CHEBFUN: A NEW KIND OF NUMERICAL COMPUTING

Lloyd N. Trefethen, University of Oxford

For a long time there have been two kinds of mathematical computation: symbolic and numerical. Symbolic computing manipulates algebraic expressions exactly, but it is unworkable for many applications since the space and time requirements tend to grow combinatorially. Numerical computing avoids the combinatorial explosion by rounding to 16 digits at each step, but it works just with individual numbers, not algebraic expressions.

This talk will describe a new kind of computing that aims to combine the feel of symbolics with the speed of numerics. The idea is to represent functions by Chebyshev expansions whose length is determined adaptively to maintain an accuracy of close to machine precision. Our Chebfun system is implemented in object-oriented Matlab, with familiar vector operations such as sum and diff overloaded to analogues for functions such as integration and differentiation. Building on this foundation, we have even overloaded "backslash" to solve linear and nonlinear differential equations. Chebfun is joint work with many people including Toby Driscoll and Nick Hale: see www.maths.ox.ac.uk/chebfun/.