EUROMECH

Final Report

Date: OCTOBER 10, 1994

Please send this report to the Secretary of the European Mechanics Council, Professor Bengt Lundberg, School of Engineering, Uppsala University, Box 534, S-751 21 Uppsala, Sweden, within one month after the Colloquium.

General

Euromech Colloquium No: 325

Title: BIFURCATION AND CHAOS IN SOLID AND STRUCTURAL DYNAMICS

Co-Chairmen: PROF. F. PFEIFFER, TECHNISCHE UNIVERSITÄT, MUNCHEN, GERMANY

Place and country: L'AQUILA, ITALY

Dates: SEPTEMBER 19-22, 1994

Finance (see enclosed sheet)

The conference fee included

Funding: CARISPAQ Foundation, University of L'Aquila, Registration fees

Accomodation (type and cost):

Meals:

Participation

Total number of participants: 54

Distribution of participants by country:

Code	Country	Number	Code	Country	Number
A	Austria	1	IRL	Ireland	
B	Belgium		LT	Latvia	
BG	Bulgaria	1	LV	Lithuania	
CH	Switzerland		N	Norway	
CS	Czechoslovakia	2	NL	Netherlands	2
D	Germany	7	P	Portugal	
DK	Denmark	1	PL	Poland	5
E	Spain		R	Rumania	
EE	Estonia		S	Sweden	
F	France		SF	Finland	
GB	Great Britain	5	YU	Yugoslavia	
GR	Greece		CIS	CIS	7
H	Hungary	1	-	Others	3
I	Italy	19			

Is there need of another colloquium on the same subject? Which year? YES 1996-97

(see comments at the end of scientific report)

Please turn

Scientific Report

The field of nonlinear oscillations of deterministic systems has been notably enriched in the last two decades through the consciousness of the complexity of the dynamic behaviour connected with the occurrence of unpredictable and chaotic motions. Most of the meaningful achievements in the field have been realized within the area of mathematical physics, the potential of these phenomena for engineering systems having been considered only in the last years. The rôle in engineering applications of computationally observed chaotic and strange phenomena was highlighted in two former EUROMECH Colloquia, the first one held at the University of Stuttgart in 1987 under the title "Nonlinear Applied Dynamics", the second one at the University of Wuppertal in 1988 with the title "Application of Chaos Concepts to Mechanical Systems". Afterwards, two IUTAM Symposia were held in this field, "Nonlinear Dynamics in Engineering Systems" at Stuttgart in 1989, "Nonlinearity & Chaos in Engineering Dynamics" at London in 1993, where the emphasis was progressively shifted to the rôle played by the geometrical concepts in nonlinear dynamics. Deep understanding of strange phenomena has shown to be possible only within the framework of the bifurcation theory for the description of local behaviour, and of the qualitative analysis based on powerful geometrical interpretation and sophisticated computational techniques for the description of global behaviour. At the same time, there has been an outbreak of studies of systems of interest in applied mechanics, for which possible chaotic behaviour has been observed either computationally or experimentally, with the associated problems of technical prediction, quenching or control.

The scope of the present Colloquium was just to consider the applications of chaos in solid and structural dynamics - still relatively few developed - within the framework of the complex bifurcational behaviour of the relevant mathematical models. This was also the motivation for the title of the Colloquium which, on a local basis, has followed a Workshop on the same item held in the University of L'Aquila in 1992.

The Colloquium has contributed to bridge the gap between theory and applications by sharing ideas and experiences among scientists working in solid and structural dynamics, contributing both to general understanding of deterministic chaos and to detection of meaningful applications. Interest has been mainly devoted to identifying the conditions under which nonlinear engineering systems exhibiting regular response can undergo bifurcations likely leading to chaotic or unpredictable phenomena. In this respect, attention has been focused on the occurrence of both actual steady chaos and of transient dynamic phenomena possibly important from the engineering integrity point of view. Analytical, numerical, geometrical and experimental approaches were presented and discussed, showing they are jointly needed for a thorough understanding of bifurcation and chaos phenomena to desirably develop not only through substantial use of modern mathematical theories and tools but also within the framework of the classical theory of nonlinear oscillations. The richness and complexity of the nonlinear behaviour of different systems of technical interest in solid and structural dynamics has been evidenced.

Invitation to the Colloquium received good answer. Fourty-one papers were presented within fourteen lecture Sessions under the following general topics:

- Analytical Techniques
- Nonlinear Vibrations and Bifurcations
- Engineering Applications
- Geometrical Analysis
- Discontinuous Systems
- Computational Techniques
- Mechanical Systems

Please use additional pages if needed and sign at the end.

- Dynamic & Time-Independent Chaos
- Bifurcation, Chaos & Stochasticity

Participants to the Colloquium came from 14 countries, including three from Turkey, Israel and Canada. This can be considered a rather well balanced scenario, consistent with the suggestions of the European Mechanics Society to secure adeguate participation from the European scientific community in the field.

Special effort was devoted to assure participation of a meaningful number of contributors from Eastern Europe and, specifically, from countries of the former Soviet Union.

At last time, some already scheduled contributors from Russia and western countries were not able to take part in the Colloquium due to visa problems and other reasons. In any case, 14 papers on a total of 41 were given by contributors from Eastern Europe, including 6 from Russian scientists. This result was also made possible due to the financial contributions from the CARISPAQ Foundation and the University of L'Aquila.

Days of work were quite dense. Papers were allowed 30 minutes presentation time, including 5 minutes for discussion. All papers received a satisfactory number of questions and comments, and the level of the discussion was usually rather penetrating. It is my feeling that participants to the Colloquium appreciated its scientific content.

No proceedings will be published. A booklet of abstracts was printed and distributed to all participants. Special issues of proper scientific journals with papers presented at the Colloquium are planned. There will certainly be a special issue of *Meccanica*. Besides, according to the interest of contributors to have their works published, a special issue of *Chaos, Solitons and Fractals* is forwarded, too, mostly for papers less strictly involved with mechanical problems. In any case, interested contributors were invited to submit their papers for publication by the end of November 1994. Papers will be published after review.

The Social activity consisted in the Colloquium dinner, and in a half-day excursion ended with a second dinner. According to the overall opinion, the atmoshere of the Colloquium was friendly and relaxed.

As to the possible need of another Colloquium on the same subject in the future, a general affirmative opinion has been informally expressed by most participants, based on the observation that the considered field of research has not yet reached its complete maturity mostly as regards the technical and engineering implications of the many theoretically observed phenomena.

Giuseppe Rega