EUROMECH

EUROPEAN MECHANICS SOCIETY

Final Report

Date: May 10,1995

Please send this report to the Secretary-General of EUROMECH, 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: 330 Dates: 1995, April 10-12

Title: Laminar/Turbulent Transition of Boundary Layer Influenced by Free-Stream Disturbances

Co-Chairman: Prof. Ing. Ferruccio Pittaluga

Place and country: Institute of Thermomechanics,
Academy of Sciences of the Czech Republic,
CZ-18200 Prague 8, Czech Republic

Is there need of another colloquium on the same subject? Which year?
YES - 1998 or 1999

Finance

Conference fee: 55 USD+/

The fee included:
- administrative costs
- Book of extended abstracts
- refreshment
- welcome dinner

Funding: Institute of Thermomechanics AS CR, Prague;
United States Air Force European Office of Aerospace Research and Development, London

Accomodation (type and cost):
Hotel of the Academy of Sciences
(bed and breakfast cca 25 USD per night)

Meals: On the individual order (5 USD per lunch)

Participation

Number of participants from each country:

Austria	-	Germany	5	Rumania	2
Belgium	2	Great Britain	13	Russia	1
Bielorussia	-	Greece	1	Slovakia	-
Bosnia	-	Hungary	-	Slovenia	-
Bulgaria	-	Ireland	-	Spain	-
Croatia	-	Italy	3	Sweden	1
Czech Republic	7	Latvia	-	Switzerland	1
Denmark	-	Lithuania	-	Ukraine	2
Estonia	-	Netherlands	2	Yugoslavia	-
Finland	-	Norway	-	Others	
France	1	Poland	-	Korea	1
Georgia	-	Portugal	1	Total	43

+/ + 40 USD additional to 55 USD by each participant who is not a member of the EUROMECH Society.

Please turn

Scientific report

EUROMECH Colloquium 330
"Laminar/Turbulent Transition of Boundary Layer Influenced by Free-Stream Disturbances"

Prague, April 10-13, 1995

The problem of the onset and development of laminar/turbulent transition in boundary layers under free-stream with disturbances of various kind received wide interest in the fluid-dynamics communities engaged in fundamental and applied research. Most of the major European research groups participated at the Colloquium.

Most of the participants (with a few exceptions only) stayed at the Institute of Thermomechanics of Academy of Sciences of the Czech Republic in Prague until April 14 to attend the Workshop of ERCOFTAC SIG on Transition.

The Colloquium was attended by 43 scientists (9 of the registered participants excused themselves), out of them 5 were from the Eastern Europe and 7 from the Czech Republic.

The main aim of the colloquium was to stimulate the exchange of ideas and results on physics of the phenomena, on mathematical aspects and on experimental legalities of the by-pass transition of 2D and 3D-boundary layers. Altogether 30 contributions were devoted to this subject. The distribution of authors by countries is as follows: Belgium 2, Czech Republic 5, Germany 3, Greece 1, Italy 2, Korea 1, Portugal 1, Romania 2, Russia 1, Sweden 1, Netherlands 2, Ukraine 3, Great Britain 6. The 34 abstracts in the Book of Abstracts include even those authors who have not arrived.

Considering the applied research methods, the contributions can be grouped as follows:

- **Analytical Studies** (4 papers)

  based on the NS-equations, the linear stability theory and the analogy between elmg. waves and waves in the fluid-flow. Their results supported the development of numerical methods or formulated some new numerical problem.

- **Numerical Studies** (8 papers)

  demonstrated a large scale of accesses to the solution; e.g. Large Eddy Simulation, linearized equations of the unsteady boundary layer, linearized NS-equations, parabolized equations of the stream stability, Direct Numerical Simulation of NS-equations and the use

of conditional averaging. The receptivity of boundary layer to the disturbances of various kinds and intensities was studied. The results obtained confirmed some of the theoretical forecasts, made clear the effect at least of some of the disturbances, and helped to explain several experimental results.

- **Modelling of transitional boundary layers** (6 papers)
  showed quite good agreement of the computation of some (but not all as usual) important boundary layer characteristics by means of various models performed there: an algebraic model for the transition region, one-equation turbulence models (k-ε) & γ models, (k-e) or (k-ε) & RMS models.
- **Experimental investigations of by-pass transition** (16 papers)
  covered a wide range of boundary conditions, as well as of processes and phenomena. For example: *boundary conditions:* smooth flat plates, a curved turbine blade, a stagnation region of a cylindrical surface, a stratification of the fluid density near the surface, external disturbances coming from the homogeneous grid-turbulence or from the wake of a body upstream the boundary layer onset, disturbances generated by oscillating surface etc. Phenomena as the flow stability, the internal structure of transitional boundary layer, the occurrence of turbulent spots, longitudinal streaks, bursts and other coherent motions were investigated. As well, some other topics were explored: the effect of the dissipative length scale at the given intensity of turbulence, the effect of the mode of the position and direction of an impinging wake on the boundary layer and the changes in the heat transfer and in the temperature distribution originating in the by-pass transition course.
  The measurements were performed mainly by means of a hot-wire anemometer. Simultaneously, several interesting benefits were reported to the performance of the HF-gauges surface in the transition research.

Some of presentations informed on preliminary results of the recently starting investigations and interesting new subjects have inured from discussions. The problem of by-pass is still a vivid one. This is why after 3-4 years, it might be helpful to call the researchers investigating the problem of by-pass transition of boundary layers together again.

It has to be stressed that computation, experiment and theory were well balanced in the contributions presented. Well enough time was available for discussion (5-10 minutes following each paper, lively discussion went on during the coffee- and lunch-breaks, and there was a general discussion after every afternoon session). In conclusion, the colloquium was a successful meeting that fulfilled all expectations.

Pavel Jonáš, 10.5.1995