INTRODUCTION TO WATER WAVES

MSRI Summer Graduate School
July 27 to August 7, 2020

Required Reading (before summer school)
Suggested books

[1] **Theory of distributions and Fourier transforms**

F. G. Friedlander, *Introduction to the theory of distributions*, 2nd ed., Cambridge University Press, Cambridge, 1998, With additional material by M. Joshi, ISBN 0-521-64015-6; 0-521-64971-4. MR 1721032. Zbl 0499.46020. Chapters 1 to 9.

[2] **Introduction to PDE's and Sobolev spaces**

L. C. Evans, *Partial differential equations*, 2nd ed., Graduate Studies in Mathematics **19**, American Mathematical Society, Providence, RI, 2010, ISBN 978-0-8218-4974-3. MR 2597943. Zbl 1194.35001. Chapters 2, 5, 6, 7.

[3] **Complex analysis, including Riemann mapping theorem**

E. M. Stein and R. Shakarchi, *Complex analysis*, Princeton Lectures in Analysis **2**, Princeton University Press, Princeton, NJ, 2003, ISBN 0-691-11385-8. MR 1976398. Zbl 1020.30001. Chapters 1, 2, 3, 4, 8.

[4] **Introduction to dispersive PDE's**

T. Tao, *Nonlinear dispersive equations: local and global analysis*, CBMS Regional Conference Series in Mathematics **106**, American Mathematical Society, Providence, RI, 2006, ISBN 0-8218-4143-2. MR 2233925. Zbl 1106.35001. doi: 10.1090/cbms/106. Chapters 1 to 3.6.

Recommended Reading
To be discussed during lectures, with emphasis on papers 1 to 7

[1] M. Ifrim and D. Tataru, The lifespan of small data solutions in two dimensional capillary water waves, *Arch. Ration. Mech. Anal.* **225** (2017), no. 3, 1279–1346. MR 3667289. Zbl 1375.35347. arXiv 1406.5471. doi: 10.1007/s00205-017-1126-z.

[2] M. Ifrim and D. Tataru, Two dimensional water waves in holomorphic coordinates II: Global solutions, *Bull. Soc. Math. France* **144** (2016), no. 2, 369–394. MR 3499085. Zbl 1360.35179. arXiv 1404.7583. doi: 10.24033/bsmf.2717.

Date: June 7, 2020.
Bibliography by Mihaela Ifrim.

[3] M. Ifrim and D. Tataru, Global bounds for the cubic nonlinear Schrödinger equation (NLS) in one space dimension, *Nonlinearity* **28** (2015), no. 8, 2661–2675. MR 3382579. Zbl 1330.35402. arXiv 1404.7581. doi: 10.1088/0951-7715/28/8/2661.

[4] J. K. Hunter, M. Ifrim, and D. Tataru, Two dimensional water waves in holomorphic coordinates, *Comm. Math. Phys.* **346** (2016), no. 2, 483–552. MR 3535894. Zbl 1358.35121. arXiv 1401.1252. doi: 10.1007/s00220-016-2708-6.

[5] J. K. Hunter, M. Ifrim, D. Tataru, and T. K. Wong, Long time solutions for a Burgers–Hilbert equation via a modified energy method, *Proc. Amer. Math. Soc.* **143** (2015), no. 8, 3407–3412. MR 3348783. Zbl 1320.35071. arXiv 1301.1947. doi: 10.1090/proc/12215.

[6] M. Ifrim and D. Tataru, The NLS approximation for two dimensional deep gravity waves, *Sci. China Math.* **62** (2019), no. 6, 1101–1120. MR 3951883. Zbl 1415.76070. arXiv 1809.05060. doi: 10.1007/s11425-018-9501-y.

[7] M. Ifrim and D. Tataru, *No solitary waves in 2-D gravity and capillary waves in deep water*, preprint, 2019. arXiv 1808.07916.

[8] D. Lannes, *The water waves problem: mathematical analysis and asymptotics*, Mathematical Surveys and Monographs **188**, American Mathematical Society, Providence, RI, 2013, ISBN 978-0-8218-9470-5. MR 3060183. Zbl 1410.35003. doi: 10.1090/surv/188.

[9] J. Shatah, Normal forms and quadratic nonlinear Klein–Gordon equations, *Comm. Pure Appl. Math.* **38** (1985), no. 5, 685–696. MR 803256. Zbl 0597.35101. doi: 10.1002/cpa.3160380516.

[10] T. Alazard and G. Métivier, Paralinearization of the Dirichlet to Neumann operator, and regularity of three-dimensional water waves, *Comm. Partial Differential Equations* **34** (2009), no. 12, 1632–1704. MR 2581986. Zbl 1207.35082. arXiv 0901.2888. doi: 10.1080/03605300903296736.

[11] T. Alazard and J.-M. Delort, Global solutions and asymptotic behavior for two dimensional gravity water waves, *Ann. Sci. Éc. Norm. Supér.* (4) **48** (2015), no. 5, 1149–1238. MR 3429478. Zbl 1347.35198. arXiv 1305.4090. doi: 10.24033/asens.2268.

[12] T. Alazard and J.-M. Delort, *Sobolev estimates for two dimensional gravity water waves*, Astérisque **374**, Société Mathématique de France, Paris, 2015, ISBN 978-2-85629-821-3. MR 3460636. Zbl 1360.35002. arXiv 1307.3836. doi: 10.24033/ast.974. `https://smf.emath.fr/publications/estimations-sobolev-pour-les-ondes-de-gravite-en-dimension-deux`.