Today

- Feedback: more minute papers, more interactive lectures, more feedback. Neater lecture notes. Guest lectures, facilities, demos creative aspects: good. Most teams OK.
- If you missed last Friday, please submit feedback at http://www.surveymonkey.com/s/ZCGTFB3

Image Self Assessments?
Plan for next Team Assignment? Only got a few.

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**SPECIFIC FV techniques**

Choice depends on physics desired

1) **DYES**
   2) **Aerosols Particles**

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

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

1) **Not Disturb flow** *"How?"*

- **Minute paper - Groups**

**Answers:**

A) Match flow speed when injecting
   - Use small ports, minimize volume injected,
   - Coat object with alcohol-dye mixture, let dry, then tow in tank: vorticity layer, wake, boundary layer
   - Or coat short strings on a rake. OK for low speed, short run times

B) Match fluid properties
   1. Density
   2. Temperature
   3. Viscosity
   4. Surface tension (match intermolecular forces)
v. Minimize chemical reactions (unless needed)

vi. Diffusion coefficient


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).

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

Mitigation Techniques:

1) Premix

For water mix dye + isopropyl alcohol

Dense Light

$\sim \gamma H_2O$

Any concentration gradient

Want dye to diffuse like ambient flow

Lewis $\# = \frac{D \gamma C_p}{h_c} = \frac{\text{mass diffusivity}}{\text{thermal diffusivity}} = 1$

$D = \text{mass diffusivity}$
Cloud tank was invented by Douglas Trumball to make realistic clouds in 'Close encounters of the third kind' (1980's sci fi). Used many times since:
http://www.youtube.com/watch?v=DwtobkYe-18

More info in Special Effects article

\[ \text{leq} \ \rho^T = \frac{1}{h_c} \Rightarrow \text{mass appearing} = 1 \]
\[ D = \text{mass diffusivity} \]
\[ c_p = \text{specific heat} \]
\[ h_c = \text{thermal conductivity} \]

Reduce \( D \) using Milky or Latex paint

Dense, Salty

Stratified Milky Latex

High Visibility:
Increase concentration
Good contrast between dyed + Ambient

Reflect
Absorb
Refact
Emit
Scatter
Max Interaction

Minimize interaction