Solving PDEs Via Minimization of the Discrepancy Between the Neighboring Taylor Polynomials

Yosef Yomdin
yosef.yomdin@weizmann.ac.il

We describe a high accuracy method for solving linear or non-linear partial differential equations, using Taylor polynomial local models for the solution. At each grid-point we consider polynomials of a fixed degree d, with free coefficients, satisfying the equation up to this degree d. Then we minimize the discrepancy betzeen the neighboring Taylor polynomials, subject to the boundary conditions. This leads to a system of equations on the unknown Taylor coefficients (linear or non-linear). In an example of the Laplace equation in 2D, with the standard stencil and the Taylor polynomials of degree 2, the discretization error of the order 10 in the gridsize can be achieved by a careful choice of the neighboring discrepancy functional to be minimized.