EUROMECH Final Report

EUROPEAN MECHANICS SOCIETY

Please send this report to the Secretary-General of EUROMECH, within one month after the Colloquium.

EUROMECH Colloquium No: 397

Title: IMPACT IN MECHANICAL SYSTEMS

Dates and location: 30 June - 02 July 1999, GRENOBLE, F.

Chairman: Bernard BROGLIATO

Co-Chairman: Bill STRONGE

Is there need of another Colloquium on the same or a related subject? Which year? Possibly, in 2 years.

Full registration fee: 1460 FF (Academics) and 1050 FF (Students)

What other funding was obtained? Electricity of France (EdF): 10 000 FF
CNRS: 10 000 FF; Association Univ. économique: 5000
Grenoble City: 5000 FF; INPG: 5000 FF; INTAS project:
6000 FF. Euromech: 3x700 FF.

What were the participants offered? Proceedings in a suitcase, cocktail, dinner, lunches, breaks.

Number of members of EUROMECH (reduced registration fee): 11

Number of non-members of EUROMECH (full registration fee): 40 (+3 members of Local organization Committee).

Number of participants from each country:

Austria	2	Germany	2	Romania	
Belgium		Great Britain	2	Russia	1
Byelorussia		Greece		Slovakia	
Bosnia		Hungary		Slovenia	
Bulgaria		Ireland		Spain	1
Croatia		Italy	2	Sweden	1
Czech Republic		Latvia		Switzerland	
Denmark		Lithuania		Ukraine	1
Estonia		Netherlands	3	Yugoslavia	2
Finland		Norway		Others (USA, Canada)	7
France	25	Poland	3		
Georgia		Portugal	2	Total	54

Please turn

Saint Martin d'Hères, 5 July 1999.

Euromech Colloquium 397 "Impact in Mechanical Systems": Final Report

The Euromech Colloquium 397 "Impact in Mechanical Systems" was held in the Ecole Nationale Supèrieure d'Ingénieurs Electriciens de Grenoble, France, from 30 June to 02 July, 1999. It gathered 54 people from 15 countries, including 46 % French, 29 % other EEC countries, 14 % East European countries and 11 % from USA and Canada. The topic of this colloquium was Nonsmooth Mechanical Systems, in particular systems with unilateral constraints and collision effects. This colloquium was supported financially by the French company Electricité de France, the Centre National de la Recherche Scientifique CNRS, the Association Universitaire de Mécanique, the Institut National Polytechnique de Grenoble, the Grenoble city and the INTAS project 96-2138. These helps have allowed us to provide some participants with financial support (Prof. Mikhlin: 3000 FF, Prof. Hurmuzlu: 1000 FF, Dr Chatterjee: 2500 FF, Prof. Monteiro Marquès: 3500 FF, Dr ten Dam: 3500 FF, Prof. Moreau: 2000 FF), plus free registration for 11 particpants.

Four main topics have been discussed during this colloquium: **i)** Mathematical aspects of nonsmooth mechanics, in finite and infinite dimensions; **ii)** Dynamic analysis of vibro-impact systems; **iii)** Numerical simulations of nonsmooth mechanical systems; **iv)** Modelling of impact phenomena. Thirty four (34) talks of 25 minutes each have been presented, together with five plenary lectures of 50 min. covering the above cited topics.

The first plenary lecture was given by Prof. Monteiro Marquès, from the University of Lisbon, Dept. of Mathematics (co-authored by Dr Kunze from the university of Koeln, Mathematics dept.). It concerned a particular Measure Differential Inclusion known as the Moreau's sweeping process and its applications to nonsmooth mechanics. The secopnd plenary lecture was given by Prof. Ivanov, from Moscow University. It concerned vibro-impact systems and their stability, grazing bifurcations and periodic solutions: even simple mechanical systems with impact phenomena require new notions of stability and extension of Lyapunov's theory. The third plenary was given by Prof. Stronge, from Cambridge University, about elasto-plastic models in two-body and multibody impacts. In particular the influence of Coulomb friction on the impact outcome has been discussed. The fourth plenary, given by Prof. Hurmuzlu, has been centered around multiple impacts, with the example of the so-called Newton's cradle. A new solution for solving the collision problem

has been presented, basing on the use of energetical restitution coefficients and impulse ratios. Experimental validations have been done. The last plenary, presented by Dr Abadie from the company Schneider Electric, concerned the description of numerical problems in the simulation of kinematic chains subject to unilateral constraints and friction, and with a particular focus on the simulation of electrical circuit breakers. Springer Verlag has accepted to publish these five plenary lectures in a book in the series Lecture Notes in Physics, next year.

The attendence of the colloquium has shown a very high interest and most of the sessions were lively. The topic of multiple impacts, which may constitute one of the major challenges in impact dynamics, has been discussed by several participants through the Newton's cradle example. Numerical Analysis has also been present in many talks, which witnesses the great importance of reliable numerical methods for such systems (which indeed require the development of specific numerical schemes). Virtual prototypiong in industry relies more and more on such tools and few (none?) available softwares are able to provide reliable and accurate results. It should be noted that several participants did not hesitate to liven up their talks by presenting little but significant experiments (Newton's cradle, the Picus Viridis, various impacting "toys") or videos (granular matter dynamics).

In conclusions this colloquium has gathered during three days Applied Mathematicians, Theoretical and Applied Mechanicians, two participants from Systems and Control Theory and one participant from History of Science who presented how Descartes'views on impacts evolved after Descartes. It has shown that the topic of nonsmooth mechanics is a quite active one now. One may regret that the topic of Granular Matter, which constitutes a very important subject in Physics, has not been more represented, despite some efforts made in this direction before the colloquium. This might be due to the existence of specific meetings on Granular Matter in the Physics community.

5 July 1999

Please use additional pages if needed. Put date and signature at the end.