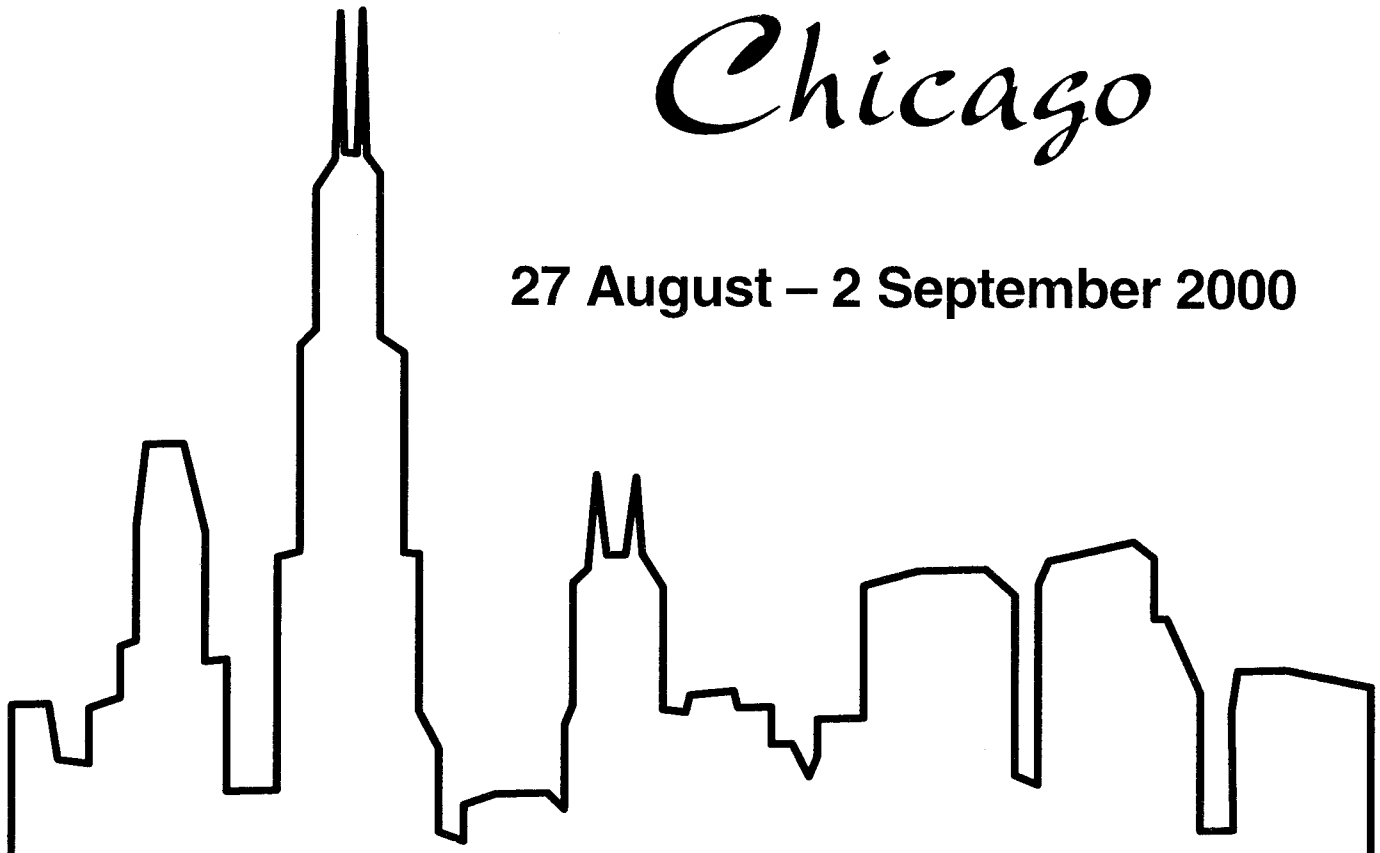
ICTAM 2000

Chicago

27 August – 2 September 2000



Abstract Book

20th International Congress of Theoretical and Applied Mechanics

IUTAM

International Union of Theoretical and Applied Mechanics

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About ICTAM

The first International Congress of Theoretical and Applied Mechanics was held in Delft in 1924 under the chairmanship of C. B. Biezeno and J. M. Burgers, the idea having been conceived by Theodore von Kármán. Since then, scientists and engineers with interests in the mechanical sciences have convened every four years for an international congress to survey advances in the field, discuss progress and new ideas, and to renew personal acquaintances and friendships. The congresses have traveled the world, visiting USA only twice before: in 1938 ICTAM V was held in Cambridge, Massachusetts, and in1968 ICTAM XII was held in Palo Alto California. The US mechanics community is pleased and honored to once again have the opportunity to host an international congress, this time the 20th in the millennium year 2000.

About IUTAM

From the meetings of the Congress Committee sprang the idea of a more permanent organization to look out for the world interests in the mechanical sciences. Thus, IUTAM, the International Union of Theoretical and Applied Mechanics, was formed on September 26, 1946. In 1947 IUTAM became a member of ICSU, the International Council of Scientific Unions, itself founded in 1931. The highest authority of IUTAM is the General Assembly, with delegates from the Adhering Organizations, each of which is affiliated with a national learned society in a given country. The Adhering Organization of USA is the US National Committee of Theoretical and Applied Mechanics (USNC/TAM).

About ICTAM2000

The 20th International Congress was invited by the US National Academy of Sciences on the recommendation of USNC/TAM. The local host is a consortium of 13 university departments, research groups and colleges, mostly from institutions located in the Midwest. The following universities are members of the host consortium: Brown University, Cornell University, Illinois Institute of Technology, Iowa State University, Michigan State University, Ohio State University, University of Chicago, University of Illinois at Chicago, University of Illinois at Urbana-Champaign (UIUC), University of Michigan, University of Minnesota, University of Notre Dame, and University of Wisconsin. The venue for ICTAM2000 is the Chicago Marriott Downtown. President of ICTAM2000 is Hassan Aref. Secretary-General of ICTAM2000 is James W. Phillips. Both are in the Department of Theoretical and Applied Mechanics (TAM) at UIUC.

About this book

The Abstract Book for ICTAM2000 is TAM Report No. 950, ISSN 0073-5264. TAM reports have been issued since 1946 when the first one was produced by then TAM Department Head Thomas J. Dolan. Coincidentally, then, the TAM reports began in the same year that IUTAM was founded. Department faculty, students, research staff, and occasional visitors publish research findings and other scholarly material in TAM reports. Most reports form the basis for archival journal publications. A listing of titles in the report series is available on the departmental web site at http://www.tam.uiuc.edu. Individual copies may be ordered by contacting the department.

triply periodic continuation into the whole space. The problem is solved by economical multipole techniques [1] and matched asymptotic expansions [2] for drops in close approach. Lubrication, although singular, allows drops to make contact. The algorithm traces contacts and separations. The shear viscosity and normal stress differences are studied by time averaging for concentrations up to 55–60%, N = 100–200, and drop-to-medium viscosity ratios to $O(10)$. The results are compared with our full boundary-integral-multipole simulations for many deformable drops at finite Ca.

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[1] Zinchenko, *JCP*, **111**, 120 (1994); Zinchenko and Davis, *JCP*, in press.
[2] Zinchenko, *Phil. Trans. Roy. Soc. Lond. A* **356**, 2952 (1998).

09:20—IL5

Settling velocity and clustering of particles in homogeneous and isotropic turbulence

Alberto Aliseda, Franek Hainaux, and Juan C. Lasheras *Department of Mechanical and Aerospace Engineering, University of California, San Diego, La Jolla, California, USA*
Alain Cartellier *CRNS, Laboratoire des Ecoulements Géophysiques et Industriels (LEGI), Grenoble, France*

We have experimentally studied the clustering effect which occurs in a turbulent channel flow laden with heavy particles of given size distribution. Using PDPA and image processing techniques, we have analyzed the effect of particles accumulation on the settling velocity. In the case of particles smaller than the Kolmogorov length scale and for mass loading from 5×10^{-3} to 10^{-1}, we have found that the dynamic interaction of the particles with the various turbulent flow structures leads to the formation of particles clusters of variable fractal dimensions. The settling velocity is shown to increase significantly with the mass loading. A closer look at the composition of the cluster shows that they tend to gather more particles of Stokes number around 1, and that the particles trapped inside them have a greater settling velocity than those which remain outside. Comparison with recent DNS and LES simulation will be presented.

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09:40—IL6

New approach to the modeling of sub-grid scale structures of disperse multiphase flows

Shu Takagi, Kazuyasu Sugiyama, and Yoichiro Matsumoto *Department of Mechanical Engineering, University of Tokyo, Tokyo, Japan*

Direct numerical simulations of multi-bubble (-particle) systems are conducted. In the present method, the boundary conditions on each disperse phase are accurately treated, using the grids much smaller than the size of disperse phase. Periodic box is used for the simulation to extract the averaged quantities. The dependence of drag coefficient on void fraction is investigated. The results show good agreement with the existing theory and experiment. The averaged flow fields around each spherical bubble (particle) are reconstructed using the DNS data. They are expressed by the spherical harmonics to reduce the size of information. Using these expressions, Sub-Grid Scale modeling is performed. Following the similar approach of the SGS model for the turbulence, we examine the several types of SGS models for dispersed flows. The results show that the present nonlinear model gives the better correlation with DNS results than Smagorinsky or Scale-Similarity type models.

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Session IO: Stability of structures
Wednesday, 30 August 2000, 08:00–10:00
Miami/Los Angeles, 5th floor
Chair: Stephen H. Crandall, Massachusetts Institute of Technology, USA

08:00—IO1

Stability domains of non-conservative systems with small parametric excitation

Alexei A. Mailybaev *Institute of Mechanics, Moscow State Lomonosov University, Moscow, Russia*

A multiple degree-of-freedom non-conservative periodic (parametrically excited) system dependent on several parameters is considered. It is assumed that the system is autonomous at some values of parameters. Stability domain for small values of the parameters, describing magnitude of parametric excitation is studied. Two basic cases are considered: when the non-perturbed (autonomous) system is subjected to divergence and flutter instability. A constructive approach allowing finding the second order approximations of the stability domain is developed. In the case of special relation of a flutter frequency of the autonomous system and a period of excitations, the stability domain has a singularity associated with a double semisimple multiplier. Different types of this singularity are listed. As an application, the stability problem for an elastic tube conveying pulsating fluid is studied. *mailybaev@inmech.msu.su*

08:20—IO2

Stress-concentration in a partly wrinkled elastic membrane

Paolo S. Valvo and Salvatore S. Ligarò *Department of Structural Engineering, University of Pisa, Pisa, Italy*

Soft elastic membranes are typically unable to sustain compressive stresses, so that an accurate estimation of the stress distribution cannot disregard the occurrence of wrinkling and buckling phenomena. This is particularly true for those regions surrounding geometrical or structural discontinuities. To assess the stress distribution in these cases, we propose a general nonlinear membrane model able to automatically account for the effects of the above stated forms of local instability. The set of nonlinear equilibrium equations is derived via the principle of stationary total potential energy and solved in a finite element context. The load–deflection response of the membrane under increasing loads is monitored by the aid of an arc-length path-tracing procedure. Application cases concern rectangular membranes endowed with circular or straight defects (holes or rigid inclusions). *p.valvo@ing.unipi.it*

08:40—IO3

Dynamic propagation and flip-flopping of buckles in pipelines

Theodoro Netto *Engenharia Oceanica, Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil*
Stelios Kyriakides *Center for Mechanics of Solids, Structures and Materials, University of Texas at Austin, Austin, Texas, USA*

The paper deals with the dynamic propagation of buckles initiated in long pipes under external pressure. The velocity of buckles initiated in stainless steel tubes with of 28 were measured. The testing pressures ranged from the propagation to the collapse pressure. The flip-flop mode of buckle propagation was found to take place for pressure levels higher than 87% of the collapse pressure. A finite element model for simulating the dynamic initiation and propagation of such buckles will be presented. The model accounts for the inertia of the pipe, the contact nonlinearity and the material inelastic