129 (2004) MATHEMATICA BOHEMICA No. 4, 421–446

NEWS AND NOTICES

# IN MEMORIAM JINDŘICH NEČAS

I. Hlaváček, O. John, A. Kufner, J. Málek, Š. Nečasová,
J. Stará, V. Šverák

Jindřich Nečas, a leading Czech mathematician and a world-class researcher in partial differential equations (PDEs), would have celebrated his 75th birthday on December 14, 2004. He passed away on December 6, 2002.

He will be remembered not only for his mathematics, but also for his friendly, engaging personality and the energy and enthusiasm which characterized his activities. He attracted many young talented mathematicians to PDEs and the Czech PDE community owes much to his natural leadership.

High points of his research include

(1) his contributions to boundary regularity theory for linear systems, where, in the 1960s, he pioneered the use of what is now often called the Rellich-Nečas identity;

(2) his contributions to regularity theory of variational integrals, such as his 1977 solution of a long-standing question directly related to Hilbert's 19th problem;

(3) his contributions to mathematical theory of the Navier-Stokes equations, including his 1995 solution of an important problem raised in a classical 1934 paper by J. Leray.

His many interests outside mathematics and physics included music, history, and philosophy.

Jindřich Nečas was born in Prague on December 14, 1929. He grew up in the town of Mělník, and he always liked to come back there. In the years 1948–1952, he studied

As Mathematica Bohemica suggested that the paper about Jindřich Nečas' life and work should contain a description of his contribution to mathematics as detailed as possible, the authors decided that each part of this article should be prepared by persons working in the corresponding area. Thus the part on mechanics was written by I. Hlaváček, regularity and nonlinear functional analysis by O. John, V. Šverák and J. Stará, the beginnings and linear theory by A. Kufner, fluid mechanics by J. Málek, V. Šverák and Š. Nečasová who also supplied biographical data and a list of last Jindřich Nečas' publications. The authors would like to thank M. Feistauer for his comments concerning Jindřich Nečas' influence to numerical analysis and Mitchell Luskin and Jiří Jarník for their assistance.

at the Faculty of Natural Sciences of the Charles University in Prague. After a short stay at the Czech Technical University (ČVUT), he started his graduate studies at the Mathematical Institute of the Czechoslovak Academy of Sciences (MÚ ČSAV) under the supervision of Professor Ivo Babuška. He obtained his PhD in 1957. In 1960 he became head of a new department at MÚ ČSAV. He was promoted to the academic rank of Docent in 1964, and in 1966 he obtained the highest scientific degree in Czechoslovakia at that time, the Doctor of Sciences. In 1967 his well-known monograph "Les méthodes directes en théorie des équations elliptiques" was published. In the same year he became head of the Department of Mathematical Analysis at the Faculty of Mathematics and Physics of Charles University (MFF UK). In 1977 he permanently left his MÚ ČSAV position for a position at the MFF UK. However, he was not promoted to the richly deserved academic rank of University Professor until 1990, due to the politics of the post-1968 era in Czechoslovakia. During the last years of his life he divided his time between Prague, where he was Professor Emeritus, and the University of Northern Illinois, DeKalb, where he held a position of Distinguished Research Professor.

His visits abroad were very important for his scientific career. His mathematics and his outgoing personality won him many friends in mathematics departments around the world.

He received many honors, including the Order of Merit of the Czech Republic, which he was awarded by President Václav Havel on October 28, 1998. The Technical University of Dresden awarded him the Doctorate Honoris Causa. Preparation of his Doctor Honoris Causa nomination at the University of Bayreuth was interrupted by his passing away.

## First steps

At the beginning of his first job in the Department of PDEs at MÚ ČSAV, J. Nečas worked in the group of Professor Ivo Babuška on problems in continuum mechanics. He was part of the team working on mathematical models used in the construction of the large Orlík Dam on the Vltava River. This work was motivated by practical engineering problems, but it also stimulated new theoretical results. J. Nečas' life-long interest in continuum mechanics and, more generally, in applications of mathematics, can be traced back to this period. His first papers [C1], [C2] as well as papers [C3], [C4] on applications of the Laplace transform were inspired by the work on the "Orlík" project.

Also, his dissertation concerning the biharmonic problem for convex polyhedra was stimulated by the problems related to the Orlík period. He defended the dissertation in 1957 and published the results in [C5], [C6] and [C8]. In these papers, he solved the biharmonic problem in an infinite wedge by means of integral transforms.

## Linear theory

Soon after finishing his dissertation, J. Nečas got interested in modern methods and the unifying themes of his work on linear problems the following topics became:

(i) The variational (Hilbert-space) approach to boundary value problems. (The term “direct approach” is also often used.)

(ii) Methods applicable to systems of equations (i.e., equations with vector-valued unknowns) and equations of higher order.

(iii) Regularity of weak solutions in domains with limited smoothness of the boundary, such as Lipschitz domains.

The motivation for his work on (ii) and (iii) (which goes back to his Orlík period) is that, for Jindřich Nečas, one of the basic prototypical equations was Lamé’s system of linear elasticity on a Lipschitz domain, a situation naturally coming up in many applications.[1]

Given (ii) and (iii), Nečas’ interest in the variational approach is very natural: the approach is very general and not very sensitive to various regularity assumptions or the vector-valued nature of the solutions.

The variational approach consists of re-formulating the boundary value problem as an abstract equation in a suitable Hilbert space. The abstract equation can usually be solved by general Hilbert-space results (such as the Riesz Representation Theorem or its generalization, the Lax-Milgram Lemma). The solution obtained in this way is called a weak solution, and often one can set things up so that weak solutions are unique. This step is often quite easy. The second, usually more difficult step, is to prove that the weak solution is in fact a classical solution. In most problems this amounts to proving that the solution is sufficiently regular.[2]

The variational approach is closely related to the theory of Sobolev spaces. These function spaces and methods related to their applications were studied in I. Babuška’s department intensively. The basic literature used was Sobolev’s fundamental monograph [S]. Jindřich Nečas, showing his independence, soon started using a new approach to Sobolev space theory introduced by E. Gagliardo.

---

[1] It is worth mentioning that even today many basic questions related to boundary regularity for this problem remain unsolved, in spite of intensive research in the area.
We recall that boundary regularity for elliptic systems in smooth domains was dealt with in a more or less definitive form in [ADN].

[2] A typical example of a regularity result is Weyl’s Lemma (1940), saying that a weakly harmonic function is in fact smooth, and hence analytic.

An important role in J. Nečas' work on boundary regularity of weak solutions is played by Rellich's identity and its generalizations. In the simplest case of the Laplace operator, the Rellich identity reads

$$(1)\quad \int_{\partial\Omega} (h_k\delta_{ij} - h_i\delta_{kj} - h_j\delta_{ik}) \frac{\partial v}{\partial x_i}\frac{\partial v}{\partial x_j} n_k \,\mathrm{d}S \\ = \int_\Omega \Big(\frac{\partial h_k}{\partial x_k}\delta_{ij} - \frac{\partial h_i}{\partial x_k}\delta_{kj} - \frac{\partial h_j}{\partial x_k}\delta_{ik}\Big)\frac{\partial v}{\partial x_i}\frac{\partial v}{\partial x_j}\,\mathrm{d}x - 2\int_\Omega h_i \frac{\partial v}{\partial x_i}(\Delta v)\,\mathrm{d}x,$$

where $v \in W^{2,2}(\Omega)$, $h_i \in C^\infty(\overline{\Omega})$, $i = 1, \ldots, n$. J. Nečas independently re-discovered this identity, generalized it, and used it to great effect to study boundary regularity. For example, by integration by parts one can get from (1) that for the equation $-\Delta u = f$ in a bounded Lipschitz domain $\Omega$ with boundary condition $u = 0$, the normal derivative is square integrable on the boundary. Using a duality argument, one can use it to solve the Dirichlet problem for boundary data which are merely in $L^2$. These ideas appear in [C11].

J. Nečas later generalized these results in [C14] and [C24]. This work became well-known and today the term Rellich-Nečas identity is often used in this connection. The research in boundary regularity for Lipschitz domains continues to be a very active research area.

Paper [C28] contains another well-known contribution of J. Nečas. It concerns equivalence of various Sobolev norms in Lipschitz domains. The simplest case is represented by the inequality

$$\|u - c\|_{L^2(\Omega)} \leqslant C\|\nabla u\|_{W^{-1,2}(\Omega)}$$

where $c$ is the average of $u$ over $\Omega$ and $\Omega$ is a bounded Lipschitz domain. This can be considered a significant generalization of the classical Poincaré inequality. Inequalities of this form have turned out to be very useful in many situations.

In paper [C18], J. Nečas used weighted Sobolev spaces. He always emphasized the importance of choosing the function spaces which are best fitted to the boundary value problem at hand. He inspired several young mathematicians to take up research on deeper properties of function spaces. Some of them started a seminar dedicated to this branch of mathematics. This was the beginning of the well-known Prague school of weighted Sobolev spaces, which continues to be very active. Its activities include Spring Schools organized regularly every five years since 1978. (See, for example, [P1] and [P2] for the proceedings of the first and the last one, respectively.)

In the paper [C17] from 1962, J. Nečas introduced an important class of domains on which Sobolev spaces have "good properties". Without giving here the full definition of his "domains of type $\mathfrak{N}$", we just remark that they have a close connection to

Lipschitz domains and domains with the cone property. In the paper [C17] he also proved the existence of "regularized distance from the boundary", which is a function $\sigma\colon\ C^\infty(\Omega)\cap C(\overline{\Omega})\to\mathbb{R}$ equivalent to $\operatorname{dist}(x,\partial\Omega)$ such that

$$|D^\alpha\sigma|\leqslant C\sigma^{1-|\alpha|}.$$

(Later this result was proved for general domains, see for example [ST] or [TR].)

A culmination of J. Nečas' research on linear problems was his 1967 monograph [A1]. The book originated as J. Nečas' lecture notes [B2] published by MÚ ČSAV as a mimeographed text in 1962–1963. Together with giving an up-to-date introduction to direct methods, the book also contains most of J. Nečas' important results on linear equations. The book aged well, and even today it can be considered one of the best textbooks on direct methods. J. Nečas had written the book in his beloved French. Despite the fact that an English translation has not appeared, the book remains one of the most frequently cited mathematical works by a Czech author.

## Regularity for nonlinear equations

A significant part of J. Nečas' work in regularity for nonlinear problems is closely related to classical questions going back to Hilbert's 19th and 20th problems. These concern existence and regularity of functions minimizing (under suitable conditions) variational integrals of the form

$$\int_\Omega F(x,u,\nabla u)\,\mathrm{d}x \tag{2}$$

and their higher-order analogues. J. Nečas started to actively work on these problems around 1965. One of the factors which turned his attention in this direction was a series of lectures by F. E. Browder at a summer school in Montreal held in 1965.

J. Nečas' first important result in this field, published in [C33], can be viewed as a highly nontrivial generalization of a famous result of C. B. Morrey from 1938. Morrey proved full regularity for minimizers of (2) in dimension 2 (under appropriate assumptions). In [C33], J. Nečas generalized this result to a large class of functionals depending on higher-order derivatives. His basic tool was a higher order version of a well-known linear $L^{2+\varepsilon}$-estimate due to N. G. Meyers [MEY], which was also proved in [C33]. Nečas' method of proof has found applications in other situations, for example in regularity problems concerning stationary solutions of certain fluid-dynamics models.

An important milestone in the study of regularity for integrals (2) in dimensions higher than two is the famous 1957 result of E. De Giorgi and J. Nash that, under appropriate assumptions, minimizers of (2) are smooth in the case of a scalar unknown function $u$. (Various important issues, such as optimal assumptions concerning the dependence of $F$ on $u$, were clarified later by Ladyzhenskaya and Uraltseva.) These works left open the case of vector-valued unknown functions $u$. The scalar case is proved by an estimate for solutions of linear equations with measurable coefficients. In 1968, E. De Giorgi and V. Mazja independently constructed examples showing that the critical estimate may fail for the corresponding linear equations with vector-valued unknowns. These examples were later refined by E. Guisti and M. Miranda. However, the original problem of regularity of minimizers of (2) remained open until it was settled by J. Nečas in 1977. Nečas showed that in dimensions five and higher one can construct analytic functions $F$ which do not depend on $x$ and $u$, are uniformly convex in $\nabla u$, have bounded second derivatives, and the integral (2) admits singular minimizers. We remark that the convexity of $F$ guarantees uniqueness of solutions to natural boundary value problems in the class of weak solutions. It also implies that weak solutions can be identified with minimizers.

Nečas' counter-example remains as astonishing today as it was when it first appeared. Further results related to this problem can be found in [C103], [C172], [MA], [SOU], [SJ]. Many basic questions concerning minimizers of (2) for vector-valued $u$ have remained open. For example, there are no known examples of non-smooth minimizers of functionals (2) for functions $u$ mapping a three dimensional domain into $\mathbb{R}^3$ (under appropriate assumptions on $F$, of course). For some recent developments see for example [SY] and [MS].

In 1979, J. Nečas together with M. Giaquinta pointed out (in [C96]) an interesting connection between regularity of nonlinear elliptic systems and a Liouville-type condition. For example, in the context of the variational integral (2) with $F(x, u, \nabla u) = F(\nabla u)$, the connection is that the regularity of minimizers of (2) is equivalent, modulo technicalities, to the absence of nontrivial global Lipschitz solutions of the corresponding Euler-Lagrange equation. (Theorems which are conceptually similar appeared first in the theory of minimal surfaces.)

The Liouville condition can be hard to check. Nevertheless, the theorem is important from the conceptual point of view. Also, it was used by J. Nečas, I. Netuka and P. L. Lions to give new proofs of regularity results of K. Uhlenbeck for $F(x, u, \nabla u) = f(|\nabla u|)$ (see [C112]), and J. Nečas used it to give a different proof of regularity results of A. I. Koshelev addressing the case when $\nabla u \to F(x, u, \nabla u)$ is not too far from $|\nabla u|^2$. Many basic problems related to these ideas have remained open.

For a short period of time, J. Nečas also paid attention to regularity for nonlinear parabolic systems. In this area his contribution cannot be overlooked, either. In 1991, he studied with V. Šverák a problem of regularity of weak solutions of the system

$$\frac{\partial u}{\partial t} = \operatorname{div}(A(\nabla u)), \quad u = (u_1(z), u_2(z), \dots, u_N(z)), \quad z = (x_1, x_2 \dots x_n, t)$$

where $A$ is a uniformly monotone mapping.[3]

In [C151], which soon became well-known among specialists, Hölder continuity of weak solutions was proved for $n \leqslant 4$ and Hölder continuity of the gradient was proved for $n \leqslant 2$ (implying full regularity in that case).

The method of proof was based on a nontrivial generalization of a well-known linear $L^{2+\varepsilon}$ estimate of N. G. Meyers [MEY] to the parabolic case. The new linear parabolic estimate enabled the authors to move the time derivative to the right-hand side and treat the system by known elliptic techniques.

We remark that it still seems to be an open problem whether, for $n = 2$, one can improve the linear $L^{2+\varepsilon}$ estimate to a Hölder estimate. (This would immediately give full regularity for the nonlinear problem.) It is known that this cannot work for $n = 3$, due to elliptic counter-examples.

## Nonlinear functional analysis

J. Nečas started working on nonlinear problems in the second half of the 1960s. In this area he was essentially influenced by F. Browder and J. Leray.

Nečas was one of the main organizers of a series of memorable summer schools on nonlinear problems. We recall at least the following:

—Richterovy Boudy in Krkonoše Mountains in 1966, with J. Leray, M. M. Vajnberg, R. Finn, E. Giusti and G. DaPrato;

—Tupadly 1969, with E. Heinz, W. Jäger, R. Payne and E. Giusti;

—Babylon 1971, with Melvyn S. Berger, Marion S. Berger, G. Prodi, S. Spagnolo, E. S. Citlanadze, H. Triebel and A. Pultr;

—Podhradí 1973, with G. Anger, V. Barbu, H. Brézis, S. Dümmel, J. Král, N. S. Kružkov and I. Vrkoč.

One of Nečas' main interests in this period was nonlinear functional analysis, especially the spectral theory for nonlinear operators. The monograph [A2] (written with S. Fučík, J. Souček and V. Souček) contains many new results in this area.

The authors consider equations of the form

$$\lambda T(u) - S(u) = f \tag{3}$$

[3] When $A$ merely satisfies the Legendre-Hadamard condition, regularity can completely fail even for solutions independent of $t$, see [MS].

in a Banach space, where $T, S$ are $a$-homogeneous odd operators satisfying additional assumptions. Roughly speaking, $T$ behaves as the identity and $S$ is continuous and compact. Equation (3) can then be considered a deformation of the familiar case when $T$ is the identity and $S$ is linear and compact. For the linear case, one way of understanding the classical results concerning (3) is to view the situation in topological terms, such as Leray-Schauder degree, Ljusternik-Shnirelman category, and min-max principles for critical points of functionals on spheres or projective spaces.

In [A2], such topological methods are applied to the nonlinear equation (3) and generalizations of well-known linear results are obtained. For example, a nonlinear version of the Fredholm Alternative Theorem is proved.

Another very interesting result proved in [A2] is an estimate from above of the number of critical points for a class of functionals on Banach spaces. The estimate is based on a generalization of the Morse-Sard theorem to an infinite-dimensional setting, for functionals which are real analytic. The general theory was applied by the authors to a variety of problems for ODEs, PDEs, integral and integro-differential equations.

Since the late 1960s, J. Nečas also did significant work on variational inequalities. This work is discussed in the next section.

In 1983, the monograph [A6] on nonlinear elliptic problems was published, with a second edition in 1986. This book offers an exposition of results in nonlinear functional analysis as well as the regularity theory for nonlinear elliptic systems (discussed in the section Regularity for nonlinear equations). It provides an excellent introduction to these topics.

## Mechanics of solids and fluids

Jindřich Nečas loved continuum mechanics. One might probably say that equations of elasticity and fluid mechanics were always on his mind, one way or another.

### Mechanics of solids

In 1967, J. Nečas founded the Continuum Mechanics Seminar which attracted a wide audience from Charles University, Czech Technical University, and various institutes of the Czech Academy of Sciences. The audience would typically include students, mathematicians, and engineers. He also lectured on continuum mechanics at the Faculty of Mathematics and Physics of Charles University. These lectures, together with the seminar, were the starting point of Nečas' next succesful book [A4], written with I. Hlaváček. The book contains many original results of Nečas and his collaborators.

Among J. Nečas' favorite topics were unilateral problems in elasticity. These can be modelled by variational inequalities. This is another area where Nečas made important contributions. Together with I. Hlaváček, J. Haslinger and J. Lovíšek he wrote the monograph [A5]. Besides providing an excellent introduction to the subject, it also gives an exposition of original results of Nečas and his collaborators. Of these we should mention at least [C100], where subtle existence results for a model of quasistatic unilateral contact with Coulomb friction are proved, and [C76], where semicoercive unilateral contact problems are discussed and solved. Monograph [A5] later appeared in Russian ([A7]) and English ([A9]).

Jindřich Nečas also made important contributions to the mathematical analysis of models describing the yielding of plastic materials. He proved existence and uniqueness of solutions for models of perfectly plastic bodies and models with isotropic or kinematic hardening. (The penalty method proved to be a very effective tool here.)

He enthusiastically embraced the 1977 existence theory of J. Ball, and together with P. G. Ciarlet studied its extensions to unilateral contact problems (see [C120], [C122], and [C123]).

He studied the dynamics of elastoplastic bodies and proved existence and uniqueness for the corresponding PDEs in [C95]. Later, he turned his attention to nonlinear thermoelasticity ([C143], [C147], [C140]).

In [C143], he studied the problem of hardening in the framework of problems with moving boundary. In [C142], [C156] he analyzed viscoelastic materials and incompressible multipolar fluids.

We must also mention the contributions of J. Nečas to numerical methods suitable for problems in solid mechanics. His proofs of important theoretical results were often based on methods that suggested a good numerical approximation. Kačanov's (secant modules) method ([C65]) with its applications in the nonlinear theory of plastic deformations ([C117]) and Galerkin's method ([A11]) are good examples.

Although Nečas' work in continuum mechanics concentrated mostly on nonlinear problems, he also made important contributions to linear theory. For example, papers [C44], [C45] give a simple algebraic criterion which is equivalent to a coercivity condition for quite general systems of linear PDEs. This result generalizes Korn's inequality known from linear elasticity and can be used to obtain ellipticity for other boundary value problems arising in applications.

### Fluid Mechanics

Nečas started working on the equations of fluid mechanics at the beginning of the 1980s. At that time, his attention turned to problems surrounding models of transonic flow. Discussions with J. Polášek in Prague and R. Glowinski and O. Pironneau in Paris played an important role in motivating this work. Nečas studied Glowinski's and Pironneau's proposal in [GP] to use entropy conditions to avoid non-physical solutions of transonic flow models. Results of these investigations are reported in monograph [A10]. A short overview can be found in the book [FE].

Nečas was well aware of the drawbacks of various transonic flow models and started working on the fundamental equations of fluid mechanics in the second half of the 1980s. These equations are notoriously difficult.[4]

In a joint work with M. Šilhavý, J. Nečas systematically studied the possibilities of introducing higher order viscosities which are compatible with basic principles of thermodynamics and frame indifference. In [C150], Nečas and Šilhavý gave a classification of these models. Paper [C138] contains existence and regularity theory for higher-order viscosity models.

Nečas' best-known result in fluid mechanics is probably the paper [C171] which concerns the question of existence of self-similar singular solutions of the classical 3d incompressible Navier-Stokes equations. The question was posed in the famous 1934 paper by J. Leray [LE] which laid the foundations of the mathematical theory of the Navier-Stokes equations. Leray noticed that possible formation of singularities from smooth data in 3d Navier-Stokes equations is compatible with all mathematical properties of the equations known at the time. In fact, he realized that the known properties could not even rule out singularities of the form

$$u(t,x) = \frac{1}{\sqrt{T-t}}U\Big(\frac{x}{\sqrt{T-t}}\Big).$$

These can be thought of as the simplest possible singularities which are mathematically compatible with every property of the Navier-Stokes equations known prior to [C171]. In particular, such singularities are compatible with energy dissipation due to viscosity; they are also compatible with all regularity results which can be proved by perturbation techniques. (Examples of such results include the Ladyzhenskaya-Serrin-Prodi condition and the regularity criteria in the well-known papers by Caffarelli, Kohn and Nirenberg and Sheffer.)

In [C171], self-similar singularities were ruled out by using a new maximum principle hidden in the equations for $U$. It is perhaps appropriate to quote from a letter which J. Leray wrote to J. Nečas and his co-authors in 1996 after receiving the paper.

...En 1934 j'avais prouvé qu'en dimension spatiale 3, pour Navier-Stokes, le problème de Cauchy sans bord possède toujours au moins une solution, régulière ou

[4] Recently, a leading researcher in mathematical fluid mechanics wrote, adapting a Winston Churchill line: "...The Reynolds equations are still a riddle. They are based on the Navier-Stokes equations, which are still a mystery. The Navier-Stokes equations are a viscous regularization of the Euler equations, which are still an enigma. Turbulence is a riddle wrapped in a mystery inside an enigma" [P. Constantin, CIME lecture notes, 2003].

non; (si elle est régulière, elle est unique; elle est régulière en dimension spatiale 2). Je croyais avoir trouvé, en dimension spatiale 3, un moyen de construire, peut-être, une solution non régulière "self-similar". Votre note et votre texte plus détaillé réussissent à prouver très ingénieusement qu'une telle solution "self-similar" n'existe pas. Je vous en félicite vivement.

J'ai longuement réfléchi, après votre lettre, à ma question de 1934: pour Navier-Stokes la solution du problème de Cauchy peut-elle être non-régulière? A mon grand regret il est sage que je cesse d'y penser. Henri Lebesgue me l'avait conseillé dès 1935!

An important extension of results in [C171] can be found in a paper by T. P. Tsai [TS].[5]

J. Nečas was also very interested in the problem of singularity formation for solutions of Euler's equations. The paper [C180] studies numerical evidence for finite-time blow-up in Euler's equations. Another interesting contribution to the theory of Euler's equations is [C184].

Finally, we would like to mention at least one more result obtained by applying regularity techniques to fluids with shear-dependent viscosity. O. A. Ladyzhenskaya (see [LA]) initiated the study of models for incompressible fluids with viscosities $\nu$ of the type

$$\nu(|D|^2) = \nu_0 + \nu_1 |D|^{r-2}\,, \qquad \nu_0, \nu_1 > 0, \tag{4}$$

and showed the existence of global-in-time weak solutions to the corresponding evolutionary 3d model for $r \geqslant \frac{11}{5}$. Given that for the classical 3d Navier-Stokes equations ($\nu_1 = 0$) such a solution exists, one expects that solutions to models with viscosities of the form (4) should exist at least for $r \geqslant 2$. The gap between the two conditions for $r$ was removed (and additional results proved) in [C160], [C162], [A11] for the spatially periodic problem, and in [C178] for no-slip boundary conditions. Proofs of existence of weak solutions in this context usually rest on a compactness result. In the above papers, the necessary compactness result is deduced from the condition

$$\int_0^T \frac{\|\nabla^2 v^\varepsilon(t)\|_2^2}{(1 + \|\nabla v^\varepsilon(t)\|_2^2)^\lambda}\,\mathrm{d}t \leqslant C \quad \text{(uniformly w.r.t. } \varepsilon) \tag{5}$$

where $v^\varepsilon$ is a suitable approximate solution.

[5] The problem of regularity of solutions for the incompressible 3d Navier-Stokes equations is one of the seven Millenium Problems named by the Clay Mathematics Institute, which is offering a monetary prize for their solutions. See http://www.claymath.org/millennium/.

Nečas' deep experience in regularity theory for nonlinear elliptic and parabolic systems played a crucial role in derivation of (5).

J. Nečas' leadership and his concern for opening opportunities to young scientists were very important for starting the series of Spring Schools on Fluid Mechanics at Paseky nad Jizerou. He was, together with J. Málek and M. Rokyta, one of the regular organizers. The Schools have been very successful, as can be seen from the distinguished list of lecturers and the large numbers of both foreign and domestic participants.

When discussing Jindřich Nečas' work in mechanics and other applications, we must also emphasize his close relations with the Numerical Analysis community. Nečas was always interested in practical issues arising in computations based on models he studied from the theoretical perspective. Some of his theoretical ideas helped in designing effective numerical algorithms. He had many friends and collaborators among both Czech and foreign numerical analysts. His work on the variational approach to PDEs has had a significant impact on the Czech finite element community.

## Final words

Jindřich Nečas was an outstanding mathematician, one of the founders of the modern school of PDEs in Prague. His gift for inspiring people helped many to start their scientific careers. His optimism and enthusiasm for science will be remembered by all who met him, and his work will continue to influence mathematical research in many ways. He will be deeply missed.

### *References*


[AD] *Adams, R. A.*: Sobolev Spaces. Academic Press, New York, 1975.

[ADN] *Agmon, S., Douglis, A., Nirenberg, J.*: Estimates near the boundary for solutions to elliptic PDEs satisfying general boundary conditions I, II. Comm. Pure Appl. Math. *12, 17* (1959, 1964), 623–727, 35–92.

[AG] *Amrouche, C., Girault, V.*: Decomposition of vector spaces and application to the Stokes problems in arbitrary dimension. Czechoslovak Math. J. *44* (1994), 109–141.

[BA] *Ball, J. M.*: Convexity conditions and existence theorems in nonlinear elasticity. Arch. Rat. Mech. Anal. *63* (1977), 337–406.

[BE] *Berger, H.*: A convergent finite element formulation for transonic flow. Numer. Math. *56* (1989), 425–447.

[BF] *Berger, H., Feistauer, M.*: Analysis of the finite element variational crimes in the numerical approximation of transonic flow. Math. Comput. *61* (1993), 493–521.

[BWW] *Berger, H., Warnecke, G., Wendland, W.*: Finite elements for transonic potential flows. Num. Meth. for PDEs *6*, 15–42.

[BRV] *Babuška, I., Rektorys, K., Vyčichlo, F.*: Mathematical Theory of Planar Elasticity. NČSAV, Praha, 1955. (In Czech.)

[BR1] *Browder, F. E.*: Variational boundary value problems for quasilinear elliptic equations of arbitrary order I. Proc. Natl. Acad. Sci. USA *50* (1963), 31–37; II. ibid., 592–598; III. ibid., 794–798.

[BR2] *Browder, F. E.*: Topological methods for nonlinear elliptic equations of arbitrary order. Pacif. J. Math. *17* (1966), 17–31.

[BR3] *Browder, F. E.*: Nonlinear functional analysis and nonlinear partial differential equations. Acta Facult. Rerum Naturalium Univ. Comeniae, Mathematica Publ. (Proceedings of the Conference Equadiff 2, Bratislava, 1966) *17* (1967), 45–64.

[ESS] *Escauriaza, L., Seregin, G., Šverák, V.*: Backward uniqueness for the heat operator in half-space. Algebra i Analiz *15* (2003), 201–214.

[FE] *Feistauer, M.*: Mathematical Methods in Fluid Dynamics. Pitman Monographs and Surveys in Pure and Applied Mathematics 67, Longman, Harlow, 1993.

[F] *Fučík, S.*: Solvability of Nonlinear Equations and Boundary Value Problems. D. Reidel, Holland, in co-edition with Society of Czechoslovak Mathematicians and Physicists, Czechoslovakia, 1980.

[FK] *Fučík, S., Kufner A.*: Nonlinear Differential Equations. SNTL, Praha, 1978 (In Czech.); English translation: Elsevier, Amsterdam, 1980.

[GI1] *Giusti, E.*: Regolaritá parziale delle soluzioni di sistemi ellittici quasi lineari di ordine arbitrario. Ann. Sc. Norm. Sup. Pisa *23* (1969), 115–142.

[GI2] *Giusti, E.*: Regolaritá parziale delle soluzioni di sistemi ellittici quasi lineari di ordine arbitrario. Ann. Sc. Norm. Sup. Pisa *27* (1973), 161–166.

[GI3] *Giusti, E.*: Precisazione delle funzioni $H^{1,p}$ e singolaritá delle soluzioni deboli di sistemi ellittici non lineari. Boll. U.M.I. *2* (1969), 71–76.

[GIA] *Giaquinta, M.*: Multiple Integrals in the Calculus of Variations and Nonlinear Elliptic Systems. Annals Mat. Studies, Princeton University Press, 1983.

[GR] *Girault, V., Raviart, P.-A.*: Finite Element Methods for Navier-Stokes Equations. Springer Series in Computational Mathematics, Springer, 1986.

[GP] *Glowinski, R., Pironneau, O.*: On the computation of transonic flows. Functional Analysis and Numerical Analysis (H. Fujita ed.), Tokyo and Kyoto, 1976. Japan Society for the Promotion of Science, 1978, pp. 143–173.

[JMS] *John, O., Malý, J., Stará, J.*: Nowhere continuous solutions to elliptic systems. Comment. Math. Univ. Carolin. *30* (1989), 33–43.

[JS] *John, O., Stará, J.*: On the regularity of the weak solution of Cauchy problem for nonlinear parabolic systems via Liouville property. Comment. Math. Univ. Carolin. *25* (1984), 445–457.

[KJF] *Kufner, A., John, O., Fučík, S.*: Function Spaces. Academia, Praha, 1977.

[LA] *Ladyzhenskaya, O. A.*: The Mathematical Theory of Viscous Incompressible Flow. Second edition, Gordon and Breach Science Publishers, New York, 1969.

[LE] *Leray, J.*: Mouvement d'un liquide viscqueus emplissant l'espace. Acta Math. *63* (1934), 193–248.

[MA] *Malý, J.*: Nonisolated singularities of solutions to a quasilinear elliptic system. Comment. Math. Univ. Carolin. *29* (1988), 421–426.

[MEY] *Meyers, N. G.*: On $L_p$ estimates for the gradient of solutions of second order elliptic divergence equations. Ann. Scuola Norm. Sup. Pisa *17* (1963), 189–206.

[MRS] *Müller, S., Rieger, M. O., Šverák, V.*: Parabolic systems with nowhere smooth solutions. Max-Planck-Institut in den Naturwissenschaften, Leipzig, Preprint no. 11 (2003), 1–23.

[MS] *Müller, S., Šverák, V.*: Convex integration for Lipschitz functions and counterexamples to regularity. Ann. Math. (2) *158* (2003), 1–23.

[P1] *Fučík, S., Kufner, A. (eds.)*: Nonlinear Analysis, Function Spaces and Applications I. Teubner-Texte vol. 19, Teubner, Leipzig, 1979.

[P2] *Opic, B., Rákosník, J. (eds.)*: Nonlinear Analysis, Function Spaces and Applications VII. Math. Inst. Acad. Sci., Praha, 2003.

[S] *Sobolev, S. L.*: Applications of Functional Analysis in Mathematical Physics. Izdat. Leningrad. Gos. Univ., Leningrad, 1950 (In Russian.); English translation: Translations of Mathematical Monographs vol. 7, Amer. Math. Society, Providence R. I., 1963.

[SJ] *Stará, J., John, O.*: On some regularity and nonregularity results for solutions to parabolic systems. Le Matematiche LV 2000-Supplemento n. 2 (2000), 145–163.

[SOU] *Souček, J.*: Nonisolated singularities of solutions to a quasilinear elliptic systems. Comment. Math. Univ. Carolin. *25* (1984), 273–281.

[SS] *Serëgin, G., Šverák, V.*: Navier-Stokes equations with lower bounds on the pressure. Arch. Ration. Mech. Anal. *163* (2002), 65–86.

[ST] *Stein, E. M.*: Singular Integrals and Differentiability Properties of Functions. Princeton, 1970.

[SY] *Šverák, V., Yan, X.*: Non-Lipschitz minimizers of smooth strongly convex functionals. Proc. Natl. Acad. Sci. USA *99* (2002), 15269–15276.

[TA] *Tartar, L.*: Introduction to oceanography. http://www.math.cmu.edu/cna/publications/OceanoSpring99.ps.

[TR] *Triebel, H.*: Interpolation Theory, Function Spaces, Differential Operators. Verlag der Wissenschaften, Berlin, 1977, second edition in J. A. Barth Verlag, Heidelberg, 1995.

[TS] *Tsai, T-P.*: On Leray's self-similar solutions of the Navier-Stokes equations satisfying local energy estimates. Arch. Ration. Mech. Anal. *143* (1998), 29–51.

## Bibliography

### Monographs

[A1] *J. Nečas*: Les méthodes directes en théorie des équations elliptiques. Academia, Praha, and Masson et Cie, Éditeurs, Paris, 1967.

[A2] *S. Fučík, J. Nečas, J. Souček, V. Souček*: Spectral Analysis of Nonlinear Operators. Springer, Berlin, 1973; Lect. Notes Math. vol. 346.

[A3] *S. Fučík, J. Nečas, V. Souček*: Einführung in die Variationsrechnung. Teubner, Leipzig, 1977; Teubner-Texte zur Mathematik.

[A4] *J. Nečas, I. Hlaváček*: Mathematical Theory of Elastic and Elasto-Plastic Bodies: An Introduction. Studies in Applied Mechanics vol. 3, Elsevier, Amsterdam, 1980; Czech edition in SNTL, Praha, 1983.

[A5] *I. Hlaváček, J. Haslinger, J. Nečas, J. Lovíšek*: Riešenie variačných nerovností v mechanike. Alfa, Bratislava, 1982 (In Slovak.); for Russian edition see [A7] and for English edition [A9].

[A6] *J. Nečas*: Introduction to the Theory of Nonlinear Elliptic Equations. Teubner-Texte zur Mathematik vol. 52, Teubner, Leipzig, 1983.

[A7] *I. Hlaváček, J. Haslinger, J. Nečas, J. Lovíšek*: Reshenie variatsionnykh neravenstv v mekhanike. Mir, Moskva, 1986; Russian translation of [A5].

[A8] *J. Nečas*: Introduction to the Theory of Nonlinear Elliptic Equations. John Wiley, Chichester, 1986; Reprint of [A6].

[A9] *I. Hlaváček, J. Haslinger, J. Nečas, J. Lovíšek*: Solution of Variational Inequalities in Mechanics. Applied Mathematical Sciences vol. 66, Springer, New York, 1988; English translation of [A5].

[A10] *J. Nečas*: Écoulements de fluide: compacité par entropie. RMA: Research Notes in Applied Mathematics vol. 10, Masson, Paris, 1989.

[A11] *J. Málek, J. Nečas, M. Rokyta, M. Růžička*: Weak and Measure-Valued Solutions to Evolutionary PDEs. Applied Mathematics and Mathematical Computation vol. 13, Chapman & Hall, London, 1996.

[A12] *J. Haslinger, I. Hlaváček, J. Nečas*: Numerical methods for unilateral problems in solid mechanics. Handbook of Numerical Analysis vol. 4 (Ciarlet, P. G., ed.). North-Holland, Amsterdam, 1995, pp. 313–485.

Textbooks

[B1] *J. Nečas*: Variational Methods for Solutions of Linear Elliptic Equations. ÚTAM ČSAV, 1960. (In Czech.)

[B2] *J. Nečas, A. Kufner*: Functional Analytic Methods of Solutions to Elliptic Partial Differential Equations. MÚ ČSAV, 1963. (In Czech.)

[B3] *J. Nečas, S. Fučík, V. Souček*: Introduction to the Calculus of Variations. SPN, Praha, 1972. (In Czech.)

[B4] *J. Nečas, O. John*: Partial Differential Equations of Mathematical Physics. SPN, Praha, 1972. (In Czech.)

[B5] *J. Nečas*: Introduction to the Mathematical Theory of Elastic and Elasto-Plastic Bodies. SPN, Praha, 1976. (In Czech.)

[B6] *J. Nečas*: Regularité des solutions faibles d'equations elliptiques non-linéaires; applications à l'elasticité. Université Pierre et Marie Curie, Laboratoire d'analyse numerique, No. 81046, 1960.

[B7] *J. Nečas*: On the Regularity of Weak Solutions to Nonlinear Elliptic Systems of Partial Differential Equations. Scuola Normale Superiore Pisa, 1979.

Published papers

1956

[C1] *J. Nečas*: Influence of outside temperature on the strain of dams and other concrete masses. Appl. Mat. *1* (1956), 103–118. (In Czech.)

[C2] *J. Nečas*: Influence of outside temperature on the strain of dams and other concrete masses (second part). Appl. Mat. *1* (1956), 186–199. (In Czech.)

[C3] *D. Mayer, J. Nečas*: Das Addieren unendlicher Reihen unter Benützung von Integraltransformationen. Appl. Mat. *1* (1956), 165–185.

1958

[C4] *J. Nečas*: Une note sur la propriété caractéristique de la transformée de Laplace d'une fonction et sur certains espace de Hilbert $\overline{H}_{kl}$ dont la somme $\sum\limits_{k=0,l=0}^{\infty} \overline{H}_{kl}$ est l'ensemble des transformées de Laplace de distributions. Čas. Pěst. Mat. *83* (1958), 160–170. (In Czech.)

[C5] *J. Nečas*: Solution du problème biharmonique pour le coin infini. I. Čas. Pěst. Mat. *83* (1958), 257–286.

[C6] *J. Nečas*: Solution du problème biharmonique pour le coin infini. II. Čas. Pěst. Mat. *83* (1958), 399–424.

1959

[C7] *J. Nečas*: Résolution du problème de Dirichlet pour les équations elliptiques aux dérivées partielles du second ordre. Czechoslovak Math. J. *9* (1959), 467–469. (In Russian.)

[C8] *J. Nečas*: Solution du problème biharmonique pour le coin infini pas convex. Čas. Pěst. Mat. *84* (1959), 90–98. (In Czech.)

[C9] *J. Nečas*: L'extension de l'espace des conditions aux limites du problème biharmonique pour les domaines à points anguleux. Czechoslovak Math. J. *9* (1959), 339–371.

1960

[C10] *J. Nečas*: Über Grenzwerte von Funktionen, welche ein endliches Dirichletsches Integral haben. Apl. Mat. *5* (1960), 202–209.

[C11] *J. Nečas*: Sur les solutions des équations elliptiques aux dérivées partielles du second ordre avec intégrale de Dirichlet non-bornée. Czechoslovak Math. J. *10* (1960), 283–289. (In Russian.)

1961

[C12] *J. Nečas*: Sur une méthode pour résoudre les équations aux dérivées partielles du type elliptique, voisine de la variationnelle. Czechoslovak Math. J. *11* (1961), 662–683.

[C13] *J. Nečas*: Sur le problème de Dirichlet pour l'équation aux dérivées partielles du quatrième ordre du type elliptique. Rend. Sem. Mat. Univ. Padova *31* (1961), 198–231.

1962

[C14] *J. Nečas*: Application de l'egalité de Rellich aux problémes aux limites. Collége de France, Sem. Eq. Der. Art., 1962, pp. 143–167.

[C15] *J. Dvořák, J. Nečas*: Determination of stresses in a rectangular wedge by superposition of stressed states of halfplanes. Rev. Math. Pures Appl. (Bucarest) *7* (1962), 467–480. (In Russian.)

[C16] *J. Nečas*: On the regularity of solutions of second-order elliptic partial differential equations with an unbounded Dirichlet integral. Arch. Ration. Mech. Anal. *9* (1962), 134–144.

[C17] *J. Nečas*: On domains of type $\mathfrak{N}$. Czechoslovak Math. J. *12* (1962), 274–287. (In Russian.)

[C18] *J. Nečas*: Sur une méthode pour résoudre les équations aux dérivées partielles du type elliptique, voisine de la variationnelle. Ann. Scuola Norm. Sup. Pisa *16* (1962), 305–326.

[C19] *J. Nečas*: Sur l'existence de la solution classique du problème de Poisson pour les domaines plans. Ann. Scuola Norm. Sup. Pisa *16* (1962), 285–296.

1963

[C20] *J. Nečas*: On the solution of elliptic partial differential equations with an unbounded Dirichlet integral. Differential Equations and Their Applications (Proc. Conf., Praha, 1962). Publ. House Czechoslovak Acad. Sci., Praha, 1963, pp. 93–104.

[C21] *J. Nečas*: Sur la coercivité des formes bilinéaires pour les equations elliptiques. Atti del VII Congresso UMI Genova 1–2 (1963).

1964

[C22] *J. Nečas*: Sur les équations différentielles aux dérivées partielles du type elliptique du deuxième ordre. Czechoslovak Math. J. *14* (1964), 125–146.

[C23] *J. Nečas*: Sur la coercivité des formes sesquilinéaires, elliptiques. Rev. Roumaine Math. Pures Appl. *9* (1964), 47–69.

1965

[C24] *J. Nečas*: L'application de l'égalité de Rellich sur les systèmes elliptiques du deuxième ordre. J. Math. Pures Appl. *44* (1965), 133–147.

1966

[C25] *J. Nečas*: Sur une méthode générale pour la solution des problèmes aux limites non-linéaires. Ann. Scuola Norm. Sup. Pisa *20* (1966), 655–674.

[C26] *J. Nečas, Z. Poracká*: On extrema of functionals. Comment. Math. Univ. Carolin. *7* (1966), 509–520.

[C27] *J. Nečas*: Sur la méthode variationnelle pour les équations aux dérivées partielles non linéaires du type elliptique; l'existence et la régularité des solutions. Comment. Math. Univ. Carolin. *7* (1966), 301–317.

[C28] *J. Nečas*: Sur les normes equivalentes dans $W_p^k$ et sur la coercivité des formes formellement positives. Sem. Math. Sup. Université Montréal (1966), 102–128.

1967

[C29] *J. Kadlec, J. Nečas*: Sulla regolarità delle soluzioni di equazioni ellittiche negli spazi $H^{k,\lambda}$. Ann. Scuola Norm. Sup. Pisa *21* (1967), 527–545.

[C30] *J. Nečas*: Sur l'appartenance dans la classe $C^{(k),\mu}$ des solutions variationnelles des équations elliptiques non-linéaires de l'ordre $2k$ en deux dimensions. Comment. Math. Univ. Carolin. *8* (1967), 209–217.

[C31] *J. Nečas*: Sur la régularité des solutions faibles des equations elliptiques non-lineaires. Collége de France (1967–1968), 20–57.

[C32] *J. Nečas*: Sur l'existence de la solution régulière pour le problème de Dirichlet de l'équation elliptique non-linéaire d'ordre $2k$. Atti Accad. Naz. Lincei Rend. Cl. Sci. Fis. Mat. Natur. *42* (1967), 347–354.

[C33] *J. Nečas*: Sur la régularité des solutions variationelles des équations elliptiques non-linéaires d'ordre $2k$ en deux dimensions. Ann. Scuola Norm. Sup. Pisa *21* (1967), 427–457.

[C34] *J. Nečas*: On the existence and regularity of solutions of nonlinear elliptic equations. Acta Fac. Rer. Nat. Univ. Comenianae Math. *17* (1967), 101–119.

[C35] *J. Nečas*: On the existence and regularity of solutions of nonlinear elliptic equations. Diff. Equations and Their Applications, Equadiff 2 (Proc. Conf., Bratislava, 1966). pp. 101–119; SPN, Bratislava, 1967.

[C36] *A. Kufner, J. Nečas*: In memoriam Jana Kadlece. Čas. Pěst. Mat. *92* (1967), 490–492. (In Czech.)

1968

[C37] *A. Kufner, J. Nečas*: In memoriam of Jan Kadlec. Czechoslovak Math. J. *18* (1968), 190–192.

[C38] *J. Nečas*: Sur la régularité des solutions faibles des équations elliptiques non linéaires. Comment. Math. Univ. Carolin. *9* (1968), 365–413.

[C39] *J. Nečas*: Convergence of a method for solving the magnetostatic field in nonlinear media. Appl. Math. *13* (1968), 456–465.

1969

[C40] *J. Nečas*: Les équations elliptiques non-linéaires. Czechoslovak Math. J. *19* (1969), 252–274.

[C41] *J. Nečas*: Sur l'alternative de Fredholm pour les opérateurs non-linéaires avec applications aux problèmes aux limites. Ann. Scuola Norm. Sup. Pisa *23* (1969), 331–345.

[C42] *J. Nečas*: Integral transforms (Operational calculus) Survey of Applicable Mathematics. Iliffe books LTD, London, 1969, pp. 1125–1136.

1970

[C43] *J. Nečas, Z. Poracká, R. Kodnár*: Remarks on a nonlinear theory of thin elastic plates. Mat. Čas. Slovensk. Akad. Vied *20* (1970), 62–71.

[C44] *I. Hlaváček, J. Nečas*: On inequalities of Korn's type. I. Boundary-value problems for elliptic system of partial differential equations. Arch. Ration. Mech. Anal. *36* (1970), 305–311.

[C45] *I. Hlaváček, J. Nečas*: On inequalities of Korn's type. II. Applications to linear elasticity. Arch. Ration. Mech. Anal. *36* (1970), 312–334.

1971

[C46] *J. Nečas*: The discreteness of the spectrum of a nonlinear Sturm-Liouville equation. Dokl. Akad. Nauk SSSR *201* (1971), 1045–1048. (In Russian.)

[C47] *A. Kratochvíl, J. Nečas*: The discreteness of the spectrum of a nonlinear Sturm-Liouville equation of fourth order. Comment. Math. Univ. Carolin. *12* (1971), 639–653. (In Russian.)

[C48] *J. Nečas*: On the demiregularity of weak solutions of nonlinear elliptic equations. Bull. Amer. Math. Soc. *77* (1971), 151–156.

1972

[C49] *J. Nečas*: Fredholm alternatives and application to boundary value problems. Trudy 3. sovetsko-chekhoslovackogo soveschanija, Novosibirsk, 1972, SOAN SSSR 1972, 162–171. (In Russian.)

[C50] *S. Fučík, J. Nečas, J. Souček, V. Souček*: Strengthening upper bound for the number of critical levels of nonlinear functionals. Comment. Math. Univ. Carolin. *13* (1972), 297–310.

[C51] *J. Nečas, J. Stará*: Principio di massimo per i sistemi ellittici quasi-lineari non diagonali. Boll. Un. Mat. Ital. *6* (1972), 1–10.

[C52] *S. Fučík, J. Nečas*: Ljusternik-Schnirelmann theorem and nonlinear eigenvalue problems. Math. Nachr. *53* (1972), 277–289.

[C53] *J. Nečas*: Remark on the Fredholm alternative for nonlinear operators with application to nonlinear integral equations of generalized Hammerstein type. Comment. Math. Univ. Carolin. *13* (1972), 109–120.

[C54] *J. Nečas*: Fredholm alternative for nonlinear operators and applications to partial differential equations and integral equations. Čas. Pěst. Mat. *97* (1972), 65–71.

[C55] *S. Fučík, J. Nečas, J. Souček, V. Souček*: New infinite dimensional versions of Morse-Sard theorem. Boll. Un. Mat. Ital. *6* (1972), 317–322.

[C56] *S. Fučík, O. John, J. Nečas*: On the existence of Schauder bases in Sobolev spaces. Comment. Math. Univ. Carolin. *13* (1972), 163–175.

[C57] *S. Fučík, J. Nečas, J. Souček, V. Souček*: Upper bound for the number of critical levels for nonlinear operators in Banach spaces of the type of second order nonlinear partial differential operators. J. Funct. Anal. *11* (1972), 314–333.

[C58] *S. Fučík, J. Nečas, J. Souček, V. Souček*: Upper bound for the number of eigenvalues for nonlinear operators. Comment. Math. Univ. Carolin. *13* (1972), 191–195.

[C59] *J. Nečas*: On the discreteness to the spectrum of a nonlinear Sturm-Liouville equation of the fourth order. Trudy 3. sovetsko-chekhoslovackogo soveschanija, Novosibirsk, SOAN SSSR (1972), 107–121. (In Russian.)

1973

[C60] *S. Fučík, J. Nečas*: Spectral theory of nonlinear operators. Proceedings of Equadiff 3. Folia Fac. Sci. Natur. Univ. Purkynianae Brunensis, Ser. Monograph., Tomus 1, 1973, pp. 163–174.

[C61] *J. Nečas*: Variational methods in nonlinear elasticity. Acta Polytechnica (1973), 129–133. (In Czech.)

[C62] *S. Fučík, J. Nečas, J. Souček, V. Souček*: Note to nonlinear spectral theory: application to the nonlinear integral equations of the Lichtenstein type. Math. Nachr. *58* (1973), 257–267.

[C63] *J. Nečas, J. Kratochvíl*: On the existence of solutions of boundary-value problems for elastic-inelastic solids. Comment. Math. Univ. Carolin. *14* (1973), 755–760.

[C64] *J. Nečas*: On the formulation of the traction problem for the flow theory of plasticity. Apl. Mat. *18* (1973), 119–127.

[C65] *S. Fučík, A. Kratochvíl, J. Nečas*: Kačanov-Galerkin method. Comment. Math. Univ. Carolin. *14* (1973), 651–659.

[C66] *J. Nečas*: Range of nonlinear operators and application to boundary value problems. Math. Balcanica *3* (1973), 383–387; Proc. Internat. Conf. Integral, Differential and Functional Equations (Bled, 1973).

[C67] *J. Nečas*: On the range of nonlinear operators with linear asymptotes which are not invertible. Comment. Math. Univ. Carolin. *14* (1973), 63–72.

[C68] *J. Nečas*: Fredholm theory of boundary value problems for nonlinear ordinary differential operators. Proceedings of Summer School at Babylon in 1971, Academia, Praha, 1973, pp. 85–119.

[C69] *S. Fučík, J. Nečas, J. Souček, V. Souček*: Upper bound for the number of eigenvalues for nonlinear operators. Ann. Scuola Norm. Sup. Pisa *27* (1973), 53–71.

1974

[C70] *J. Nečas*: Mathematical models of elastic-inelastic materials. Schriftenreihe Zentralinst. Math. Mech. Akad. Wiss. DDR, No. 20 (1974), 227–232.

[C71] *S. Fučík, J. Nečas, J. Souček, V. Souček*: Krasnoselskii's main bifurcation theorem. Arch. Ration. Mech. Anal. *54* (1974), 328–339.

[C72] *J. Nečas, J. Naumann*: On a boundary value problem in nonlinear theory of thin elastic plates. Apl. Mat. *19* (1974), 7–16.

[C73] *S. Fučík, M. Kučera, J. Nečas, J. Souček, V. Souček*: Morse-Sard theorem in infinite dimensional Banach spaces and investigation of the set of all critical levels. Čas. Pěst. Mat. *99* (1974), 217–243.

[C74] *J. Nečas*: Application of Rothe's method to abstract parabolic equations. Czechoslovak Math. J. *24* (1974), 496–500.

[C75] *S. Fučík, A. Kratochvíl, J. Nečas*: Kačanov-Galerkin method and its application. Acta Univ. Carolin.-Math. et Phys. *15* (1974), 31–33.

1975

[C76] *J. Nečas*: On regularity of solutions to nonlinear variational inequalities for second-order elliptic systems. Rend. Mat. *8* (1975), 481–498.

[C77] *O. John, J. Nečas*: On the solvability of von Kármán equations. Apl. Mat. *20* (1975), 48–62.
[C78] *S. Fučík, A. Kratochvíl, J. Nečas*: Kačanov's method and its application. Rev. Roumaine Math. Pures Appl. *20* (1975), 907–916.
[C79] *S. Fučík, M. Kučera, J. Nečas*: Ranges of nonlinear asymptotically linear operators. J. Differ. Eq. *17* (1975), 375–394.
[C80] *J. Nečas*: An approximate method for finding the critical points of even functionals. Trudy Mat. Inst. Steklov. *134* (1975), 235–239.
[C81] *M. Müller, J. Nečas*: Über die Regularität der schwachen Lösungen von Randwertaufgaben für quasilineare elliptische Differentialgleichungen höherer Ordnung. Czechoslovak Math. J. *25* (1975), 227–239.

1976

[C82] *J. Nečas*: Theory of locally monotone operators modeled on the finite displacement theory for hyperelasticity. Beiträge Anal. *8* (1976), 103–114.
[C83] *J. Nečas, M. Štípl*: A paradox in the theory of linear elasticity. Apl. Mat. *21* (1976), 431–433.
[C84] *A. Doktor, J. Nečas, R. Švarc*: A remark on applications of the Laplace transform to abstract differential equations of parabolic type. Čas. Pěst. Mat. *101* (1976), 7–19.
[C85] *J. Nečas*: Introduction to variational methods of solution of elliptic equations with applications to theory of elasticity. Proceedings of Summer School on Numerical Solution of Elliptic Equations by Finite Elements Method, Charles University, 1976.

1977

[C86] *J. Nečas*: Example of an irregular solution to a nonlinear elliptic system with analytic coefficients and conditions for regularity. Abh. Akad. Wiss. DDR Abt. Math.-Natur.-Tech., Jahrgang *1* (1977), 197–206.
[C87] *M. Kučera, J. Nečas*: Interior regularity of solutions to systems of variational inequalities. Čas. Pěst. Mat. *102* (1977), 73–82.
[C88] *J. Jarušek, J. Nečas*: Sur les domaines des valeurs des opérateurs non-linéaires. Čas. Pěst. Mat. *102* (1977), 61–72.

1978

[C89] *J. Nečas, J. Stará, R. Švarc*: Classical solution to a second order nonlinear elliptic system in $\mathbb{R}^3$. Ann. Scuola Norm. Sup. Pisa Cl. Sci. *5* (1978), 605–631.
[C90] *M. Kučera, J. Nečas, J. Souček*: The eigenvalue problem for variational inequalities and a new version of the Ljusternik-Schnirelmann theory. Nonlin. Anal., Academic Press, 1978, pp. 125–143.
[C91] *J. Nečas, L. Trávníček*: Variational inequalities of elastoplasticity with internal state variables. Theory of Nonlinear Operators (Proc. Fifth Internat. Summer School, Central Inst. Math. Mech. Acad. Sci. GDR, Berlin, 1977), vol. 6, Abh. Akad. Wiss. DDR, Abt. Math. Naturwiss. Tech., 1978. Akademie-Verlag, Berlin, 1978, pp. 195–204.
[C92] *J. Nečas*: An example of a nonsmooth solution of a nonlinear elliptic system with analytic coefficients and a smoothness condition. Proceedings of an All-Union Conference on Partial Differential Equations (Moscow State Univ., Moscow, 1976). Mekh., 1978. Moskov. Gos. Univ., pp. 174–177. (In Russian.)

1979

[C93] *A. Kratochvíl, J. Nečas*: Secant modulus method for the construction of a solution of nonlinear eigenvalue problems. Boll. Un. Mat. Ital. B *16* (1979), 694–710.

[C94] *K. Gröger, J. Nečas*: On a class of nonlinear initial value problems in Hilbert spaces. Math. Nachr. *93* (1979), 21–31.

[C95] *K. Gröger, J. Nečas, L. Trávníček*: Dynamic deformation processes of elastic-plastic systems. Z. Angew. Math. Mech. *59* (1979), 567–572.

[C96] *M. Giaquinta, J. Nečas*: On the regularity of weak solutions to nonlinear elliptic systems via Liouville's type property. Comment. Math. Univ. Carolin. *20* (1979), 111–121.

[C97] *J. Nečas*: On the regularity of weak solutions to variational equations and inequalities for nonlinear second order elliptic systems. Equadiff 4 (Proc. Czechoslovak Conf. Differential Equations and Their Applications, Prague, 1977), vol. 703, Lect. Notes Math. Springer, Berlin, 1979, pp. 286–299.

1980

[C98] *J. Nečas, O. A. Oleĭnik*: Liouville theorems for elliptic systems. Dokl. Akad. Nauk SSSR *252* (1980), 1312–1316. (In Russian.)

[C99] *M. Giaquinta, J. Nečas*: On the regularity of weak solutions to nonlinear elliptic systems of partial differential equations. J. Reine Angew. Math. *316* (1980), 140–159.

[C100] *J. Nečas, J. Jarušek, J. Haslinger*: On the solution of the variational inequality to the Signorini problem with small friction. Boll. Un. Mat. Ital. B *17* (1980), 796–811.

[C101] *J. Nečas, L. Trávníček*: Evolutionary variational inequalities and applications in plasticity. Apl. Mat. *25* (1980), 241–256.

[C102] *J. Mawhin, J. Nečas, B. Novák*: Zemřel docent Svatopluk Fučík. Čas. Pěst. Mat. *105* (1980), 91–101. (In Czech.)

[C103] *J. Nečas, O. John, J. Stará*: Counterexample to the regularity of weak solution of elliptic systems. Comment. Math. Univ. Carolin. *21* (1980), 145–154.

[C104] *J. Nečas*: Variational inequalities in elasticity and plasticity with application to Signorini's problems and to flow theory of plasticity. Z. Angew. Math. Mech. *60* (1980), 20–26.

[C105] *A. Kratochvíl, J. Nečas*: Gradient methods for the construction of Ljusternik-Schnirelmann critical values. RAIRO Anal. Numér. *14* (1980), 43–54.

[C106] *J. Mawhin, J. Nečas, B. Novák*: In memoriam professor Svatopluk Fučík. Czechoslovak Math. J. *30, 105* (1980), 153–162.

1981

[C107] *J. Nečas*: A necessary and sufficient condition for the regularity of weak solutions to nonlinear elliptic systems of partial differential equations. Nonlinear Analysis (Berlin, 1979), vol. 2, Abh. Akad. Wiss. DDR, Abt. Math. Naturwiss. Tech., 1981. Akademie-Verlag, Berlin, 1981, pp. 201–209.

[C108] *J. Nečas*: Elliptic differential equations. Math. Kongress DDR 1981, Math. Gesellschaft DDR, Leipzig, 1981.

[C109] *I. Hlaváček, J. Nečas*: Optimization of the domain in elliptic unilateral boundary value problems by finite element methods. Equadiff 5, Proceedings 1981, Teubner Texte B 47, pp. 131–135.

[C110] *O. John, J. Nečas, J. Stará*: On the regularity for 2nd order nonlinear elliptic systems. Equadiff 5, Proceedings 1981, Teubner Texte B 47, pp. 165–168.

1982

[C111] *I. Hlaváček, J. Nečas*: Optimization of the domain in elliptic unilateral boundary value problems by finite element method. RAIRO Anal. Numér. *16* (1982), 351–373.

[C112] *P.-L. Lions, J. Nečas, I. Netuka*: A Liouville theorem for nonlinear elliptic systems with isotropic nonlinearities. Comment. Math. Univ. Carolin. *23* (1982), 645–655.

[C113] *M. Giaquinta, J. Nečas, O. John, J. Stará*: On the regularity up to the boundary for second order nonlinear elliptic systems. Pacific J. Math. *99* (1982), 1–17.
[C114] *J. Nečas*: On the solution of the 19th Hilbert's problem. Recent trends in mathematics. Reinhardsbrun 1982. Teubner Texte, Leipzig. vol. 50, 1982, pp. 214–223.

1983

[C115] *J. Nečas, I. Marek*: 60th anniversary of birthday of Professor Karel Rektorys. Czechoslovak Math. J. *33* (1983), 320–323.
[C116] *J. Nečas, I. Marek*: Šedesátiny Prof. RNDr. Karla Rektoryse, DrSc. Čas. Pěst. Mat. *108* (1983), 104–109.
[C117] *J. Nečas, I. Hlaváček*: Solution of Signorini's contact problem in the deformation theory of plasticity by secant modules method. Apl. Mat. *28* (1983), 199–214.
[C118] *J. Nečas*: On regular solutions to the displacement boundary value problem in finite elasticity. Trends in Applications of Pure Mathematics to Mechanics, vol. 4 (Bratislava, 1981), vol. 20, Monographs Stud. Math. Pitman, Boston, Mass., 1983, pp. 176–185.

1984

[C119] *M. Feistauer, J. Mandel, J. Nečas*: Entropy regularization of the transonic potential flow problem. Comment. Math. Univ. Carolin. *25* (1984), 431–443.
[C120] *Ph. G. Ciarlet, J. Nečas*: Problèmes unilatéraux en élasticité non linéaire tridimensionnelle. C. R. Acad. Sci. Paris Sér. I Math. *298* (1984), 189–192.

1985

[C121] *M. Feistauer, J. Nečas*: On the solvability of transonic potential flow problems. Z. Anal. Anwend. *4* (1985), 305–329.
[C122] *Ph. G. Ciarlet, J. Nečas*: Injectivité presque partout, auto-contact, et non-interpénétrabilité en élasticité non-linéaire tridimensionnelle. C. R. Acad. Sci. Paris Sér. I Math. *301* (1985), 621–624.
[C123] *Ph. G. Ciarlet, J. Nečas*: Unilateral problems in nonlinear, three-dimensional elasticity. Arch. Ration. Mech. Anal. *87* (1985), 319–338.

1986

[C124] *J. Nečas*: Entropy compactification of the transonic flow. Equadiff 6 (Brno, 1985). Lect. Notes Math. 1192, Springer, Berlin, 1986, pp. 399–408.
[C125] *J. Nečas*: On singularities of solutions to nonlinear elliptic systems of partial differential equations. Nonlinear Functional Analysis and Its Applications, Part 2 (Berkeley, Calif., 1983), vol. 45, Proc. Sympos. Pure Math. Amer. Math. Soc., Providence, R.I., 1986, pp. 219–228.
[C126] *M. Feistauer, J. Nečas*: On the solution of transonic flows with weak shocks. Comment. Math. Univ. Carolin. *27* (1986), 791–804.
[C127] *J. Nečas*: Entropy compactification of the transonic flow. Mathematical Methods in Engineering, Karlovy Vary I, 1986, pp. 97–101.

1987

[C128] *J. Nečas, A. Lehtonen, P. Neittaanmäki*: On the construction of Lusternik-Schnirelmann critical values with application to bifurcation problems. Appl. Anal. *25* (1987), 253–268.
[C129] *Ph. G. Ciarlet, J. Nečas*: Injectivity and self-contact in nonlinear elasticity. Arch. Ration. Mech. Anal. *97* (1987), 171–188.

[C130] *J. Mandel, J. Nečas*: Convergence of finite elements for transonic potential flows. SIAM J. Numer. Anal. *24* (1987), 985–996.

[C130a] *J. Nečas*: Strongly dissipative nonlinear hyperbolic systems. Proceeding of a seminar at Souš, Fyzika a matematika, JČMF Praha (1987), 7–13. (In Czech.)

1988

[C131] *J. Nečas*: Finite element approach to the transonic flow problem. Proceedings of the Second International Symposium on Numerical Analysis (Praha, 1987), vol. 107, Teubner-Texte Math. Teubner, Leipzig, 1988, pp. 70–74.

[C132] *M. Feistauer, J. Nečas*: Viscosity method in a transonic flow. Comm. Partial Differ. Equ. *13* (1988), 775–812.

[C133] *M. Feistauer, J. Nečas*: Remarks on the solvability of transonic flow problems. Manuscripta Math. *61* (1988), 417–428.

[C134] *J. Nečas*: A viscosity solution method for transonic flow. Functional and numerical methods in mathematical physics. vol. 271, Naukova Dumka, Kiev, 1988, pp. 155–161. (In Russian.)

[C135] *A. Friedman, J. Nečas*: Systems of nonlinear wave equations with nonlinear viscosity. Pacific J. Math. *135* (1988), 29–55.

[C136] *O. John, V. A. Kondrat'ev, D. M. Lekveishvili, I. Nečas, O. A. Oleĭnik*: Solvability of the system of von Kármán equations with nonhomogeneous boundary conditions in nonsmooth domains. Trudy Sem. Petrovsk. *258* (1988), 197–205. (In Russian.)

1989

[C137] *J. Nečas*: Dynamic in the nonlinear thermo-visco-elasticity. Symposium Partial Differential Equations (Holzhau, 1988), vol. 112, Teubner-Texte Math. Teubner, Leipzig, 1989, pp. 197–203.

[C138] *J. Nečas, A. Novotný, M. Šilhavý*: Global solution to the ideal compressible heat conductive multipolar fluid. Comment. Math. Univ. Carolin. *30* (1989), 551–564.

[C139] *M. Feistauer, J. Nečas, V. Šverák*: On the weak compactness of solutions to the equations of compressible flow. Appl. Anal. *34* (1989), 35–52.

1990

[C139a] *J. Nečas*: The current state and future of nonlinear analysis in Czechoslovakia. Pokroky Mat. Fyz. Astronom. *35* (1990), 250–255.

[C140] *J. Nečas, A. Novotný, V. Šverák*: Uniqueness of solutions to the systems for thermoelastic bodies with strong viscosity. Math. Nachr. *149* (1990), 319–324.

[C141] *J. Nečas, P. Klouček*: The solution of transonic flow problems by the method of stabilization. Appl. Anal. *37* (1990), 143–167.

[C142] *J. Milota, J. Nečas, V. Šverák*: On weak solutions to a viscoelasticity model. Comment. Math. Univ. Carolin. *31* (1990), 557–565.

[C143] *J. Nečas, T. Roubíček*: Approximation of a nonlinear thermoelastic problem with a moving boundary via a fixed-domain method. Apl. Mat. *35* (1990), 361–372.

1991

[C144] *J. Nečas*: Theory of multipolar viscous fluids. The mathematics of finite elements and applications, VII (Uxbridge, 1990). Academic Press, London, 1991, pp. 233–244.

[C145] *H. Bellout, F. Bloom, J. Nečas*: Global existence of weak solutions to the nonlinear transmission line problem. Nonlin. Anal. *17* (1991), 903–921.

[C146] *J. Nečas, A. Novotný, M. Šilhavý*: Global solution to the compressible isothermal multipolar fluid. J. Math. Anal. Appl. *162* (1991), 223–241.

[C147] *J. Nečas, M. Růžička*: A dynamic problem of thermoelasticity. Z. Anal. Anwend. *10* (1991), 357–368.
[C148] *J. Nečas, A. Novotný*: Some qualitative properties of the viscous compressible heat conductive multipolar fluid. Comm. Partial Differ. Equ. *16* (1991), 197–220.
[C149] *Ch. P. Gupta, Y. C. Kwong, J. Nečas*: Nonresonance conditions for the strong solvability of a general elliptic partial differential operator. Nonlin. Anal. *17* (1991), 613–625.
[C150] *J. Nečas, M. Šilhavý*: Multipolar viscous fluids. Quart. Appl. Math. *49* (1991), 247–265.
[C151] *J. Nečas, V. Šverák*: On regularity of solutions of nonlinear parabolic systems. Ann. Scuola Norm. Sup. Pisa Cl. Sci. *18* (1991), 1–11.

1992

[C152] *H. Bellout, F. Bloom, J. Nečas*: A model of wave propagation in a nonlinear superconducting dielectric. Differ. Int. Equ. *5* (1992), 1185–1199.
[C153] *J. Málek, J. Nečas, A. Novotný*: Measure-valued solutions and asymptotic behavior of a multipolar model of a boundary layer. Czechoslovak Math. J. *42* (1992), 549–576.
[C154] *J. Nečas, A. Novotný, M. Šilhavý*: Global solution to the viscous compressible barotropic multipolar gas. Theoret. Comput. Fluid Dynamics *4* (1992), 1–11.
[C155] *H. Bellout, F. Bloom, J. Nečas*: Phenomenological behavior of multipolar viscous fluids. Quart. Appl. Math. *50* (1992), 559–583.
[C156] *J. Nečas, M. Růžička*: Global solution to the incompressible viscous-multipolar material problem. J. Elasticity *29* (1992), 175–202.

1993

[C157] *J. Jarušek, J. Málek, J. Nečas, V. Šverák*: Variational inequality for a viscous drum vibrating in the presence of an obstacle. Rend. Mat. Appl. *12* (1993), 943–958.
[C158] *H. Bellout, F. Bloom, J. Nečas*: Solutions for incompressible non-Newtonian fluids. C. R. Acad. Sci. Paris Sér. I Math. *317* (1993), 795–800.
[C159] *H. Bellout, F. Bloom, J. Nečas*: Existence of global weak solutions to the dynamical problem for a three-dimensional elastic body with singular memory. SIAM J. Math. Anal. *24* (1993), 36–45.
[C160] *J. Málek, J. Nečas, M. Růžička*: On the non-Newtonian incompressible fluids. Math. Models Methods Appl. Sci. *3* (1993), 35–63.

1994

[C161] *J. Nečas*: Theory of multipolar fluids. Problems and Methods in Mathematical Physics (Chemnitz, 1993). Teubner-Texte Math., Teubner, Stuttgart, 1994, pp. 111–119.
[C162] *H. Bellout, F. Bloom, J. Nečas*: Young measure-valued solutions for non-Newtonian incompressible fluids. Comm. Partial Differ. Equ. *19* (1994), 1763–1803.
[C163] *Ch. P. Gupta, Y. C. Kwong, J. Nečas*: Landesman-Lazer condition for properly elliptic operators. Boll. Un. Mat. Ital. A *8* (1994), 65–74.
[C164] *H. Bellout, J. Nečas*: Existence of global weak solutions for a class of quasilinear hyperbolic integro-differential equations describing viscoelastic materials. Math. Ann. *299* (1994), 275–291.

1995

[C165] *H. Bellout, F. Bloom, J. Nečas*: Bounds for the dimensions of the attractors of nonlinear bipolar viscous fluids. Asymptotic Anal. *11* (1995), 131–167.

[C166] *H. Bellout, F. Bloom, J. Nečas*: Existence, uniqueness, and stability of solutions to the initial-boundary value problem for bipolar viscous fluids. Differ. Int. Equ. *8* (1995), 453–464.

[C167] *H. Bellout, F. Bloom, J. Nečas*: Bounds for the dimensions of the attractors of nonlinear bipolar viscous fluids. Asymp. Anal. *11* (1995), 131–167.

1996

[C168] *J. Nečas*: Theory of multipolar fluids. World Congress of Nonlinear Analysts '92, vol. I–IV (Tampa, FL, 1992). De Gruyter, Berlin, 1996, pp. 1073–1081.

[C169] *H. Bellout, J. Nečas*: The exterior problem in the plane for a non-Newtonian incompressible bipolar viscous fluid. Rocky Mountain J. Math. *26* (1996), 1245–1260.

[C170] *J. Nečas, M. Růžička, V. Šverák*: Sur une remarque de J. Leray concernant la construction de solutions singulières des équations de Navier-Stokes. C. R. Acad. Sci. Paris Sér. I Math. *323* (1996), 245–249.

[C171] *J. Nečas, M. Růžička, V. Šverák*: On Leray's self-similar solutions of the Navier-Stokes equations. Acta Math. *176* (1996), 283–294.

[C172] *Wenge Hao, S. Leonardi, J. Nečas*: An example of irregular solution to a nonlinear Euler-Lagrange elliptic system with real analytic coefficients. Ann. Scuola Norm. Sup. Pisa Cl. Sci. (4) *23* (1996), 57–67.

[C173] *J. Málek, J. Nečas*: A finite-dimensional attractor for three-dimensional flow of incompressible fluids. J. Differ. Equ. *127* (1996), 498–518.

1999

[C174] *S. Leonardi, J. Málek, J. Nečas, M. Pokorný*: On axially symmetric flows in $R^3$. Z. Anal. Anwend. *18* (1999), 639–649.

[C175] *J. Málek, J. Nečas, M. Pokorný, M. E. Schonbeck*: On possible singular solutions to the Navier-Stokes equations. Math. Nachr. *199* (1999), 97–114.

[C176] *H. Bellout, J. Nečas, K. Rajagopal*: On the existence and uniqueness of flows of multipolar fluids of grade 3 and their stability. Int. Journ. Eng. Sciences *37* (1999), 75–96.

[C177] *F. Mošna, J. Nečas*: Nonlinear hyperbolic equations with dissipative temporal and spatial non-local memory. Z. Anal. Anwend. *18* (1999), 939–951.

2001

[C178] *J. Málek, J. Nečas, M. Růžička*: On the weak solutions to a class of non-Newtonian incompressible fluids in bounded three-dimensional domains: the case $p \geqslant 2$. Adv. Differ. Equ. *6* (2001), 257–302.

[C179] *J. Nečas, T. Roubíček*: Buoyancy-driven viscous flow with $L^1$-data. Nonlin. Anal. Ser. A: Theory Methods *46* (2001), 737–755.

[C180] *E. Behr, J. Nečas, H. Wu*: On blow up of solution for Euler equations. M2AN Math. Model. Numer. Anal. *35* (2001), 229–238.

2002

[C181] *J. Málek, J. Nečas, K. R. Rajagopal*: Global analysis of the flows of fluids with pressure-dependent viscosities. Arch. Ration. Mech. Anal. *165* (2002), 243–269.

[C182] *J. Nečas, J. Neustupa*: New conditions for local regularity of a suitable weak solution to the Navier-Stokes equation. J. Math. Fluid Mech. *4* (2002), 237–256.

[C183] *J. Málek, J. Nečas, K. R. Rajagopal*: Global existence of solutions for flows of fluids with pressure and shear dependent viscosities. Appl. Math. Lett. *15* (2002), 961–967.

[C184] *H. Bellout, E. Cornea, J. Nečas*: On the concept of very weak $L^2$ solutions to Euler's equations. SIAM J. Math. Anal. *33* (2002), 995–1006.

2003

[C185] *J. Hron, J. Málek, J. Nečas, K. R. Rajagopal*: Numerical simulations and global existence of solutions of two-dimensional flows of fluids with pressure- and shear-dependent viscosities. Modelling 2001 (Pilsen), Math. Comput. Simulation *61* (2003), 297–315.