
**04-9 IUTAM Symposium on Laminar-Turbulent Transition
Bangalore, India, December 13-17, 2004****a) Scientific Committee**

Rama Govindarajan (Chair, INDIA), Roddam Narasimha (IUTAM Representative), Daniel Arnal (France), Mike Gaster (United Kingdom), Leonhard Kleiser (Switzerland), Y. P. Kohama (Japan), William Saric (U.S.A), H. Zhou (China)

b) Short summary of scientific progress achieved

The sixth IUTAM meeting in the series, which was held at Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India, focused on the progress after the fifth meeting held at Sedona in 1999. The symposium adhered to the IUTAM format of single session. The symposium included seven invited lectures, fifty oral presentations and eight posters.

During the course of the symposium, the following became evident. The area of laminar-turbulent transition has progressed considerably since 1999. Better theoretical tools, for handling nonlinearities as well as transient behaviour are now available. This is accompanied by an enormous increase in the level of sophistication of both experiments and direct numerical simulations. The result has been that our understanding of the early stages of the transition process is now on much firmer footing and we are now able to study many aspects of the later stages of the transition process. Consequently, considerable light was thrown during the symposium on, e.g., the role of streamwise streaks, flow separation, complex geometry, turbulent spots etc. We are also now capable of better approaches to flow control.

The immediate future is likely to see important advances in this area and it is hoped that the symposium has added momentum to this effort. From the high level of interactions during the conference and the feedback from participants, it seems likely that this is the case. Therefore the symposium achieved its purpose.

I would like to sincerely thank the IUTAM for giving me the opportunity to organize and chair this event and also for generous financial support.

c) Countries represented and number of participants

The meeting attracted 113 participants from 15 countries:

Brazil (1), Canada (1), China (2), France (5), Germany (9), India (49), Israel (2), Japan (12), Malaysia (1), Russia (4), Spain (1), Sweden (6), Switzerland (3), The Netherlands (1), United Kingdom (11) and USA (5).

d) Publication of Proceedings of the Symposium

The papers presented at this symposium are to be published by Kluwer - Springer Academic Publishers, The Netherlands in the volume "Laminar-Turbulent Transition". The final version of the proceedings is in preparation.

e) Financial supports

We are grateful to our sponsors listed below who have supported the various activities of the symposium.

- International Union of Theoretical and Applied Mechanics, Russia
- Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore
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- Hindustan Aeronautics Limited, Bangalore, India
- Indian National Science Academy, Government of India
- Department of Science & Technology, Ministry of Science & Technology-India
- Hitech Engineering Equipments, Bangalore, India
- Real Time Tech Solutions, Private Limited, Bangalore, India

f) Scientific program**Day 1**

Opening lecture: Mike Gaster, *Laminar separation bubbles*

Instability I

Vassilis Theofilis, *On fundamental instability mechanisms of nominally two-dimensional separation bubbles*

Gregoire Casalis, *Global instability of the flow induced by wall injections*

Flow control I

Ardeshir Hanifi, *Optimal suction design for hybrid laminar flow control*

Seichihiro Izawa, *Transition control in a flat-plate boundary layer*

Jerome Hoepffner, *Linear feedback control of transition in shear flows*

Manikandan Mathur, *Effect of ambient viscosity on the entrainment and dynamics of a buoyant jet*

Instability II

Invited lecture: Dan Henningson, *Transient growth with application to bypass transition*

VV Kozlov, *Development of forerunners on fronts of longitudinal structures in the boundary layer*

B Hof, *First observation of coherent travelling wave states in experimental pipe flow*

Transition I

H Zhou, *Inherent mechanism for laminar-turbulent transition*

Gilles Studer, *Experimental and numerical analysis of unsteady boundary layer transition using continuous wavelet transform*

Stefan Hein, *Nonlinear nonlocal analysis of crossflow dominated transition scenarios using DNS-like resolution*

Transition II

Toshiaki Kenchi, *The effect of length scale of free stream turbulence on boundary layer transition*

Ulrich Rist, *Unsteady disturbance generation and amplification in the boundary-layer flow behind a medium-sized roughness element*

Day 2

Transition III

Invited lecture: Xuesong Wu, *The role of free-stream disturbances in laminar-turbulent transition*

Jens Fransson, *Experimental study of the stabilization of Tollmien-Schlichting waves by finite amplitude streaks*

Masahito Asai, *Development of streamwise streaks in a quasi-laminar boundary layer downstreams of localized suction*

Instability III

J J Healey, *A new convective instability with growth normal to a boundary layer*

Luca Brandt, *Numerical studies of streak instability in boundary layers*

Kirti Sahu, *A possible linear instability mechanism in small-scale pipe flows*

JP Gostelow, *Effects of strong adverse pressure gradients and incident wakes on transition and calming*

Invited lecture: Jeffrey D Crouch, *Modeling the effects of two-dimensional steps on transition due to Tollmien-Schlichting waves*

Compressible Flow

N Semionov, *Experimental study of turbulence beginning and transition control in a supersonic boundary layer on a swept wing*

Christian Stemmer, *Transition investigations on hypersonic flat-plate boundary layer flows with chemical and thermal non-equilibrium*

Cross Flow

Shohei Takagi, *Characteristics of unsteady disturbances due to streamline-curvature instability in a three-dimensional boundary layer*

V Krishnan, *Observations of crossflow transition on a swept wing with GAW-2 airfoil section*

Flow Control

C Davies, *Disturbance developments in boundary layers over compliant surfaces*

PK Sen, *Suppression of wall turbulence based on stability and turbulence analysis using compliant surfaces*

Meelan Choudhari, *A computational study of roughness-induced transient growth*

Mattias Chevalier, *Linear control and estimation in boundary layer flows*

Day 3

Transition IV

Invited lecture: Tom Mullin, *Recent observations in the transition to turbulence in a pipe*

Patrice LeGal, *Transition to turbulence of the torsional Couette flow*

Marcello Medeiros, *A mechanism of production of sub harmonic waves in nonlinear wave packets in boundary layers*

Philipp Schlatter, *Applicability of LES models for prediction of transitional flow structures*

Transition V

L Krishnan, *Turbulent spots in a compressible boundary-layer flow*

Tal Yehoshua, *Evolution of vortices ejected from zero-mass-flux actuator into cross-flow*

Rajat Mittal, *Resonant mode interaction and transition in a canonical separated flow*

Paresh Chokshi, *Stability and transition in the flow of polymer solutions*

Instability IV

Invited lecture: Jaywant Arakeri, *Localised instability in unsteady separation bubbles*

Pierre Ricco, *Effect of free-stream turbulence on a compressible laminar boundary layer*

A Sameen, *Effect of viscosity stratification on secondary and nonmodal instabilities*

Michael Broadhurst, *Spectral element stability analysis of vortical flows*

Instability V

Dieter Sartorius, *Experimental study of resonant interactions of instability waves in an airfoil boundary layer*

Peter Carpenter, *Klebanoff modes in swept boundary layers*

Joern Sesterhenn, *Effects of compressibility and nose radius on instabilities near the attachment line of swept wings*

Day 4

Flow Control III

Sanjay Mittal, *Effect of elastic supports on the critical value of Reynolds number past a cylinder*

Yasuaki Kohama, *Improvement of lift-to-drag ratio of the artificially generated instabilities on a laminar flow airfoil*

Separated flow

Wolfgang Rodi, *DNS of separation-induced transition under the influence of distributed and concentrated free-stream fluctuations*

Tilmann Hetsch, *The effect of sweep angle on laminar separation bubbles*

ON Ramesh, *On the bursting criterion for laminar separation bubble*

Instability VI

Christophe J Robinet, *Two-dimensional local instability: complete eigen value spectrum*

Jitesh Gajjar, *Instability of flow past a cascade of circular cylinders*

Sriram Hegde, *A wave driver theory for vertical waves propagating across junctions between rigid and compliant walls*

Closing lecture: Hermann Fasel, *DNS including control of transition/separation*

Report composed by Rama Govindarajan and Anjana Krishnaswamy.