04.Overview 3 Refractive index, rheoscopic, and particle tracking techniques

Wednesday, September 6, 2023

TODAY

- Admin
- Refractive Index Techniques
- Rheoscopic fluids
- Particle Tracking

Admin

Schedule
Reading
ITLL tour
How to Post demo

Flow Vis 2023 Schedule					Version		9/5/2023		
Week		Major assignment due online to both Flowvis.org and Canvas	Critique 1	Critique 2	Critique 3	Report due to both Flowvis.org and Canvas	Review due	Admin and misc HW due	Reading	Lecture
week 1								copyright, syllabus, flowvis.org login, join Slack and iClicker	Guidebook: Intro, Overview 1 and 2	
	Friday, September 1, 2023									3 Overview B: boundary techniques
	Monday, September 4, 2023							Labor Day		
	Wednesday, September 6, 2023								Overview 2	4 Overview C:refractive index, rheoscopic, particles
week 2								Bring your camera. CATME survey due	Overview 3 Lighting, and 4 Photog A Workflow and B Cameras	Lighting
	Friday, September 8, 2023	Best of Web					Vote on Best of		Overview 5 post	5 Photog: framing, cameras

Reading clicker

A) There's a textbook?
B) I forgot the reading assignment 19%
C) I glanced at it 42%
D) I read the assignment 27%
E) It's awesome, I've read ahead 12%

Creative Commons

If everybody does the reading, lecture will move faster.
Some examples are the same, but I'll try to make them different.
Here in class I can use copyrighted material. Textbook is all FV student work or Creative Commons copyright.[

New to ITLL?

Tours/logins at ITLL.colorado.edu 5:15 pm @Launchpoint

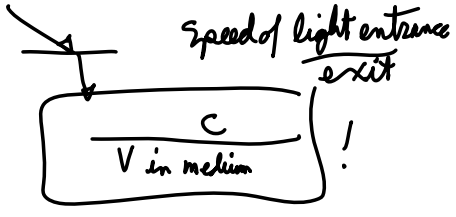
How to post demo

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; rheoscopic
   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.

b. Index of refraction techniques

Minute paper, in groups: What is the index of refraction?



Index of refraction = refractive index = η = eetah = $\frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}} = \frac{c}{v} = \frac{\lambda_{vacuum}}{\lambda_{medium}}$

η

η v Speed of light in medium

η always > 1

η = 1.5 for glass
= 1.3 for water, plexiglas, approximately
=1.00029 in air

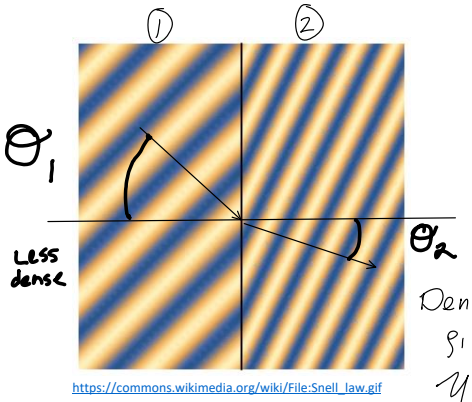
Frequency and color do not change. Speed slows in a denser medium and wavelength shrinks

$V = \lambda f$

$= [L][\frac{1}{t}]$

$\frac{L}{t}$

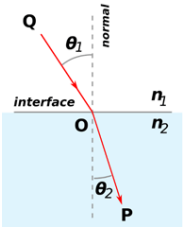
https://upload.wikimedia.org/wikipedia/commons/5/5c/Snell_law.gif



https://commons.wikimedia.org/wiki/File:Snell_law.gif

SNELL'S LAW

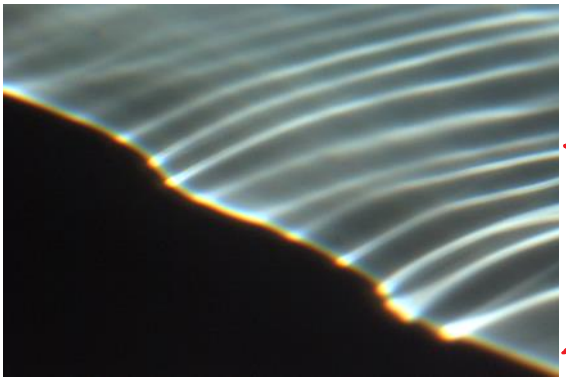
$\frac{\eta_1}{\eta_2} = \frac{\sin\theta_2}{\sin\theta_1}$



Denser $\rho_1 < \rho_2$

$\eta_1 < \eta_2$

Specific techniques: schlieren, shadowgraphy, interferometry, holography,
Free liquid/gas surfaces, thin film effects (soap bubbles), oil on puddles



CAUSTICS

DISPERSION

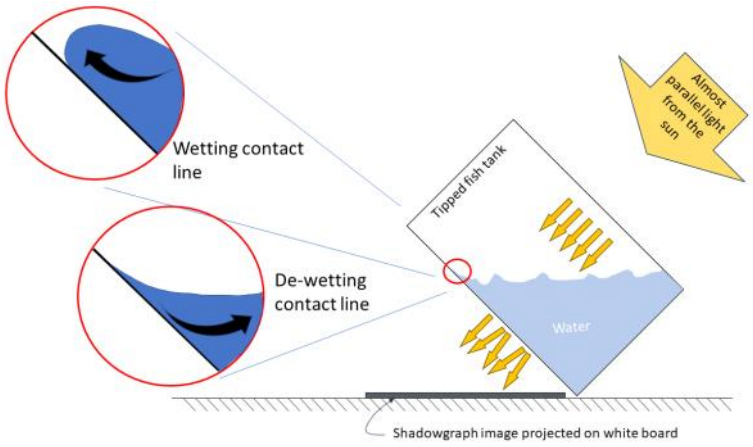
$\eta(f)$

depends on frequency of light

Pasted from <http://www.colorado.edu/MCEN/flowvis/galleries/2007/assignment4/Hnath.jpg>

A rectangular tank, partially filled with water, was tipped on edge. Sunlight projected through the waters' edge to the ground, resulting in Moiré interference patterns : CAUSTICS.

Owen Hnath, Gordon Browning, Tracy Eliasson, Travis Gaskill, Trisha Harrison 2007



https://www.flowvis.org/Flow%20Vis%20Guide/refractive-index-techniques/

Contact line: solid, fluid and gas meet together. Simple model mathematically makes a singularity; very interesting to applied math folks. Now more sophisticated theories:

Wang, Hao. "From Contact Line Structures to Wetting Dynamics." *Langmuir* 35, no. 32 (August 13, 2019): 10233–45. https://doi.org/10.1021/acs.langmuir.9b00294.

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