ABSTRACT

Classical alternating direction (AD) and fractional step (FS) methods for parabolic equations, based on some standard implicit time stepping procedure such as Crank-Nicolson, can have errors associated with the AD or FS perturbations that are much larger than the errors associated with the underlying time stepping procedure. We show that minor modifications in the AD and FS procedures can virtually eliminate the perturbation errors at an additional computational cost that is less than ten per cent of the cost of the original AD or FS method. Moreover, after these modifications, the AD and FS procedures produce identical approximations of the solution of the differential problem. It is also shown that the same perturbation of the Crank-Nicolson procedure can be obtained with AD and FS methods associated with the backward Euler time stepping scheme. An application of the same concept is presented for second-order wave equations.