

# Student projects

## **Pseudospectral methods**

Project supervisor: Ben Goddard

Project type

dissertation

Suitable degrees

Mathematics (BSc, MA & MMath-Y5)

#### **Project description**

Pseudospectral methods are a powerful class of widely-used techniques for the numerical solution of boundary value problems, eigenvalue problems and partial differential equations. If one wants to solve such a problem to high accuracy on a simple domain and if the resulting solution is smooth (infinitely differentiable) then pseudospectral methods are generally the best tool. Typically, one would expect ten digits of accuracy, compared to two or three digits for finite difference. Relatedly, pseudospectral methods demand less computer memory and processor time than the alternatives for a given accuracy. This project concerns both the analytical, underlying mathematical properties of these methods (e.g. exponential convergence rate for smooth solutions, aliasing, computational complexity) and their numerical implementation. The method will be implemented in Matlab for a range of simple problems, allowing the theoretical aspects to be demonstrated numerically.

### **Prerequisites**

Numerical Ordinary Differential Equations and Applications (http://www.drps.ed.ac.uk/18-19/dpt/cxmath10060.htm)

Familiarity with Matlab

Knowledge of Fourier series would be helpful

## **Recommended reading**

L. N. Trefethen, Spectral methods in MATLAB, SIAM, 2000 (electronic version available through the Library).

J. P. Boyd, Chebyshev and Fourier Spectral Methods, Springer-Verlag, 2001 (http://www-personal.umich.edu/~jpboyd/BOOK\_Spectral2000.html).