Some Suggested Project Topics

1. Report on some interesting aspect of chebfun and/or use chebfun to solve a more interesting problem than the one in the homework exercise. You can read lots of interesting things about chebfun at www.chebfun.org by clicking on “Get started” or “View examples.” For example, you might see if chebfun can solve the nonlinear pendulum problem without your having to explicitly code Newton’s method. [See “Chebfun Guide,” section 10 (at website above) and reference “Automatic Frechet differentiation for the numerical solution of boundary-value problems,” by Birksson and Driscoll, ACM TOMS 38 (2012), pp. 1-26.] Or you might see if chebfun can solve a BVP with a discontinuity such as \(\frac{d}{dx} (p(x) \frac{du}{dx}) = f\) on \((0,1)\), \(u(0) = u(1) = 0\), where, say, \(p(x) = 1\) for \(x < 1/2\) and \(p(x) = 10\) for \(x > 1/2\). [See section 7 of “Chebfun Guide” or the “Demos” menu of chebgui.] There are many other interesting aspects of chebfun that you could report on and experiment with. If you see something that you would like to study further, let me know.


3. Numerics in the Fokas method. A few of you have been attending Bernard Deconinck’s lectures on the Fokas method for solving IBVP’s. The method expresses the solution as an integral. See if you can evaluate such an integral accurately. (Perhaps this is something that could be done in chebfun.) [Ref. N. Flyer and A.S. Fokas, “A hybrid analytical-numerical method for solving evolution partial differential equations. I. The half-line,” the Royal Society Proceedings A, July, 2008.]

5. Some other interesting papers about which you might make an interesting report:

