

Techniques 1

Wednesday, March 10, 2010
6:08 PM

Today:

- Schedule
- Reports
 - References
 - Reynolds number calcs
 - Estimate motion blur
- Resolution
 - Temporal
 - Spatial
- Techniques
 - Seeded Flows
 - Dye, not Die
- Course feedback
 - What are the strengths of the course so far?
 - What improvements should be made?
 - Consider all aspects
 - Lectures: content, technique, guests
 - Assignments: timing, expectations
 - Feedback mechanisms
 - Facilities and equipment
 - Teams

<file:///C:/Users/hertzber/Documents/FlowVis/Admin/schedule.doc>

~ Posted

- Reports
 - References
- Every assertion about science that you make, every fact you state, needs a reference, unless it's your discovery, your new work.

Styles:

- Alphabetical

Can also say
Fischer (2005)!!
showed xxx

□ Diethyl phthalate is a good choice for cardiovascular modeling because of its high index of refraction and low viscosity. This is coupled with a health hazard rating of 1, flammability rating of 1 and a reactivity rating of 0 (Fischer 2005). DEP is a commonly used plasticizer, present in many household products, and is not a health hazard according to a current toxicological review (Api 2001). There has been some controversy about its effects on human health (Colon et al. 2000; Hill et al. 2003; Sonde et al. 2000) but this can be mitigated by simple laboratory procedures including handling with gloves and adequate ventilation. It is also relatively inexpensive at approximately \$16 per liter (Fischer 2005).

Fischer Scientific (2005) <http://www.fischerscientific.com>
Forsythe W (ed) (1954) Smithsonian physical tables, 9th edn. The Smithsonian Institution, Washington
□ Giner J, Ibarz A, Garza S, Xhian-Quan S (1996) Rheology of clarified cheery juices. J Food Eng 30:147-154
Hill S, Shaw B, Wu A (2003) Plasticizers, antioxidants, and other contaminants found in air delivered by PVC tubing used in respiratory therapy. Biomed Chromatogr 17:250-262

- Numbered

- Vortex/wall interactions are found in many fluid systems,¹ particularly in aerodynamic applications. For example, a vortex generated on the surface of a maneuvering airfoil during a dynamic stall process can interact with the airfoil surface, affecting the aerodynamic properties.²⁻⁴ Vortex/wall interactions have also been studied as an important element of turbulent boundary layers:⁵⁻⁷ the legs of a
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¹T. L. Doligalski, C. R. Smith, and J. D. A. Walker, "Vortex interactions with walls," Annu. Rev. Fluid Mech. 26, 573 (1994).

²W. J. McCroskey, "Unsteady airfoils," Annu. Rev. Fluid Mech. 14, 285 (1982).

³M. S. Francis and J. E. Keese, "Airfoil dynamic stall performance with large-amplitude motions," AIAA J. 23, 1653 (1985).

⁴L. Carr, "Progress in analysis and prediction of dynamic stall," J. Aircraft 25, 6 (1988).

- Reynolds number calcs

$$Re = \frac{\rho U D}{\mu} = \frac{U D}{\nu} \quad \text{since } \nu = \frac{\mu}{\rho} \begin{matrix} \text{absolute} \\ \text{density} \end{matrix} \begin{matrix} \text{kinematic} \end{matrix}$$

An example calculation for Reynolds number in water would be

$$Re = \frac{UD}{\nu} = \frac{(0.1 \frac{m}{s})(0.05 m)}{1.004 \times 10^{-6} \frac{m^2}{s}} = 4980 \approx 5000$$

Where the velocity scale was chosen because.... etc.

Show ingredients

Use correct sig figs

An example in air:

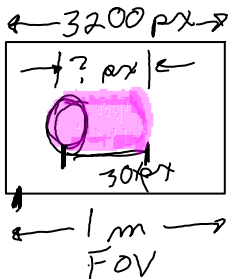
$$Re = \frac{UD}{\nu} = \frac{(1 \frac{m}{s})(0.5 m)}{1.516 \times 10^{-5} \frac{m^2}{s}} = 32981.53 \approx 30,000$$

- o Estimate motion blur: How many pixels did the flow move during the exposure?

Example: Flow speed $\sim 1 \text{ m/s}$

FOV $\sim 1 \text{ m}$

shutter speed = $\frac{1}{100} \text{ sec}$



$$\begin{aligned} \text{Distance} &= 1 \frac{m}{s} \times \frac{1}{100} \text{ sec} \\ &= 0.01 \text{ m} = 1 \text{ cm} \end{aligned}$$

$$\# \text{ pixels} = 0.01 \text{ m} \times \frac{3200 \text{ px}}{1 \text{ m}}$$

$$= 32 \text{ px}$$

For good time/space resolution, keep #px blurred $< 5\%$ of image width
Good idea to estimate motion blur before you take the picture

= PREVISUALIZE

RESOLUTION

Can 2 things be resolved?



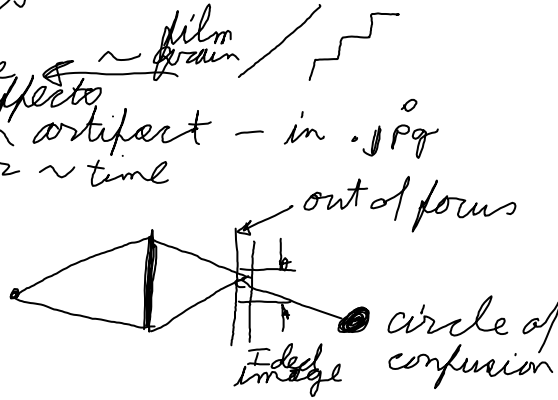
↑ 2 lines, can't be resolved

Resolution \equiv distance for 2 objects to be recognized as separate

separate ' ' "

Spatial resolution can be DEGRADED by

- Bad focus
- Rastering
- Pixel size \sim film grain
- Diffraction effects
- Compression artifact - in .jpg
- Motion blur \sim time
- Focus if circle of confusion $>$ pixel size



- Diffraction effects if lens aperture or pixel size $<$ wavelength of light
- Current sensor sizes $\sim 35 - 3 \text{ mm}$ $\Rightarrow 10 - 1 \mu\text{m}$; $\lambda \sim 0.5 \mu\text{m}$
 $\sim 3 \text{ K px}$ Getting close
- See <http://www.cambridgeincolour.com/>. Good info on sensors, lenses for aperture effects, also can have impact on small high res sensors
- Please, no image submissions for this class $< 1000 \text{ px wide}$