THE SCHEMES FOR THE ADVECTION EQUATION

Petr Vabishchevich
Nuclear Safety Institute, Russian Academy of Sciences, Moscow, Russia;
North-Eastern Federal University, Yakutsk, Russia
e-mail: vabishchevich@gmail.com

The advection equation is the basis for mathematical models of continuum mechanics. In the approximate solution of nonstationary problems it is necessary to inherit main properties of the conservatism and monotonicity of the solution.
In this report, the advection equation is written in the symmetric form, where the advection operator is the half-sum of advection operators in conservative (divergent) and non-conservative (characteristic) forms. The advection operator is skew-symmetric. Standard finite element approximations in space are used.
The standard explicit two-level scheme for the advection equation is absolutely unstable. New conditionally stable regularized schemes are constructed, on the basis of the general theory of stability (well-posedness) of operator-difference schemes, the stability conditions of the explicit Lax-Wendroff scheme are established.
Unconditionally stable and conservative schemes are implicit schemes of the second (Crank-Nicolson scheme) and fourth order. The conditionally stable implicit Lax-Wendroff scheme is constructed. The accuracy of the investigated explicit and implicit two-level schemes for an approximate solution of the advection equation is illustrated by the numerical results of a model two-dimensional problem.