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Symbolical and numerical study of Fourier series and PDEs using Maxima

Emmanuel Roque[1]***, José A. Vallejo***[1] [emmanuelroquej@protonmail.ch]

[1] Faculty of Science, State University of San Luis Potosí, México

Fourier Analysis provides a set of techniques for solving partial differential equations (PDEs) in both bounded and unbounded domains, and various types of initial conditions. In the bounded domain case, the basic idea is to apply the separation of variables method which leads to a well-defined algorithm for developing the solution in a Fourier series. Therefore, this problem is tractable with a Computer Algebra System (CAS). In this work we introduce a Maxima package (called `pdefourier`) to solve it.
The package is able to compute the Fourier series of a function both numerically and symbolically, admitting piecewise-defined functions as arguments. It contains solvers for the one-dimensional heat and wave equations on a domain $[a, b]$ with general boundary conditions of the form

$$\alpha_1 u(a,t) + \beta_1 u_x(a,t) = f_1(t)$$
$$\alpha_2 u(b,t) + \beta_2 u_x(b,t) = f_2(t)\,.$$

Also, the package can solve the two-dimensional Laplace equation for a variery of domains (rectangles, disks, annuli, wedges) and boundary conditions (Dirichlet, Neumann and mixed).

In this talk, the underlying algorithms and technical details of the implementation will be discussed.

Keywords
Fourier Analysis, PDEs, Mathematical Software.