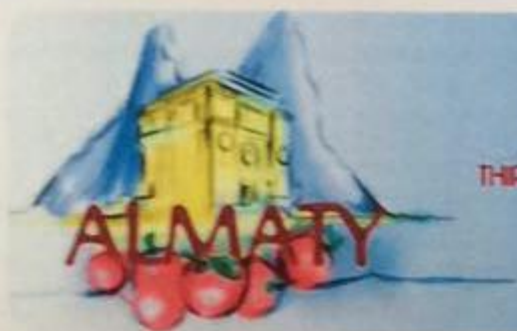


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THE ABSTRACT BOOK



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Faruk UYGUL	
Multiplier Amenability of Banach Algebras	117
Vijay Kumar VYAS	
q -Sumudu transforms of basic generalized hypergeometric functions	117
Vladimir VASILYEV	
On periodic wave factorization	118
Aizhan YDYRYS, Nazerke TLEUKHANOVA	
On multipliers of Fourier series in the Lorentz space	119
Alibek YESKERMESSULY	
About the defect indices of fourth-order differential operator with rapidly oscillating coefficients	120
Nurgissa YESSIRKEGENOV	
On a problem for wave equation with data on the whole boundary	121
2 APPLIED MATHEMATICS	123
Akmaral ABDIGALIYEVA, Zhailaubai ZHUBATOV, Dauren ZHAKE-BAYEV	
High order finite-difference method for simulation isotropic turbulence flow	124
Emmanuel ADEYEFA, R.O. FOLARANMI	
A new class of orthogonal polynomials (Adeolu polynomials) for derivation of initial value solvers	125
D. ALIBIYEV, G. KHAKIMZYANOV, A. KAZHIKENOVA, E. IBRAEVA	
Spreading of flame front I by the predictor-corrector scheme	126
Allaberen ASHYRALYEV, Begench GURBANOV, Ramil SALIMOV	
The identification problem for hyperbolic Schrodinger equation	127
Allaberen ASHYRALYEV, Ramil SALIMOV, Begench GURBANOV	
Fractional derivatives and fractional integrals linked to the fractional powers of positive operators	128
Allaberen ASHYRALYEV, Fatma Songul OZESENLI TETIKOGLU, Tulay KAHRAMAN	
Source identification problem for an elliptic-hyperbolic equation	129
Allaberen ASHYRALYEV, Baktygul KARABAEVA, Abdizhahan SARSENBI	
Stable difference scheme for the solution of an elliptic equation with the involution	130
Allaberen ASHYRALYEV, Bahriye KARACA	
A note on the Dirichlet problem for model complex partial differential equations	131
Allaberen ASHYRALYEV, Uelker OKUR	
Crank-Nicolson difference scheme for the stochastic parabolic equation with the dependent operator coefficient	132
Kadriye AYDEMİR, O. Sh. MUKHTAROV, Hayati OLGAR	
Differential operator equations with interface conditions in modified direct sum spaces	133
Anvar AZIMOV, Syrym KASENOV, Daniyar NURSEITOV, Simon SEROVA-JSKY	
Inverse problem for the Verhulst equation of limited population growth with discrete experiment data	134
Kheireddine BELAKROUM, Allaberen ASHYRALYEV, Assia GUEZANE-LAKOUD	
A note on the nonlocal boundary value problem for a third order partial differential equation	135
Galina BIZHANOVA	
Solution of the free boundary problem for the parabolic equations with unknown temperature and velocity	136

High order finite-difference method for simulation isotropic turbulence flow

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Abstract: The work deals with the modeling of turbulent energy using two different methods: finite-difference and spectral methods. To simulate the turbulent process the filtered three-dimensional non-stationary Navier-Stokes equation is used. The problem is solved by using hybrid methods, where the equation of motion is solved by using finite-difference methods in combination with cyclic penta-diagonal matrix, which allowed to reach high order of accuracy and to simulate turbulence decay at Reynolds number $Re=300$ for comparing with theoretical solution of Taylor and Green. The spectral method is used for solution of Poisson equation, which is makes it possible to gain the time. For validation of the given algorithm we solved the classical problem of Taylor and Green modeling of isotropic turbulence flow. Where at the work of Taylor and Green [1], the problem is solved analytically and defined all the turbulence characteristics. In the results of our simulation we have compared the turbulence characteristics with analytical solution: the change of turbulent kinetic energy, dissipation energy over the time and longitudinal and transverse one-dimensional spectra are defined. In this paper a three-dimensional non-stationary Navier-Stokes equation is solved for simulation of isotropic turbulence flow. For solving Navier-Stokes equation, we use a splitting scheme by physical parameters that consist of three stages. At the first stage, the Navier-Stokes equation is solved, without taking pressure into account. For approximation of the convective and diffusion terms of the intermediate velocity field finite-difference methods in combination with cyclic penta-diagonal matrix is used [2], which allowed to increase the order of accuracy in time and in space $O(t^3, h^4)$ without changing the amount of points. At the second stage the Poisson equation is solved, which is satisfies the continuity equation with considering the velocity field from the first stage. For solving the Poisson equation we use spectral method in combination with Fourier transform. The obtained pressure field with using fast Fourier transform is translated from the phase space to physical and used at the third stage for the recalculate of the final velocity field [3].

Keywords: finite-difference method, spectral method, Poisson equation, cyclic penta-diagonal matrix

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