Flattening the error curve of predictor algorithms for implicit methods in IVP

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We consider the efficient implementation of implicit methods applied with constant stepsizes to initial value problems. The use of constant step sizes has several advantages: practical global error estimation, possibility of extrapolation to increase accuracy, theoretical backward error analysis/modified equations results, and no need for practical local 'error estimates'. The main drawback of using constant step sizes is of course its possible inefficiency. Nevertheless, application of constant step sizes after time-rescaling of the differential equations is a way to allow for variable step sizes in the original time in order to regain efficiency. In this talk we present a universal predictor algorithm based on predicted error corrections. It can be applied not only to the initial guess but also to the subsequent iterates of the fixed-point/modified Newton (FN) iteration process, hence leading to a global new type of iterations mixing predictors and FN iterations. This general acceleration technique is flexible, embarrassingly parallel, and does not require any additional function evaluations. It can drastically reduce the number of function evaluations needed in the FN iterations process making implicit methods extremely efficient at the cost of some extra memory usage, illustrating the well-known computer science principle of time-memory trade-off.