Stabilized Numerical Schemes for Singularly Perturbed Delay Differential Equations

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There is general agreement among scientists that delay differential equations have a richer mathematical framework, and better consistency with observations, compared with corresponding models without memory or after-effects. However, many problems that modeled by delay differential equations – especially in the study of chemical kinetics, or immune system interactions – are 'stiff', in the sense that they have properties that make them slow and expensive to solve using explicit numerical methods. The efficient use of reliable numerical methods (based in general on implicit formulae) for dealing with stiff models involves a degree of sophistication not necessarily available to nonspecialists. In this paper, we suggest the so called mono-implicit continuous Runge-Kutta schemes, a subclass of semi-implicit continuous Runge-Kutta schemes, for numerical approximations of delay differential equations. The schemes are suitable for both stiff and non-stiff initial value problems. Stability properties of the methods are investigated. Some examples are considered to show the efficiency of the numerical methods.