Commentationes Mathematicae Universitatis Carolinae

Pavol Quittner

Spectral analysis of variational inequalities [Abstract of thesis]

Commentationes Mathematicae Universitatis Carolinae, Vol. 29 (1988), No. 1, 199

Persistent URL: http://dml.cz/dmlcz/106616

ralization of the results contained in the paper of M. Feistauer (Appl. Mat. 29(1984), 423-458) for rotating blade rows.

On the basis of the continuity equation, condition of irrotational flow and the equation for density we use stream function formulation. The nonlinear equation for ψ

$$\sum_{i=1}^{2} \frac{\partial}{\partial x_i} (b(x_1,x_2,(\nabla\psi)^2) \frac{\partial\psi}{\partial x_i}) = \omega \frac{\partial r^2}{\partial x_1} (x_1) \quad (\omega = \text{const.})$$

is investigated in the periodic domain Ω. The function b denotes the term $1/h\varrho$, where ϱ is the density of the fluid and the functions r, h characterize the geometry of the layer of variable thickness. In the incompressible case ϱ is constant and b is the function of x_1 only. If the fluid is compressible, the density ϱ is an <u>implicit</u> function of x_1, x_2 and $(\nabla\psi)^2$:

$$\varrho = \varrho_0 [1 + \frac{\varkappa-1}{2a_0^2}\omega^2 r^2 - \frac{\varkappa-1}{2a_0^2} (rh\varrho)^{-2}(\nabla\psi)^2]^{1/(\varkappa-1)}$$

In order to express ϱ <u>uniquely</u>, we assume that the flow is subsonic. So we get the coefficient $b(x_1,x_2,(\nabla\psi)^2(x_1,x_2))$.

We consider the boundary conditions of several types. We can choose some suitable combinations of Dirichlet, Neumann, incomplete Dirichlet, periodic or trailing conditions.

The problem is formulated variationally. The existence and uniqueness of the solution and the properties of its finite element approximation are studied. The convergence of the finite element method is proved and some aspects of algorithmization are explained. Special attention is paid to iterative processes for the calculation of the approximate solution. Results of calculated flow fields are presented (including the comparison with the integral equation method).

SPECTRAL ANALYSIS OF VARIATIONAL INEQUALITIES

P. QUITTNER, Institute of Physics, CE FV SAV, Dúbravská cesta 9, Bratislava, Czechoslovakia
(17.6. 1987, supervisor J. Nečas)

This dissertation is concerned with the existence of eigenvalues and bifurcation points of variational inequalities and with the solvability of the inequality

(1) $\qquad u \in K: \quad \langle \lambda u - Au - f, v-u \rangle \geq 0 \qquad \forall v \in K,$

where K is a convex cone in a Hilbert space H, $A: H \to H$ is a completely continuous linear operator and λ is a real parameter.

The first chapter contains preliminaries.

In the second chapter, some elementary properties of the set of eigenvalues of variational inequalities are proved.

In the third chapter, the generalization of E. Miersemann's results on higher eigenvalues of variational inequalities in the potential case is given.

The fourth chapter brings a new method for obtaining the eigenvalues of variational inequalities. Moreover, this method gives some information on the solvability of the inequality (1).

In the last chapter, the existence of eigenvalues and bifurcation points of inequalities of reaction-diffusion type is proved.