Time Discretization of Parabolic Equations by Laplace Transformation and Quadrature

Vidar Thomée

Department of Mathematics, Chalmers University of Technology, SWEDEN

Corresponding Author : Vidar Thomée, thomee@math.chalmers.se

ABSTRACT

We discuss three numerical methods for the discretization in time of an initial value problem for a parabolic differential equation in a Banach space framework. Each of the methods applies a quadrature rule to a contour integral representation of the solution in the complex plane, in which the integrand contains the resolvent of the elliptic operator involved. For each quadrature point an elliptic problem has to be solved to determine the value of the integrand, and these elliptic problems may be soved in parallel.. The first two methods involve the Laplace transform of the forcing term, but the third does not. The results may be used in the error analyses in the least squares norm or the maximum-norm of the fully discrete methods obtained by application of our time discretizaton methods to a spatially semidiscrete version of an initial-boundary value problem for a parabolic partial differential equation, based on finite elements.