05.Overview3

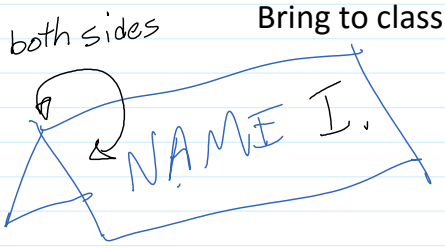
Today:

Admin

Choices in imaging: Index of refraction, Lighting, particle tracking Imaging

Admin

Please make a table tent with your name on it. Write Large and dark! Bring to class every day. Thanks!



- One request: if you are posting a video from YouTube please add the following code to the end of the Youtube link: ?rel=0
- Prof. Truscott and Phantom V2011: October 24, 25, 26. Save the date!

Phantom v2511, v2011, v1611 & v1211

RESOLUTION		v2511	v2011	v1611	v1211
H	V	Max FPS	Max FPS	Max FPS	Max FPS
1280	800	25,600	22,500	16,600	12,600
1280	720	28,500	25,100	18,400	14,000
1024	800	30,500	26,900	19,700	15,000
1024	512	47,300	41,800	30,700	23,400
896	800	33,600	29,800	21,800	16,600
768	768	39,100	34,700	25,300	19,300
640	480	69,900	62,400	45,500	34,700
512	512	75,400	67,700	49,100	37,500
512	384	99,500	89,000	65,000	49,600
384	256	170,600	154,200	112,300	85,700
256	256	205,000	187,200	135,400	103,600
256	128	375,700	343,500	253,000	193,900
128	64	764,700*	708,800*	538,400	415,500
128	32	1,000,000*	1,000,000*	840,000*	653,000*
128	16	1,000,000*	1,000,000*	1,000,000*	820,000*

*Assumes FAST option is installed

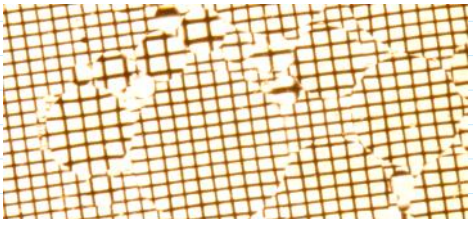
ISO: 6400

- When posting, watch out for homonyms: words that sound the same but are spelled differently with different meaning
  Roll is not role.
- Seminar: Advances in Understanding the Kinetics of Common Combustion Radicals, Nicole J Labbe
  September 1, 2016 3:30-4:45pm ECCR1B40

Overview Continued: Types of Flow Vis

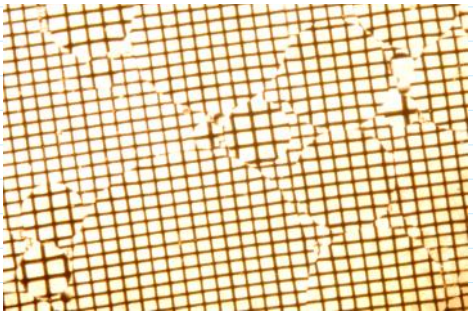
Index of Refraction techniques

Inserted from: <file://C:\Users\hertzber\Documents\01CLASSES\FlowVis\StudentWork07\GetWet\Eliasson\GetWet.tif>

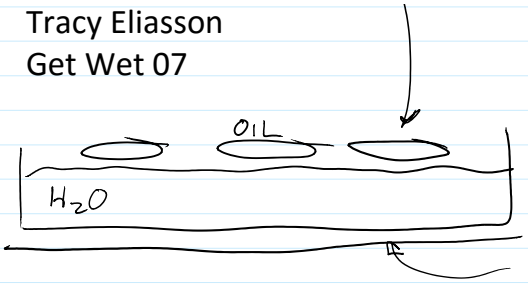


Liquid lenses formed by oil floating on water distort the grid beneath.

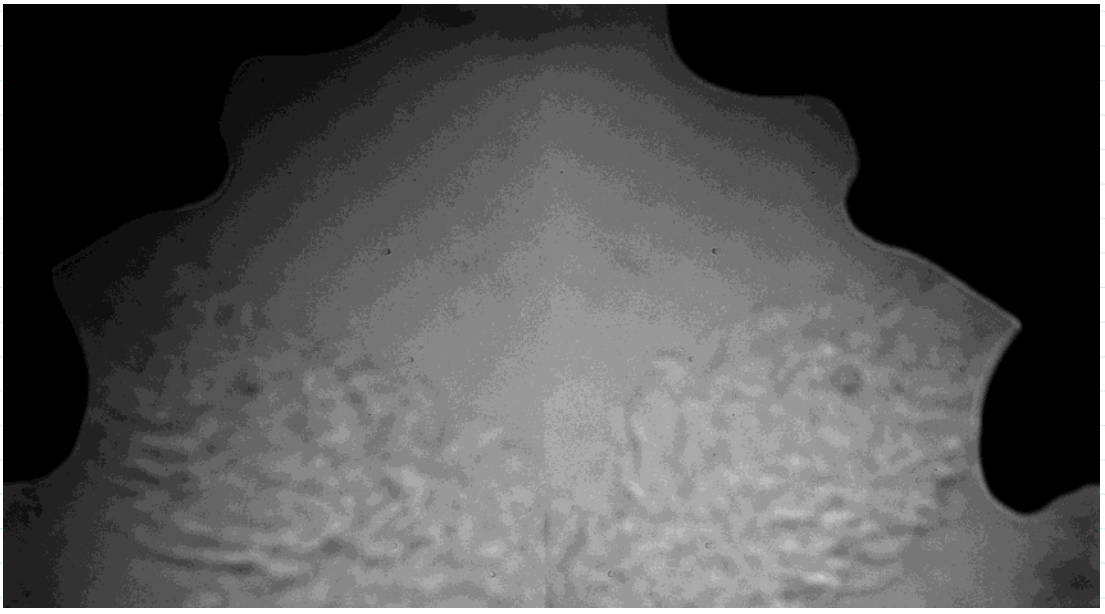
Tracy Eliasson
Get Wet 07



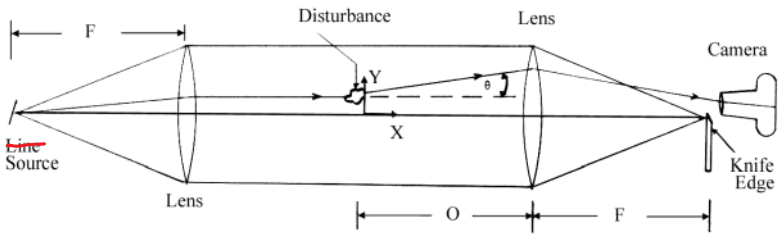
Tracy Eliasson
Get Wet 07



Graph paper

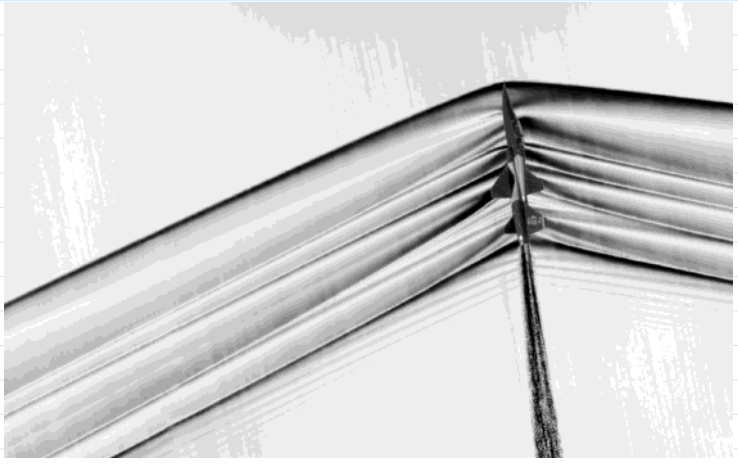


Schlieren composite of two human exhalations. Owen Hnath, Group Alpha, Team 3, Fall 2007
http://www.colorado.edu/MCEN/flowvis/galleries/2007/assignment6.html



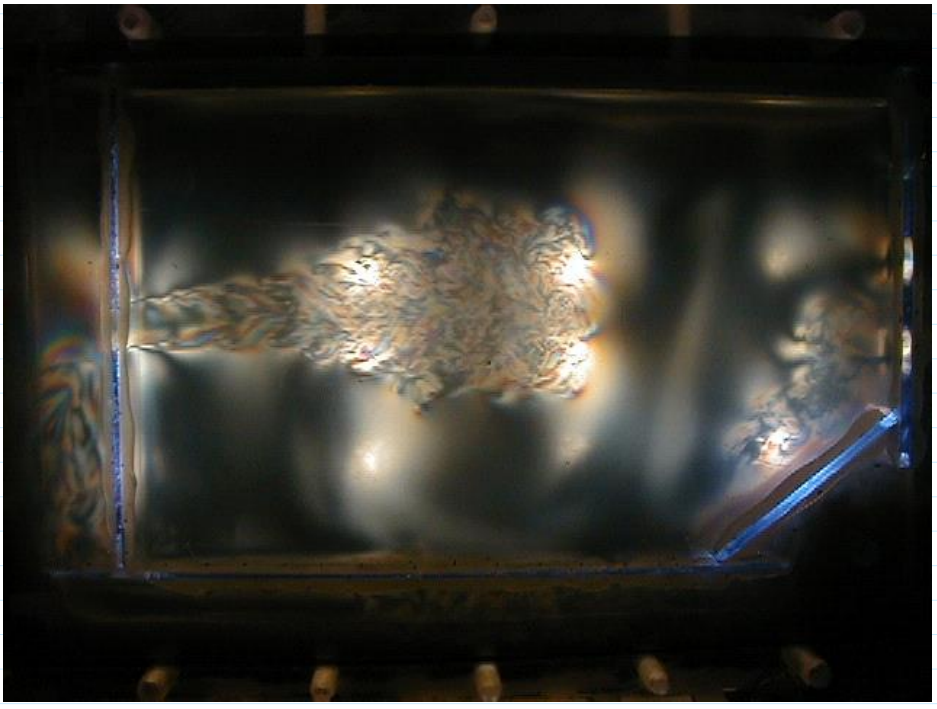
POINT

Figure 3. Schlieren System with a Small Disturbance



BOS=Background Oriented Schlieren
Uses sky light, and distance to get parallel light
Aircraft: T-38, F-18 or F-15

http://www.nasa.gov/centers/armstrong/features/shock_and_awesome.html



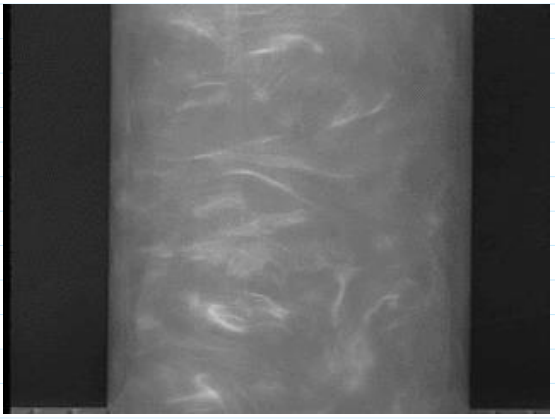
Streaming birefringence
'Blackstock fluid'
Suspension of microscale mica flakes.

http://www.laminarsciences.com/

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 also sells it.
https://www.youtube.com/watch?v=vrTM9O6owII Pe



http://buphy.bu.edu/~duffy/thermo/4B2077.html

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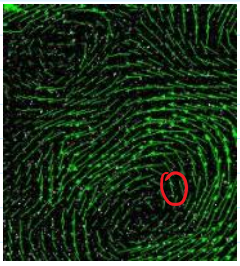
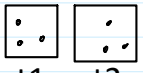
c. Particle tracking techniques

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



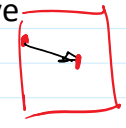


Divide image into subwindows

t1 t2

Cross-correlation give displacement vector

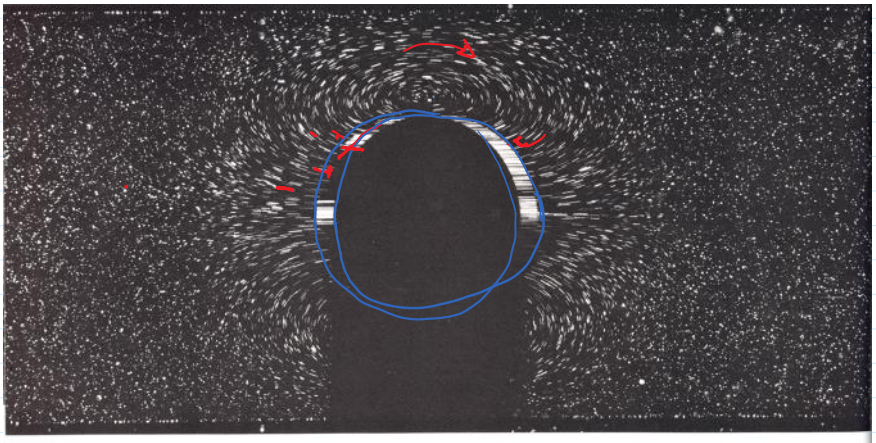
$\frac{\Delta \vec{x}}{\Delta t}$ = VELOCITY



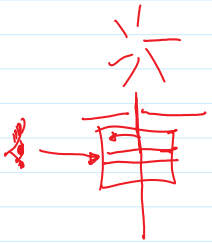
Pasted from <http://www.google.com/images?q=particle+image+velocimetry&hl=en&client=firefox-a&hs=NUI&rls=org.mozilla:en-US:official&prmd=ivnsb&source=lnms&tbs=isch:1&ei=9CY3TcyNH8L7lweQ2uSMAw&sa=X&oi=mode_link&ct=mode&cd=2&ved=0CBAQ_AUoAQ&biw=993&bih=412>

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

From Van Dyke's Gallery 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*



Small glitter particles: Pearl-Ex. Sold as iridescent pigment in art supply stores. Try Guiry's, at Pearl and Folsom.

OVERVIEW Part 3: Lighting

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

For now, let's look at some examples from the Best of Web selections. More on light/matter interactions on next iteration.

OVERVIEW Part 4: Image Acquisition.
We'll do this section in more depth than in the rest of our Overview.

Good digital photography reference:

David Fearon, *The Ultimate Guide to Digital Photography 4*, 4th ed. (Dennis Publishing, 2010).
http://www.docstoc.com/docs/8819795/The-Ultimate-Guide-To-Digital-Photography
Free download (ads)
http://magbooks.org/post-10428/the-ultimate-guide-to-digital-photography-4

Lynda.com: video tutorials for photography, video production
CU has a site license Just google CU Lynda, log in with identikey

1) Framing
    a. #1 rule of photography: Make The Subject Fill The Frame
        Image dimensions of less than 700 pixels won't be accepted.
    b. Know your scale. Take an extra image with a ruler in it.
        You'll need to specify your FOV = Field of View
        i.e. "top to bottom was 10 cm"
        Sometimes the image will supply the scale, such as the diameter of a jet.
    c. Work it. Take many images, from varied POV = Points of View
        - Get close, pull back. Move around the sides.
        - Try a mirror to see the back.
        - Consider making a stereo image
        - Try video, a few seconds or minutes

Video tutorials
http://vimeo.com/videoschool/101

Vimeo = upscale YouTube.
FV videos will be posted there by FlowVis@CUBoulder

        - Change the lighting.
        - Try time lapse (smartphone camera app is easy to use)
        - Consider the motion: Capture the whole track, and also zoom in on a particular moment/location
        - Plan a second try. Look at results at full resolution first, not just on camera LCD. Takes time.