

## Math 290J (Introduction to Water Waves)

- Meeting Time: T 1:00P-2:50P
- Location: MS 6627
- To avoid clashes with the DLS, we begin on January 19th. The first lecture will be an overview of the physics of the equation and our goals for the course; this will be presented by Rowan Killip.

### Topics for lectures:

- Local well-posedness in 2D without surface tension. (2 Lectures)  
Present §1-§4 of [7] in the first lecture, with emphasis on the first three sections and merely the statement of results from §4.  
Well-posedness via the energy method should be the topic of the second lecture (§5-6).
- Local well-posedness in 2D with surface tension. (1 Lecture)  
See [1, 3]. These employ a similar method and should be consulted together. For the lecture, present §6 from [3]; this is independent of the technical §4-5. The paper [1] is perhaps too general for clear presentation.
- Local smoothing. (1 Lecture)  
Present appendix A from [3]. This is an instance of the method of positive commutators and is essentially independent of the other parts of the paper.
- Review of the Dirichlet to Neumann map. (1 Lecture)  
This is an essential tool in most treatments of the water wave problem. Synthesize and review [1, §2] and [6, §3].
- Taylor instability and the linearized problem. (1 Lecture)  
Relevant sources are [2, §2], [4, §1–2], [5, p.19-20].

### REFERENCES

- [1] T. Alazard, N. Burq, and C. Zuily, *On the Water Waves Equations with Surface Tension*. Preprint [arXiv:0906.4406](https://arxiv.org/abs/0906.4406).
- [2] T. Beale, T. Hou, J. Lowengrub, *Growth rates for the linearized motion of fluid interfaces away from equilibrium*. *Comm. Pure Appl. Math.* **46** (1993), no. 9, 1269–1301. MR1231428
- [3] H. Christianson, V. Hur, G. Staffilani, *Strichartz estimates for the water-wave problem with surface tension*. Preprint [arXiv:0908.3255](https://arxiv.org/abs/0908.3255).
- [4] W. Craig, *An existence theory for water waves and the Boussinesq and Korteweg-de Vries scaling limits*. *Comm. Partial Differential Equations* **10** (1985), no. 8, 787–1003. MR0795808
- [5] P. G. Drazin and W. H. Reid, *Hydrodynamic stability*, Cambridge 1981.
- [6] D. Lannes, *Well-posedness of the water-waves equations*. *J. Amer. Math. Soc.* **18** (2005), no. 3, 605–654. MR2138139
- [7] S. Wu, *Well-posedness in Sobolev spaces of the full water wave problem in 2-D*. *Invent. Math.* **130** (1997), no. 1, 39–72. MR1471885
- [8] H. Yosihara, *Gravity waves on the free surface of an incompressible perfect fluid of finite depth*. *Publ. Res. Inst. Math. Sci.* **18** (1982), no. 1, 49–96. MR0660822