LARRY SHAMPINE, Southern Methodist University, Dallas, TX 75275
BVP Solver that Controls Residual and Error

Programs for the numerical solution of boundary value problems (BVPs) for ordinary differential equations generally try to control the true error. BVP solvers require users to provide guesses for the desired solution and a mesh that reveals its behavior. Because these guesses may be poor, the asymptotic approximations that justify error estimates may not be very good, or perhaps not even valid. This is of particular concern when a user asks for only modest accuracy. A more robust approach is to control a residual in the numerical solution because it is possible to estimate it reliably, no matter how bad the guesses. This is the approach taken in bvp4c, the MATLAB BVP solver. Unfortunately control of the residual controls only indirectly the true error that is of most interest to users. Nevertheless, we show that for some methods, a control of a kind of residual controls the true error directly. Our investigation has resulted in a new BVP solver called bvp5c. It is used *exactly* like bvp4c and has some advantages in addition to a robust and more natural control of error.