04.Overview 3 Rheoscopic, particle tracking, lighting

8/29/2022 Monday, Week

Today

Admin

Reading Assignment: Beginning through Overview 4B-Cameras. Weds 4C Lenses focal length

iClicker poll: https://join.iclicker.com/01AH8

A) There's a textbook? 6%
B) I forgot the reading assignment 68%
C) I glanced at it 19%
D) I read the assignment 6%
E) It's awesome, I've read ahead 0%

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

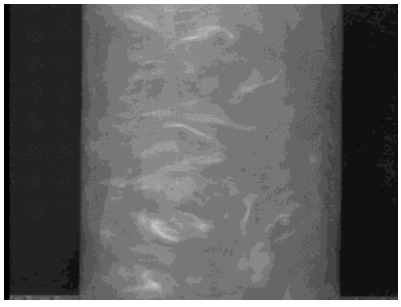
1. Flow phenomenon: Water boiling? Faucet dripping?
2. Visualization technique: Add dye? See light distorted by air/water surface?
   a. Seeded Boundary
   b. Refractive Index
   c. Particle Tracking
3. Lighting: Continuous? Strobe? Sheet?
4. Image acquisition: Still? Video? Stereo? Time lapse? High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

Overview Continued: Types of Flow Vis

Particle Tracking Techniques

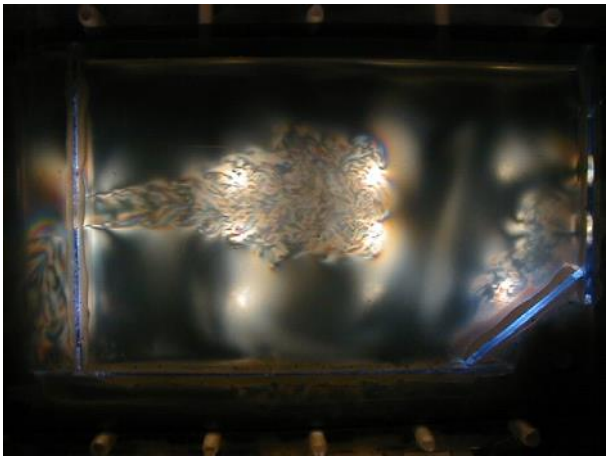
But first, a little in-between technique:

Rheoscopic Fluids
http://www.stevespanglerscience.com/pearl-swirl-rheoscopic-concentrate.html
'Pearl Swirl' $5/gallon
Shiny opaque or translucent particles, crystal flakes, ~10 µm size, aligns with shear gradient.
Used in soaps, shampoos
Kalliroscope used to be the only available type, made from fish scales.
https://www.youtube.com/watch?v=vrTM9O6owII



http://buphy.bu.edu/~duffy/thermo/4B20_77.html

Easy to make from shaving cream: stearic acid crystals
Borrero-Echeverry, Daniel, Christopher J. Crowley, and Tyler P. Riddick. "Rheoscopic Fluids in a Post-Kalliroscope World." *Physics of Fluids* 30, no. 8 (August 1, 2018): 087103. https://doi.org/10.1063/1.5045053.



Streaming birefringence
'Blackstock fluid' has 2 indices of refraction
Suspension of microscale mica flakes.

http://www.laminarsciences.com/

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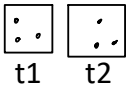
c. Particle tracking techniques

Individual particles are seen. Can be qualitative or quantitative (Particle Image Velocimetry, PIV).
Two images made, close together in time
http://fiji.sc/wiki/index.php/File:Surface_wave.gif

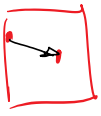


Divide image into subwindows

t1 t2

Cross-correlation gives displacement vector

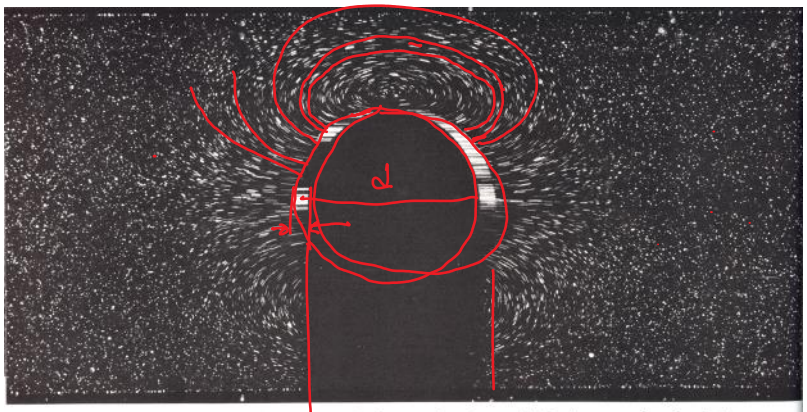
$\frac{\Delta \vec{x}}{\Delta t}$ = VELOCITY



Pasted from <http://www.google.com/images?q=particle+image+velocimetry&hl=en&client=firefox-a&hs=NUI&rls=org.mozilla:en-US:official&prmd=ivnsb&source=lnms&tbs=isch:1&ei=9CY3TcyNH8L7lweQ2uSMAw&sa=X&oi=mode_link&ct=mode&cd=2&ved=0CBAQ_AUoAQ&biw=993&bih=412>

Or, with motion blur, length of track can indicate speed.

From Van Dyke's Album of Fluid Motion



9. **Sphere moving through a tube at $R=0.10$, absolute motion.** In contrast to the photograph above, here the camera remains fixed with respect to the distant fluid. During the exposure the sphere has moved from left to right less than a tenth of a diameter, to show the absolute motion of the fluid. At this small Reynolds number the flow pattern, shown by magnesium cuttings in oil, looks completely symmetric fore-and-aft. *Coutanceau 1968*

$Re = \frac{\rho U d}{\mu}$ dynamic absolute

$\left(\nu\right) = \frac{\mu}{\rho}$ kinematic

$Re = \frac{Ud}{\nu}$

Streamline

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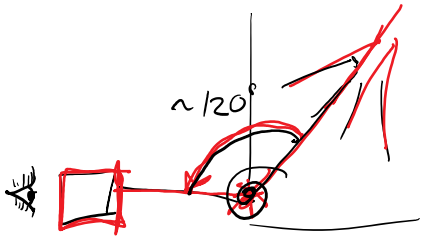
Streamline
=everywhere TANGENT
Close together = fast flow

Small glitter particles: Pearl-Ex. Sold as iridescent pigment in art supply stores. McGuckin's or Guiry's, at Pearl and Folsom. Pearl-Ex is mineral (TiO2 coated mica), not plastic, maybe safer for environment. Don't breathe it, or any dust, or get it in your eyes.

OVERVIEW Choice 3: Lighting



Your camera can only see light. Think about where it comes from and how (reflection, refraction, scattering) it gets into your lens.

Any zoomers today?

In your small group, choose an example from one of your Best of Web selections, or a previous year's selection and send me the link.

- Where and what is the light source? Is it continuous (in time)? Strobe? Sheet?
- What is the interaction with matter that makes light enter the camera lens?

Then a few groups will present to the class.
More on light/matter interactions on next iteration.