

Final term project reports are due Wednesday of exam week (March 19 2008) Please deliver them either as .doc Word files, .pdf's or paper. You are encouraged to put your full suite of digital images in a folder on the lab pc (in e:\rhines\oc569a-08\mystudentname).

If you look at some term project reports from earlier years you will see they vary greatly in length and detail. There are no rigid rules about length but we suggest 15 pages (example: 1.5 line spacing, font 12 Garamond or Times New Roman) of text plus figures and references.

Here is the structure (which you can witness by opening any volume of Journal of Fluid Mechanics or Experiments in Fluids looking for substantial lab experiment papers).

1. Introduction

You should summarize the motivation for the experiment. Normally this would include a literature survey but for our course this is not necessary; we have not asked you to search the past literature on your experiment, although some of you have volunteered to do so. Of course that would be the next step in carrying your experiment toward a true Ph.D. thesis chapter or a journal publication.

The motivation can be quite an extensive section, suggesting how an experiment could address significant basic scientific questions and significant applications to the environment or engineering. Thus an experiment might help to understand how waves and vortices interact (a basic physics question). It might also give useful results about atmospheric flows in the lee of mountains or the design of bridge pilings in a river.

2. Experimental design

Here you lay out the construction of the experiment, complete with measurements of apparatus (e.g., a 132 cm diameter circular Plexiglas cylinder).. Describe limitations (how would it better be done the next time around). **Describe apparatus for measurements, photography and controlling the experiment (e.g. Arduino boards, pumps, electronic thermometers, lighting, tracers, particles, cameras).**

3. Scaling

You need to describe the key parameters in the experiment. These can be both external and internal (see writeup #2 about this). Non-dimensional parameters (Reynolds number, Rossby number...) need to be related to the life-size application. Lab experiments almost always have to compromise in simulating reality. But, as in building a scale-model airplane, you can get a surprising number of parameters 'right'.

Internal parameters are those that emerge as part of the flow (part of the 'solution') rather than those imposed at the beginning. Waves of a particular wavelength develop as you specify the frequency of a wavemaker. Their amplitude depends on the amplitude of the wavemaker. Their length scale and amplitude then determines a nonlinearity parameter, the 'wave steepness' which is U/c (U is a typical fluid particle velocity, and c a phase speed, wavelength λ /wave period). U/c is also approximately the wave amplitude η (in cm.) divided

by the wave's lengthscale L in cm. (Note the natural length scale L of a wave is really $\lambda/2\pi$ because that is a good measure of a spatial derivative, $\partial\eta/\partial x \sim \eta/L$ not η/λ .)

3. Experimental procedure

From your notebook, how did you carry out the experiments. Number of runs, configuration, measurements made. Here describe measurement apparatus, visualization methods, cameras, dyes, particles, lighting.

Be particularly clear here about quantitative measurements, how they were set up and recorded. It is essential to record all the environmental variables (salinities, temperatures...).

4. Analysis

What did you do to analyze the images, quantitative measurements?

5. Findings

Both qualitative results and measurements are combined to say what you have learned. If possible you should estimate error bars for your measurements, though this is not always possible. **An important step in experiments involves 'regime diagrams'.** Say you do one experiment and it is interesting. Then you measure some aspect of it quantitatively..a velocity or temperature field in space or time. After that it is natural to ask how the flow phenomenon depends on the parameters for the experiment. You often can control these, so you might vary the amplitude of the forcing and the time-scale of the forcing. This is a 2-parameter study, and you may see very different flows as you move through that space. The flow may be steady and smooth in one region and turbulent in another. The boundary between the two regimes is a stability boundary, which can be very important. This can lead to a 2-dimensional figure in which you indicate the nature of the flow as a function of the 2 parameters. Often you will not have time or energy to cover the space thoroughly, but some 'parameter searching' in your experiment is very important.

6. Conclusion

Summarize the goals and results. What would you do next? What applications of the experiment now seem important. How would you have done it differently?

7. Acknowledgements

Briefly describe the resource base you called upon (My Arduino board was developed during the course; I obtained my digital oscilloscope from Prof. Fluke).

8. References

Any literature you have used. This is particularly important if you have learned something essential from other peoples' work. Be very clear about your original contribution, alongside the ideas of others.