The Pseudospectral Method

Comprehension

1. Explain the concept of *exact* interpolation behaviour in the context of pseudospectral methods. What are cardinal functions?
2. Explain the meaning of the term *pseudospectral*. What is so *spectral* about the pseudospectral method?
3. What are the main differences between Fourier and Chebyshev approaches? Give application examples.
4. Discuss pros and cons of the Fourier method compared with the finite-difference method. Give examples where you would prefer one over the other. What is the role of computer architecture?

Theory

5.

In general, the spectrum $F(k)$ of the derivative of a function $f(x)$ is given by

$$F(k) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} f(x) e^{-ikx} dx.$$

Use integration by parts to show that (only by) assuming $f(x)$ vanishes if $x \to \pm\infty$ we obtain the extremely useful result that $F^{(n)}(k) = (ik)^n F(k)$ is the spectrum of the nth derivative of $f(x)$.

Notebooks

6. Run the notebooks *ps_fourier_derivative_solution , ps_fourier_acoustic_1d*, *ps_cheby_derivative* . Try to understand the cells, modify parameters, and discuss the results.