Advanced Computation in Fluid Mechanics
Literature Reviews

The literature reviews should be a one page summary (for each Review 1-3; 3 in total) of the papers/book sections that are listed. The format of the text is not important so do not put too much effort into this. You are not supposed to read each paper in full detail, but you should be able to briefly explain the main ideas of the papers. In addition, for each review you should address some specific questions related to each topic, as given below. You do not have to give strict mathematical definitions, instead try to answer the questions in a way understandable to non-experts.

Review 1: Turbulence and blow up of smooth solutions

Literature: [4], [9], [2], [8]

1. What is a strong/classical/smooth solution? What is a weak solution?
2. How is blow up defined in [4], [9] and [8], respectively?
3. What is well-posedness? What is well-posedness *in output*?
4. How is the Clay Prize problem formulated?

Review 2: The d'Alembert paradox

Literature: [11], [12], [1] (chapter 1), [13], [5]

1. What is the d'Alembert paradox?
2. Is the paradox solved? If so, what is the solution?
3. What are the practical implications of the paradox?

Review 3: Flow separation, flying and aerodynamic forces

Literature: [10], [14], [3], [6], [7]

1. What is flow separation? What determines if a flow separates or not?
2. How is it possible to fly? (to generate 10 times higher lift than drag)
3. How is lift and drag computed for an airplane?

References

[1] G. Birkhoff, *Hydrodynamics: a study in logic, fact, and similitude*, Princeton University Press, 1950.

[2] S. I. Chernyshenko, P. Constantin, J. C. Robinson, and E. S. Titi, *A posteriori regularity of the three-dimensional navier-stokes equations from numerical computations*, J. Math. Phys., (to appear).

[3] S. J. Cowley, *Laminar boundary layer theory: a 20th century paradox?*, Proceedings of ICTAM 2000 (eds. H. Aref and J.W. Phillips), Kluwer, 2001.

[4] C. L. Fefferman, *Official clay prize problem description: Existence and smoothness of the navier-stokes equation*, http://www.claymath.org/millennium/, (2000).

[5] J. Hoffman and C. Johnson, *Resolution of d'alembert's paradox*, J. Math. Fluid Mech., (accepted).

[6] ——, *Flow separation in fluids with very small viscosity*, (in preparation).

[7] ——, *Why it is possible to fly*, (in preparation).

[8] ——, *Blow up of incompressible euler equations*, BIT Numerical Mathematics, (to appear).

[9] T. Y. Hou and R. Li, *Blowup or no blowup? the interplay between theory and numerics*, Physica D, special issue Euler Equations: 250 Years On, (2008).

[10] P. Moin and J. Kim, *Tackling turbulence with supercomputers*, Scientific American, (1997).

[11] L. Prandtl, *On motion of fluids with very little viscosity*, Third International Congress of Mathematics, Heidelberg, http://naca.larc.nasa.gov/digidoc/report/tm/52/NACA-TM-452.PDF, (1904).

[12] K. Stewartson, *D'alembert's paradox*, SIAM Review, 23(3) (1981), pp. 308–343.

[13] J. J. Stoker, *Review of hydrodynamics (1950) by garrett birkhoff*, Bull. Amer. Math. Soc., 57(6) (1951), pp. 497–499.

[14] D. You and P. Moin, *Large-eddy simulation of flow separation over an airfoil with synthetic jet control*, Center for Turbulence Research Annual Research Briefs, (2006).