

Please send this report to the Secretary of the European Mechanics Council, Professor Bengt Lundberg, Dept of Mechanical Engineering, Luleå University of Technology, S-951 87 Luleå, Sweden, within one month after the Colloquium.

### General

Euromech Colloquium No: 280

Title: Identification of non linear mechanical systems from dynamic tests

Co-Chairmen: L. JEZEQUEL

Place and country: Ecole Centrale de Lyon - Avenue Guy de Collongue - 69131 - Ecully cedex  
BP. 163 - FRANCE

Dates: October 29-31 1991

### Finance

The conference fee 1450.00 included lunch, and proceedings (A.A. Balkema Eds.)

Funding: Ecole Centrale de Lyon, Ecole Nationale des Travaux Publics de l'Etat, DRET, HP, etc...  
So scientists of Eastern Countries paid nothing (neither fee, nor hotel, plane)

Accommodation (type and cost): Hôtel \*\* (275,00 FF with breakfast)

Meals: dinner 60,00 F (Hôtel Campanile Dardilly or Ecully)

### Participation

Total number of participants:

Distribution of participants by country:

<u>Code</u>	<u>Country</u>	<u>Number</u>	<u>Code</u>	<u>Country</u>	<u>Number</u>
A	Austria	<u>0</u>	I	Italy	<u>3</u>
B	Belgium	<u>1</u>	IRL	Ireland	<u>2</u>
BG	Bulgaria	<u>1</u>	N	Norway	<u>0</u>
CH	Switzerland	<u>3</u>	NL	Netherlands	<u>1</u>
CS	Czechoslovakia	<u>2</u>	P	Portugal	<u>0</u>
D	Germany	<u>5</u>	PL	Poland	<u>2</u>
DK	Denmark	<u>0</u>	R	Rumania	<u>2</u>
E	Spain	<u>0</u>	S	Sweden	<u>2</u>
F	France	<u>15</u>	SF	Finland	<u>0</u>
GB	Great Britain	<u>12</u>	YU	Yugoslavia	<u>0</u>
GR	Greece	<u>0</u>	SU	Soviet Union	<u>3</u>
H	Hungary	<u>2</u>	-	Others	<u>2</u>

Is there need of another colloquium on the same subject? Which year?

1993

## Scientific Report

**EUROMECH 280**

**SYMPOSIUM ON IDENTIFICATION OF NON LINEAR  
MECHANICAL SYSTEMS FROM DYNAMIC TESTS,**

**Lyon, FRANCE.**

**October 29-31, 1991.**

### **I Introduction to this Symposium:**

The modeling and the identification of non-linear mechanical systems need a generalization of modal synthesis techniques, parametric and non-parametric models built from the time-domain and frequency domain responses (transient or stationary responses), in order to take into account friction, instabilities, shocks, chaos...

The main aim of this symposium is to make a survey of the up-to-date developments which improve the comprehension of nonlinearities and the modeling of mechanical systems.

### **II The Main Scientific topics and scope of this Symposium:**

Euromech 280 will provide an opportunity for discussions of the problems raised by the analysis and identification of nonlinear mechanical systems. Indeed, the origin of nonlinearities in the field of mechanical engineering are numerous:

- Large deflections of beams and plates
- Plastic and viscoplastic behaviour of materials
- Dry friction and gaps at the interfaces
- Inertial nonlinearities and gyroscopic effects
- Impact phenomena ...

The introduction of nonlinear terms in the equilibrium equations induces complicated dynamic behaviour even in the case of low degrees-of-freedom systems:

- Subharmonic and superharmonic responses

- Nonlinear instabilities
- Chaotic behaviour ...

When the origin of the nonlinearities is not clearly known, the experimental identification of mechanical systems needs non-parametric modeling:

- Pseudo force methods
- Equivalent linearization procedures
- Volterra and Wiener series
- Chronological series (NARMAX,...)
- Multi-frequency transfer functions

When the origin of the nonlinearities are well known the analysis of the dynamic behaviour of the mechanical systems is linked to the identification of parameters obtained from dynamic tests. This strategy often leads to an inverse problem in order to determine the parameters of interface and material behaviour from dynamic structural responses .

So the main topics are:

#### A- NON PARAMETRIC MODELING

- Detection of nonlinearities of mechanical systems from the analysis of dynamic responses.
- Extension of the modal synthesis to the nonlinear case.
- Non parametric models in the time domain and the frequency domain.
- Modeling of nonlinear systems based on the pseudo force method and linearization procedures.

#### B- PARAMETRIC MODELING

- Identification of physical parameters from transient and stationary responses.
- Dynamic behaviour of mechanical systems with friction.
- Stability of self-excited systems.
- Identification of nonlinear model from impact tests.

### III Interesting Results:

Papers, lectures, and discussions, especially distinguish two classes of results. First, parameter modeling based on several definitions of nonlinear modes. It deals with the construction of particular periodic solutions (nonlinear modes) being able to give the response of the considered structure to a quite general excitation, by a modal synthesis superposition.

Secondly, several procedures of non-parametric identification using the building of kernels clearly appear to be very important and powerful. Papers linked to Volterra kernels gives interesting new results.

Here, identification of such kernels with simple excitations allows to synthesize the response to general excitations, by using integral formulas.

Then we notice that discussions, diner, ... lead to the set up of new dialogues between scientists (For example between the local organizing committee and Polish scientists), and new links between universities.

## **V Organization:**

Financial supports from industry, universities (Ecole Centrale de Lyon, Ecole Nationale des Travaux Publics de l'Etat), association MV2, DRET, etc...(see the booklet of program, extended abstracts) allows the following things:

- scientists of eastern countries pay nothing (neither hôtel, nor registration fee, neither diner,...)
- proceedings will be edited and send to each participant.
- a part of social event have been paid by Association MV2.

## **VI Next Symposium:**

Another Symposium will be organized in Ecole Centrale de Lyon :

Title: International Conference on Active Control in Mechanical Engineering.

Date: 15-16-17 June 1993.

Location: Ecole Centrale de Lyon - 36 Avenue de Collongue - BP 163 - 69 131 Ecully - Cedex - FRANCE

Information: Prof. L. Jézéquel - MV2 - ECL -  
36 Avenue de Collongue - BP 163 - 69 131 Ecully - Cedex - FRANCE  
Telephone: 78 33 81 27 poste 46 45  
Telefax: 72 18 91 44

Summary: the aim of this conference is to review the active control in theoretical and applied mechanics. All the fields of applications (Vehicles, Aeronautics, Foundations, Space Structures,...) are considered.

Keys: Mechanical Engineering, Vibrations, Active Control, Applied Mechanics, Theoretical Mechanics.



Prof. L. JÉZÉQUEL