures
vortex stretching
concentration gradient
↓
Marangoni forces; surface tension

Good, inclusive list. Not all are forces, but all can 'drive' a flow via a set of physics or mechanism. Heat, for example.

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

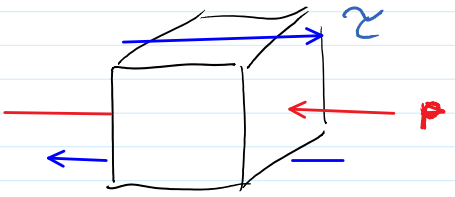
Body

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

http://www.youtube.com/watch?v=fAbycqD2UmQ Protrude Flow
Ferromagnetic fluid (ferrofluid). Iron nanoparticles suspended in oil, follows magnetic field direction.
We have a couple of quarts available.
Nontoxic, but very messy.
"Normal field instability"
http://www.colorado.edu/MCEN/flowvis/galleries/2010/Team-2/FV_popup1-16.htm

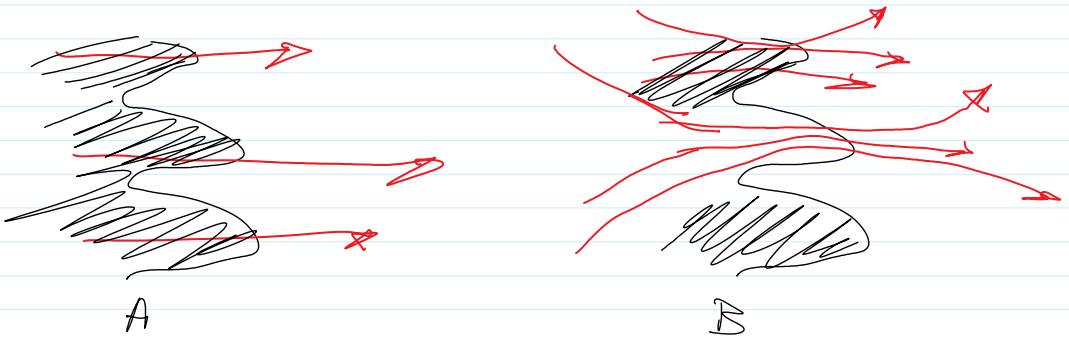
Surface

Acts on the surface of a volume of fluid

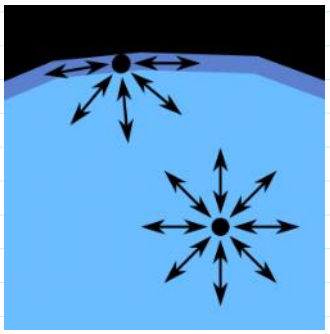


p Pressure: always perpendicular to surface
τ Shear: always parallel to surface

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.

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

http://www-math.mit.edu/~dhu/Striderweb/striderweb.html Water-walking insects

Conclusion: Whenever you are observing fluids, list the forces that may be acting, ***that make it look like that.***

Examples? Let's look at
http://fuckyeahfluiddynamics.tumblr.com/