

## 18. Bit depth to DyeTech

Wednesday, October 28, 2020 3:55 PM

HDR = High Dynamic Range

Take multiple images with varied (bracketed) exposures of the same scene, some under exposed, some over exposed. In-camera or post-processing algorithm assembles them together to provide additional measurand (light) resolution in highlight and shadow areas. Can make nighttime images look like daylight.

Here is an HDR image (made with 5 images from -3 to +3 EV) by Phil Nystrom 2018.



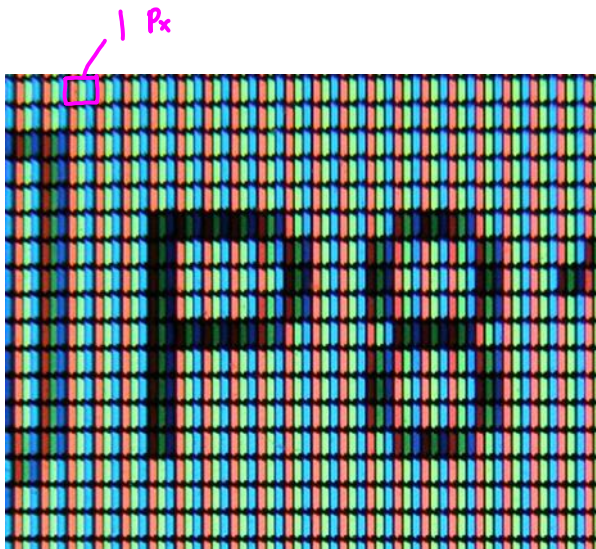
The word *pixel* is based on a contraction of *pix* ("pictures") and *el* (for "element");

Pasted from <http://en.wikipedia.org/wiki/Pixel>

On a screen, = 1 red, 1 blue, & 1 green light emitter.

In editing software, access them separately in *color channels*

i.e. can control all blue pixels by themselves



RGB is a common color space, good for screens. [http://en.wikipedia.org/wiki/File:Closeup\\_of\\_pixels.JPG](http://en.wikipedia.org/wiki/File:Closeup_of_pixels.JPG)

CMYK (Cyan, Magenta, Yellow and black) is another color space, good for printing

R,G,B = 0,0,0 = black, off.

R,G,B, = 255, 255, 255 = all full on = white (8 bits =  $2^8 = 256$  possible levels)

R,G,B = 0,0, 256 = blue

FFFFFF = full white in hexadecimal, one digit can count to 16; 0-9, then a-f  
0000FF= blue  
808080=gray

#### Color channels

Red channel: Can address just the red elements in all the pixels. See histograms, adjust range and contrast

#### Suggested experiment:

Test the dynamic range of your camera: take images of a gray card. At low ISO, see how many stops of underexposure will make it black, and how many of overexposure will make it white. Probably a total range of 6-9. What happens at high ISO?

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## SPECIFIC FV techniques

Boundary techniques. Boundary between 'seeded' and unseeded fluid.

Choice depends on physics desired

I DYES **Today**. Mostly in water.

Light/matter interactions in general

2 Index of refraction techniques

3 Light emitting fluids

4 Particles. In air (aerosols, fog, smoke)

5 Particles in water

In this class, often visualization technique determines physics examined, but usually physics are determined by system under study, and FV technique applied should not disturb the flow/physics

I Dye Considerations:

- 1) Want dye to NOT disturb flow
- 2) Want dye to show up - HIGH VISIBILITY
- 3) Special techniques

Minute paper: How to not disturb flows with dye?

Injection velocity; slow injection speed

Inject upstream so disturbance is minimized

Match viscosities

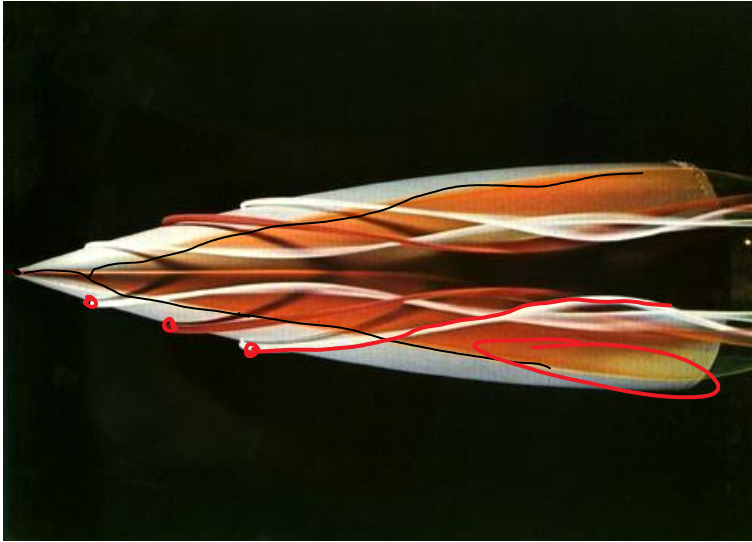
Minimize volume of dye

previous answers:

- Match fluid properties, including
  - velocity(speed and direction)
  - Density
  - viscosity
  - Polarity; miscibility; (will it mix)
  - pressure
  - Temperature
  - contrast
  - Molecular weight
  - intermolecular forces (to minimize surface tension)
  - Diffusion coefficient
- No chemical reaction
- Match vorticity as well as velocity
- Inject upstream of test section
- Allow for equalization time
- Use small ports, minimize volume injected, ✓
  - Premix dilute solution
- Consider location of injection; reveals different physics
  - [http://www.efluids.com/efluids/gallery/gallery\\_pages/HW004/text.jsp](http://www.efluids.com/efluids/gallery/gallery_pages/HW004/text.jsp)

by Henri Werlé, at  
ONERA = NASA of France

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by Henri Werlé, at  
ONERA = NASA of France  
Master of colored dye streams

Ogive  
Shape

Tempera

- Avoid injection altogether: Coat object with alcohol-dye mixture or water soluble paint, let dry, then tow in tank. Shows vorticity layer, wake, boundary layer
- Or coat short strings on a rake. OK for low speed, short run times



Example of dye that visualizes physics without disturbance

N.J. Mueschke et al., "Measurements of molecular mixing in a high-Schmidt-number Rayleigh-Taylor mixing layer," *Journal of Fluid Mechanics* 632, J. Fluid Mech. (UK) (2009): 17-48.

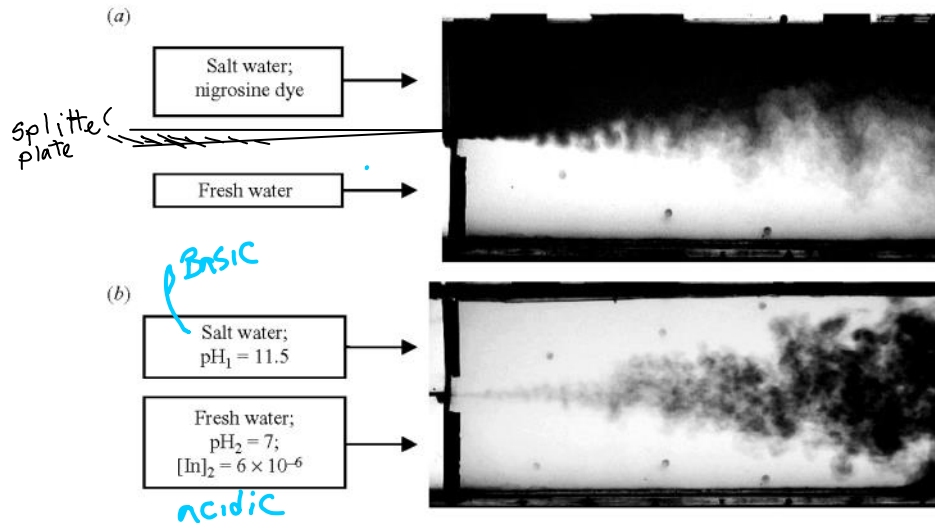


FIGURE 4. Photographs (contrast enhanced for visualization) of the buoyancy-generated mixing layer in a typical water channel experiment. (a) Nigrosine dye was added to the top stream. (b) Phenolphthalein was added to the bottom stream, which changes to its pink form as the two streams molecularly mix (here, "pink" is shown as dark regions within the mixing layer).

Indicator dye

Ph indicator, shows where mixing got to molecular level.

Tough to match all these properties! Dye properties are different from ambient fluid.

To match density, try a premix:

For food dye in water, premix dye (dense, sinks in water) and isopropyl alcohol (floats) to get neutral buoyancy in water

The concentration gradient between dyed and undyed fluid may cause dye to diffuse too rapidly, misleading when studying mixing. **Turbulence** also causes fast diffusion, making visualization of the overall flow structure difficult. **Try some milk or latex paint to slow turbulent diffusion.**

Famous example:

Cloud tank was invented by Douglas Trumbull to make realistic clouds in 'Close encounters of the third kind' (1980's sci fi). Used many times since <https://www.youtube.com/watch?v=pYVybOyMz-A>

"The effect's process begins with filling a water tank halfway with saltwater which is then layered with a thin plastic sheet. Fresh water is poured over the thin layer of plastic to fill the rest of the tank. This leaves the visual effects artist to remove the thin layer of plastic to reveal what seems to be a single body of water, but is really two layers of different densities: salt water and fresh water. Finally, paint is injected into the tank and it flows through the water, forming an organic cloud figure..."

A 2000 gallon glass tank was used that was approximately seven feet tall, seven feet wide and four feet deep which would have to be emptied and refilled after every shot."

From <<https://donofriofilm.wordpress.com/2013/12/16/cloud-tank-effects/comment-page-1/>> references <http://singlemindedmovieblog.blogspot.com/2010/04/old-school-effects-cloud-tank.html>

DIY version: <http://www.youtube.com/watch?v=hxgVKWe5Vm0>

