

Spencer Sherwin
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IUTAM Laminar– Turbulent Transition

9th IUTAM Symposium, London, UK,
September 2–6, 2019

Laminar Turbulent Transition Iutam Symp

**W. O. Criminale, T. L. Jackson, R. D.
Joslin**



Laminar Turbulent Transition Iutam Symp:

Laminar-Turbulent Transition H.F. Fasel, W.S. Saric, 2013-03-09 The origins of turbulent flow and the transition from laminar to turbulent flow are among the most important unsolved problems of fluid mechanics and aerodynamics Besides being a fundamental question of fluid mechanics there are any number of applications for information regarding transition location and the details of the subsequent turbulent flow The JUT AM Symposium on Laminar Turbulent Transition co hosted by Arizona State University and the University of Arizona was held in Sedona Arizona Although four previous JUT AM Symposia bear the same appellation Stuttgart 1979 Novosibirsk 1984 Toulouse 1989 and Sendai 1994 the topics that were emphasized at each were different and reflect the evolving nature of our understanding of the transition process The major contributions of Stuttgart 1979 centered on nonlinear behavior and later stages of transition in two dimensional boundary layers Stability of closed systems was also included with Taylor vortices in different geometries The topics of Novosibirsk 1984 shifted to resonant wave interactions and secondary instabilities in boundary layers Pipe and channel flow transition were discussed as model problems for the boundary layer Investigations of free shear layers were presented and a heavy dose of supersonic papers appeared for the first time The character of Toulouse 1989 was also different in that 3 D boundary layers numerical simulations streamwise vortices and foundation papers on receptivity were presented Sendai 1994 saw a number of papers on swept wings and 3 D boundary layers Numerical simulations attacked a broader range of problems

IUTAM Symposium on Laminar-Turbulent Transition and Finite Amplitude Solutions Tom Mullin, R. R. Kerswell, 2005-12-28 An exciting new direction in hydrodynamic stability theory and the transition to turbulence is concerned with the role of disconnected states or finite amplitude solutions in the evolution of disorder in fluid flows This volume contains refereed papers presented at the IUTAM LMS sponsored symposium on Non Uniqueness of Solutions to the Navier Stokes equations and their Connection with Laminar Turbulent Transition held in Bristol 2004 Theoreticians and experimentalists gathered to discuss developments in understanding both the onset and collapse of disordered motion in shear flows such as those found in pipes and channels The central objective of the symposium was to discuss the increasing amount of experimental and numerical evidence for finite amplitude solutions to the Navier Stokes equations and to set the work into a modern theoretical context The participants included many of the leading authorities in the subject and this volume captures much of the flavour of the resulting stimulating and lively discussions *Laminar-Turbulent Transition* D. Arnal, R. Michel, 2012-12-06 The subject of laminar turbulent transition is of considerable practical importance and has a wide range of engineering applications For this reason the International Union of Applied Mechanics decided to sponsor a third Symposium on Laminar Turbulent Transition which would be organised by the ONERA Toulouse Research Center and held at Ecole Nationale Supérieure de l'Aéronautique et de l'Espace in 1989 It was supposed that like the two previous IUTAM Symposia Stuttgart 1979 and Novosibirsk 1984 the symposium would be devoted to experimental of laminar turbulent

transition In fluids i.e. the and theoretical studies physical problem of transition and mathematical modelling in shear flows The contributed papers were selected by the Scientific Committee from extended abstracts The larger number of highly qualified papers submitted for presentation led us to include in the program poster sessions which could be held during morning lunch and afternoon breaks and to take the decision that the symposium should last five days from Monday 11 to Friday 15 September An excursion on Wednesday offering a well deserved rest and the occasion of new personal exchanges between the participants seems to have been appreciated by all The symposium consisted of 8 invited lectures and 62 contributed papers presented either on oral or poster sessions

IUTAM Laminar-Turbulent Transition Spencer Sherwin, Peter Schmid, Xuesong Wu, 2021-07-30 This volume comprises the carefully revised papers of the 9th IUTAM Symposium on Laminar Turbulent Transition held at the Imperial College London UK in September 2019 The papers focus on the leading research in understanding transition to turbulence which is a challenging topic of fluid mechanics and arises in many modern technologies as well as in nature The proceedings are of interest for researchers in fluid mechanics and industry who have to handle these types of problems such as in the aeronautical sector

Seventh IUTAM Symposium on Laminar-Turbulent Transition Philipp Schlatter, Dan S. Henningson, 2010-03-11 The origins of turbulent flow and the transition from laminar to turbulent flow are the most important unsolved problems of fluid mechanics and aerodynamics sides being a fundamental question of fluid mechanics there are numerous applications relying on information regarding transition location and the details of the subsequent turbulent flow For example the control of transition to turbulence is specially important in 1 skin friction reduction of energy efficient aircraft 2 the performance of heat exchangers and diffusers 3 propulsion requirements for personic aircraft and 4 separation control While considerable progress has been made in the science of laminar to turbulent transition over the last 30 years the continuing increase in computer power as well as new theoretical developments are now revolutionizing the area It is now starting to be possible to move from simple 1D eigenvalue problems in canonical flows to global modes in complex flows all accompanied by accurate large scale direct numerical simulations DNS Here novel experimental techniques such as modern particle image velocimetry PIV also have an important role Theoretically the influence of non normality on the stability and transition is gaining importance in particular for complex flows At the same time the enigma of transition in the oldest flow investigated Reynolds pipe flow transition experiment is regaining attention Ideas from dynamical systems together with DNS and experiments are here giving us new insights

Seventh IUTAM Symposium on Laminar-Turbulent Transition Philipp Schlatter, Dan S. Henningson, 2011-11-29 The origins of turbulent flow and the transition from laminar to turbulent flow are the most important unsolved problems of fluid mechanics and aerodynamics sides being a fundamental question of fluid mechanics there are numerous applications relying on information regarding transition location and the details of the subsequent turbulent flow For example the control of transition to turbulence is specially important in 1 skin friction reduction of energy efficient aircraft 2 the performance of heat exchangers

and diffusers 3 propulsion requirements for personic aircraft and 4 separation control While considerable progress has been made in the science of laminar to turbulent transition over the last 30 years the continuing increase in computer power as well as new theoretical developments are now revolutionizing the area It is now starting to be possible to move from simple 1D eigenvalue problems in canonical flows to global modes in complex flows all accompanied by accurate large scale direct numerical simulations DNS Here novel experimental techniques such as modern particle image velocimetry PIV also have an important role Theoretically the influence of non normality on the stability and transition is gaining importance in particular for complex flows At the same time the enigma of transition in the oldest flow investigated Reynolds pipe flow transition experiment is regaining attention Ideas from dynamical systems together with DNS and experiments are here giving us new insights

Laminar-Turbulent Transition Ryoji Kobayashi, 2013-03-12 The International Union of Theoretical and Applied Mechanics IUTAM decided in 1992 to sponsor the fourth Symposium on Laminar Turbulent Transition Sendai Japan 1994 The objectives of the present Symposium were to deepen the fundamental knowledge of stability and laminar turbulent transition in three dimensional and compressible flows and to contribute to recent developing technologies in the field This Symposium followed the three previous IUTAM Symposia Stuttgart 1979 Novosibirsk 1984 and Toulouse 1989 The Scientific Committee selected two keynote lectures and 62 technical papers The Symposium was held on the 5th to 9th of September 1994 at the Sendai International Center in Sendai The participants were 82 scientists from 10 countries The keynote lectures have critically reviewed recent development of researches concerning the laminar to turbulent transition phenomena from the fundamental and the application aspects Many papers presented were concerned about the detailed mechanism of the boundary layer transition receptivity secondary instability turbulent spot and bypass transition Particular emphasis was further placed on the transition of three dimensional boundary layers on rotation systems and on swept wings Attention was also given to compressible hypersonic flows *Sixth IUTAM Symposium on Laminar-Turbulent Transition* Rama

Govindarajan, 2006-01-18 The dynamics of transition from laminar to turbulent flow remains to this day a major challenge in theoretical and applied mechanics A series of IUTAM symposia held over the last twenty five years at well known Centres of research in the subject Novosibirsk Stuttgart Toulouse Sendai and Sedona Arizona has proved to be a great catalyst which has given a boost to research and our understanding of the field At this point of time the field is changing significantly with several emerging directions The sixth IUTAM meeting in the series which was held at the Jawaharlal Nehru Centre for Advanced Scientific Research Bangalore India focused on the progress after the fifth meeting held at Sedona in 1999 The symposium which adhered to the IUTAM format of a single session 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 *Proceedings of the 10th IUTAM Symposium on Laminar-Turbulent Transition* Kentaro Kato,Ayumu Inasawa,Masaharu Matsubara,2025-09-26 The 10th IUTAM Symposium on Laminar Turbulent Transition held in September 2024 at Shinshu University in Nagano Japan attracted nearly 135 participants from 18 countries across five continents and featured more than 100 presentations in addition to keynote and plenary lectures by eight internationally renowned invited speakers Topics included high speed flows boundary layer transition cross flow instability free stream turbulence roughness separation general instabilities and complex flows The presentations were a well balanced mix of theoretical numerical and experimental approaches that are necessary to advance the field of instability and transition That experiments still have a role to play is especially true for boundary layer transition and separation at all speed ranges since non ideal boundary conditions such as roughness free stream turbulence sound heat transfer etc that are hard to accurately model play an important role for how disturbances enter into and develop in the system This book contains selected contributions representing a wide range of disciplines presented at the symposium Researchers studying transition to turbulence and engineers who must deal with this problem e g those in the aeronautical field will easily find meaningful ideas and knowledge in these proceedings **IUTAM Symposium on Laminar Turbulent Transition ; 3** ,1989 *IUTAM Symposium: Laminar-Turbulent Transition* ,2000 The origins of turbulent flow and the transition from laminar to turbulent flow are among the most important unsolved problems of fluid mechanics and aerodynamics Besides being a fundamental question of fluid mechanics there are any number of applications for information regarding transition location and the details of the subsequent turbulent flow The IUTAM Symposium on Laminar Turbulent Transition Co hosted by Arizona State University and the University of Arizona was held in Sedona Arizona Although four previous IUTAM Symposia bear the same appellation Stuttgart 1979 Novosibirsk 1984 Toulouse 1989 and Sendai 1994 the topics that were emphasized at each were different and reflect the evolving nature of our understanding of the transition process The Sedona 1999 meeting focused almost exclusively on open systems and as such on wall bound shear flows The major impact topics were receptivity of initial disturbances cross flow instabilities supersonic flows and control of transition Many papers were on combined numerical and experimental work The objectives of many of these studies were to properly define the fundamental physics of the stability and transition process As a consequence this fundamental knowledge now enables different techniques of transition control and its subsequent decrease in drag One expects increased emphasis on this topic in the future **IUTAM Symposium on Laminar Turbulent Transition ; 2** ,1984 *IUTAM Symposium on Laminar-turbulent Transition* International Union of Theoretical and Applied Mechanics,Union Internationale de Mécanique Théorique et Appliquée,1980 *IUTAM Laminar-Turbulent Transition* Spencer Sherwin,Peter Schmid,Xuesong Wu,2022 This volume comprises the carefully revised

papers of the 9th IUTAM Symposium on Laminar Turbulent Transition held at the Imperial College London UK in September 2019 The papers focus on the leading research in understanding transition to turbulence which is a challenging topic of fluid mechanics and arises in many modern technologies as well as in nature The proceedings are of interest for researchers in fluid mechanics and industry who have to handle these types of problems such as in the aeronautical sector

Laminar-turbulent Transition Viktor Vladimirovich Kozlov,1985 At the suggestion of the USSR National Committee of Theoretical and Applied Mechanics the International Union of Theoretical and Applied Mechanics made a decision to organize the Second IUTAM Symposium on Laminar Turbulent Transition in Novosibirsk Professor Yanenko was entrusted to be the chairman of the scientific committee It was proposed that about 100 scientists would participate in the Symposium and that 60 lectures and invited lectures would be delivered as for the theme of the Symposium it was devoted to experimental and theoretical studies of laminar turbulent transition in fluids and gases i.e the physical problems of transition and mathematical modeling in shear flows It was planned to lay a special emphasis on fundamental mechanisms of the transition process The scientific committee approved of the scope of the Symposium having considered the changes in the directions of the studies which took place since the First Symposium For example there was singled out the problem of transformation of external disturbances into eigenoscillations of shear flows i.e the receptivity problem which was only slightly touched upon at the First Symposium A new section appeared devoted to the interaction of the flow separation phenomenon and its stability It was planned to focus the attention on the secondary instability at transition to turbulence at the non linear stage of the flow breakdown as well as on the loss of stability and the disturbances development in 3 D flows

Turbulence in Fluids Marcel Lesieur,2008-03-26 Turbulence is a dangerous topic which is often at the origin of serious fights in the scientific meetings devoted to it since it represents extremely different points of view all of which have in common their complexity as well as an inability to solve the problem It is even difficult to agree on what exactly is the problem to be solved Extremely schematically two opposing points of view had been advocated during these last thirty years the first one was statistical and tried to model the evolution of averaged quantities of the flow This community which had followed the glorious trail of Taylor and Kolmogorov believed in the phenomenology of cascades and strongly disputed the possibility of any coherence or order associated to turbulence On the other bank of the river stood the coherence among chaos community which considered turbulence from a purely deterministic point of view by studying either the behaviour of dynamical systems or the stability of flows in various situations To this community were also associated the experimentalists and computer simulators who sought to identify coherent vortices in flows Situation is more complex now and the existence of these two camps is less clear In fact a third point of view pushed by people from the physics community has emerged with the concepts of renormalization group theory multifractality mixing and Lagrangian approaches

Laminar-turbulent Transition R. Eppler,H. Fasel,1980 *Laminar-turbulent transition* Richard Eppler,H. Fasel,1980

Laminar-turbulent Transition R. Eppler,H. Fasel,1980

Combustion Modelling A. Hanifi,P.H. Alfredsson,A.V. Johansson,D.S. Hennigson,2012-12-06 The aim of the present book is to give in a single volume an introduction to the fields of transition turbulence and combustion modelling of compressible flows and to provide the physical background for today s modelling approaches in these fields The basic equations for compressible flows are presented Ch 1 The fundamental aspects of hydrodynamical instability are discussed Ch 2 along with transition prediction methods in industrial applications Ch 3 Turbulence modelling approaches ranging from single point models Ch 4 5 to large eddy simulation techniques Ch 6 direct numerical simulations Ch 7 and turbulence combustion modelling Ch 8 are covered The book addresses engineers and researchers in industry or academia who are entering into the fields of transition turbulence or combustion modelling research or who need to apply turbulence or transition prediction methods in their work

Theory and Computation of Hydrodynamic Stability W. O. Criminale,T. L. Jackson,R. D. Joslin,2003-10-23 The study of hydrodynamic stability is fundamental to many subjects ranging from geophysics and meteorology through to engineering design This treatise covers both classical and modern aspects of the subject systematically developing it from the simplest physical problems then progressing chapter by chapter to the most complex considering linear and nonlinear situations and analysing temporal and spatial stability The authors examine each problem both analytically and numerically many chapters end with an appendix outlining relevant numerical techniques All relevant fluid flows are treated including those where the fluid may be compressible or those from geophysics or those that require salient geometries for description Details of initial value problems are explored equally with those of stability As a result the early transient period as well as the asymptotic fate for perturbations for a flow can be assessed The text is enriched with many exercises copious illustrations and an extensive bibliography and the result is a book that can be used with courses on hydrodynamic stability or as an authoritative reference for researchers

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