

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: 272

Title: RESPONSE OF SHEAR FLOWS TO IMPOSED UNSTEADINESS

Co-Chairmen: G. BINDER, D. RONNEBERGER

Place and country: AUSSOIS, FRANCE

Dates: January 14-18, 1991

### Finance

The conference fee: 1600 FF, everything included, i.e. room & board, refreshments, banquet, booklet, transportation from/to Lyon airport or nearest train-station.

Funding: CNRS, Ministère de la Défense, European Research Office of US Army and for Aerospace R&D, Inst. Nat. Polytech. de Grenoble, Univ. Joseph Fourier Grenoble.

Accommodation (type and cost):

Meals: } At Centre Paul Langevin, Vacation center of the CNRS, at Aussois in the Alpes

### Participation

Total number of participants: 60

Distribution of participants by country:

Code	Country	Number	Code	Country	Number
A	Austria	_____	I	Italy	1
B	Belgium	_____	IRL	Ireland	_____
BG	Bulgaria	1	N	Norway	_____
CH	Switzerland	_____	NL	Netherlands	2
CS	Czechoslovakia	_____	P	Portugal	_____
D	Germany	9	PL	Poland	_____
DK	Denmark	1	R	Rumania	_____
E	Spain	_____	S	Sweden	_____
F	France	26	SF	Finland	_____
GB	Great Britain	8	YU	Yugoslavia	_____
GR	Greece	1	SU	Soviet Union	5
H	Hungary	_____	-	Others	6

Note : two last minute cancellations from Israel because of the events in the Gulf

{ Australia : 1  
USA : 3  
Turkey : 2

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

In about 4 or 5 years

## General comments

There were three full days devoted to the scientific meeting since the participants arrived at Aussois on Monday January 14 and left on Friday 18. Thirty six papers of 25 minutes each with discussion and three review papers of 50 minutes were scheduled (Altogether fifty three papers were submitted). Two general discussions were also included (see the conference program). The fact that the meeting and all the participants were accommodated in the same building created many opportunities for informal discussions.

The number of participants was voluntarily kept below 65. Because of last minute cancellations the final number of participants did not exceed the upper EUROMECH limit of 60 !

The rustic comfort, the quality of the food, the amiability and cooperation of the personnel of the Paul Langevin Center contributed to creating a friendly, relaxed and, yet, studious atmosphere. Aussois is a small mountain resort in beautiful surroundings and the organizers were concerned about the unfair competition the ski slopes could possibly present for the attendance of some scientific sessions. They are happy to note that they were concerned in vain since all sessions were very well attended despite splendid weather and the young age of many participants.

In the spirit of EUROMECH conferences this meeting was quite informal with many questions asked and impromptu comments made during the presentations. Most papers presented work in progress or even in the first stages of development. Several participants were new in the field and came to the meeting with the avowed aim to learn about recent advances on unsteady flows. Nearly one third of the participants were doctoral students.

## Scientific report

The organizers wished to bring together scientists working on forced unsteady flows in various branches of fluid mechanics. The meeting was fairly successful in this respect, since despite a solid representation from the basic fluid mechanics and turbulence community, there also were participants working in aerodynamics, hydraulics, acoustics, fluid machinery and bio-mechanics.

Nearly half of the conference was devoted to unsteady turbulent flows. The question of the proper scaling of these flows was at the center of many discussions. Several sets of data --among which the response of pneumotachographs to acoustic forcing presented at the conference is not the least original-- indicate that the best frequency scaling for the time dependent parts of both the velocity and the turbulent intensity is with inner variables for the case of channel/pipe or flat plate boundary layer flows. But some authors still prefer not to commit themselves and quote forcing frequencies in Hz. Amplitude effects scale to a certain degree with the amplitude of the wall shear-stress. Important departures from these laws in the presence of time-mean adverse pressure gradients were described. Significant differences between the unsteady properties of turbulent momentum and heat transport were reported for the first time at the conference, in particular, that forcing may have stronger effects on the temperature than on the velocity field and that the temperature may lag appreciably behind the velocity even at relatively low imposed frequencies. An original attempt to develop a truly unsteady turbulent model with closure assumptions taking into account the relaxation time of turbulence deserves to be mentioned. The lack of data on the response of the turbulent shear-stress has been deplored in several occasions, especially in the context of the closure problem.

New developments in research on unsteady flows not focussed directly on turbulence are difficult to outline because the geometry often adds new degrees of complexity. Let us nevertheless point out results on the sensitivity of flows, especially of separated flows, to transverse forcing, new data on the drag of accelerated spheres and disks, in particular on the effects the flow history, and observations on the generation of shock waves on oscillating airfoils at remarkably low mean Mach numbers.

A few original flows or applications were described, as a jet in a chamber of decreasing volume to simulate injection into the cylinder of an internal combustion engine or as the viscous vortex wave mechanism used for the improvement of filtration devices.

The majority of the work presented at the conference was experimental but it was shown that modern computers now have the capability of handling at reasonable cost unsteady flows in complex geometries as in elastic, curved or branching tubes, particularly important in biomechanics, or in turbomachinery. Two premières reported at the conference should be mentioned: experimentation on a transputer with 24 processors for the computation of the flow around oscillating airfoils and a direct numerical simulation of unsteady turbulent flow in a channel.

As far as new experimental techniques are concerned, the rapid scanning laser doppler method described at the meeting is particularly well suited for unsteady flows.