01-6 IUTAM Symposium on Computational Mechanics of Solid Materials at Large Strains
University of Stuttgart, August 20-24, 2001

a) Scientific Committee

C. Miehe (Germany, Chairman), R. de Borst (Netherlands), J. Engelbrecht (Estonia, IUTAM repres.), T. Inoue (Japan), M. Kleiber (Poland), A. Needleman (USA), M. Ortiz (USA), D.R.J. Owen (UK), A. Zaoui (France), F. Ziegler (Austria)

b) Short summary of scientific progress achieved

Computational methods and simulation techniques play a central role in advancing the understanding of complex material behavior. In recent years, many important achievements have been made in the field of the theoretical formulation, the mathematical analysis and the numerical implementation of finite deformation processes in solids.
The aim of the symposium was to give a state of the art and a survey about recent developments in this field and to create perspectives for future research trends. It provided a forum for the interaction among young and established researchers from solid mechanics, applied mathematics and materials science.
About 100 researchers from 14 different nations attended the presentations and took actively part in discussions. The scientific program consisted of 45 lectures given by leading international scientists.

They covered the fields of

- theoretical and computational approaches to the modeling of large-strain elastic and inelastic deformations of solids applied to metals, polymers and geomaterials,
- mathematical analysis of finite inelastic deformations of solids, incremental variational formulations, treatment of non-convex problems and microstructures,
- alternative continuous and discrete micromechanical approaches to deformation mechanisms in solid materials on different phenomenological scales,
- homogenization methods and adaptive computational tools for the determination of effective overall properties of heterogeneous materials such as polycrystals, composites and granular materials,
- simulation of failure mechanisms and material instability phenomena in solids based on non-local descriptions and discrete crack modeling.

The symposium was both a scientific and social success. All presentations matched a high level and initiated lively discussions among the participants. In the last weeks we got many thanks for such an interesting and stimulating event. I would like to pass on this praise to the IUTAM for the generous financial support and for giving me the possibility of organizing this event.

c) Countries represented and number of participants

There have been about 100 participants from the following 14 countries:
Germany, United States of America, France, Austria, Netherlands, Estonia, Principality of Liechtenstein, Japan, Poland, United Kingdom, South Africa, Sweden, Czech Republic, Denmark

d) Publication of Proceedings of the Symposium

The Proceedings will be published by Kluwer Academic Publishers.

e) Financial support

The IUTAM grant of $ 5000 was spent on reimbursement of traveling expenses. In the run-up to the conference many industrial companies could be convinced to support this IUTAM symposium as sponsors. Thanks to them, an attractive social program could also be offered.

f) Scientific program

Session 1: Advanced applications

D. Fritsch, W. Ressel, W. Schiehlen, C. Miehe (Welcome)

H. Rattensperger, J. Eberhardsteiner, **H.A. Mang,** *Numerical investigation of high-pressure hydraulic hoses reinforced with steel wire braid.*
D. Perić, W. Dettmer, E.A. de Souza Neto, *Computational strategies for inelastic solids at large strains: some recent issues with industrial applications.*
Session 2: Crystals and polycrystals, phase transitions

L. Anand (Keynote lecture), *Polycrystalline shape-memory materials: effect of crystallographic texture.*
T. Inoue, P. Ding, S. Imatani, D.-Y. Ju, E. Vries, *Forging simulation incorporating strain-induced phase transformation using the finite volume method.*
E. Nakamachi, *Development of crystal plasticity design system to generate a high-strength and high-formability material.*

Session 3: Convexity properties in elasticity, Microstructures

M. Šilhavý, *Convexity properties and relaxation of isotropic stored energies and sets of deformation gradients.*
A. DeSimone, *Numerical experiments on phase-transforming elastomers.*
J. Schröder, P. Neff, *On the construction of polyconvex, transversely isotropic free energy functions.*

Session 4: Reliability-based analysis, waves, inverse problems

M. Kleiber, J. Rojek, R. Stocki, *Reliability-based analysis of large deformations in metal forming operations.*

J. Engelbrecht, A. Ravasoo, A. Salupere, *Nonlinear waves in solids and the inverse problems.*

Session 5: Foundations of plasticity

O.T. Bruhns, *Objective rates in finite elastoplasticity.*
S. Reese, *Anisotropic elastoplastic material behavior in fabric structures.*
H.D. Alber, *Mathematical analysis of constitutive equations: existence of solutions and collapse theorems.*

Session 6: Variational methods in plasticity, Microstructures II

M. Ortiz (Keynote lecture), *Variational methods in convex and non-convex plasticity.*
K. Hackl, *On the calculation of material microstructures using relaxed energies.*
A. Mielke, *Mathematical modeling of elastoplasticity using a dissipation metric.*

Session 7: Single and polycrystal plasticity, Nonlocal models

S. Nemat-Nasser (Keynote lecture), *Physically-based single and polycrystal plasticity models and their experimental verification.*
A. Needleman, *Localized plastic flow in ductile single crystals: a nonlocal continuum analysis.*
B. Svendsen, *Continuum thermodynamic modeling and simulation of single crystals and polycrystals at large deformation including the effect of geometrically-necessary dislocations.*

Session 8: Heterogeneous Materials

S. Héraud, L. Allais, **H. Haddadi**, C. Teodosiu, A. Zaoui, *A numerical mesoscope for the investigation of local fields in microheterogeneous rate-dependent elastoplastic materials at finite strain.*
S. Schmauder, U.Weber, E. Soppa, *Computational mechanics of heterogeneous materials - influence of residual stresses.*

Session 9: Finite Deformations of Polymers

M.C. Boyce, *Micromechanics of deformation in thermoplastic elastomers*
S. Govindjee*, Finite deformation fracture and failure of tires.*
W. Ehlers, B. Markert, *Theoretical and computational simulation of viscoelastic polymeric foams at finite strains.*

Session 10: Advanced Computational Methods

C. Carstensen (Keynote lecture), *Nonconvex energy minimization and relaxation in computational material science.*
K. Runesson, P. Hansbo, F. Larsson, *Space-time adaptivity for large strain viscoplasticity based on goal-oriented a posteriori error measures.*

R. Mahnken, **E. Stein**, *Finite deformation plasticity with damage and asymmetric compression-tension behavior including parameter identification.*

Session 11: Texture Development, Modeling of Polycrystals

D. Besdo, *On the influence of texture model types on simulations of sheet metal forming.*
A. Bertram, T. Böhlke, *Micro-macro-simulation and phenomenological modeling of the texture. Induced elastic and plastic anisotropy in metal forming processes.*
F. Auslender, M. Bornert, A. Zaoui, T. Hoc, R. Masson, *An affine micromechanical approach for the prediction of the elastoplastic behavior of polycrystals at finite strain.*

Session 12: Homogenization Methods, Multiscale Problems

H. Moulinec, J.C. Michel, **P.M. Suquet** (Keynote lecture), *Analysis of the local response of nonhomogeneous materials using fast Fourier transforms.*
P. Gilormini, Y. Liu, **P. Ponte-Castañeda**, *Homogenization-based constitutive models for polycrystalline metals undergoing finite strain.*
Y. Tomita, Y. Higa, *Multiscale characterization of deformation behavior of metal-matrix composite under plane strain conditions*.

Session 13: Computational Modeling of Cracking

T. Belytschko (Keynote lecture), *Discontinuous approximations for cracks and shear bands.*
V. Tvergaard, *Cohesive zone modeling of crack growth along different functionally graded joints between two materials.*
A. Delaplace, A. Ibrahimbegovic, *discrete modeling of cracking of brittle materials in large relative motion and localization problem.*

Session 14: Advanced Finite Elements

G.N. Wells, **R. de Borst,** L.J. Sluys, *A large-strain enhanced finite element method for cohesive-zone models.*
D. Reddy, *Affine-approximate finite element methods and stabilization techniques in elasticity.*

Session 15: Anisotropic Finite Inelasticity

P. Haupt, T. Kersten, *On the representation of anisotropic viscoplasticity.*
A. Menzel, **P. Steinmann,** *Formulation and computation of geometrically non-linear anisotropic in-elasticity.*
G.A. Holzapfel, T.C. Gasser, *A structural elastoplastic model for the large-strain behavior of biological soft tissues: continuum formulation and numerical approximation.*

Session 16: Material Growth

G.A. Maugin, S. Imatani (Keynote lecture), *material growth in solid-like materials.*

W. Daves, W. Stadlbauer, E.A. Werner, **F.D. Fischer,** *Modeling and characterization of large shear strains at a rail surface.*
C. Miehe, M. Lambrecht, J. Schotte, *Computational homogenization of materials with microstructures based on incremental variational formulations.*

Report composed by Christian Miehe