Preface

In the thin boundary layer of air along aircraft surfaces, somewhere transition from the laminar to the turbulent state will occur. As the transition marks a significant increase in viscous drag, the transition location is an important design parameter. But the physics of stability and transition of fluid flows are quite complex. A better knowledge of what is going on will enable to implement the concept of *Laminar Flow Control* in future generations of aircraft.

Since the pioneering experiments of Reynolds, more than a century ago, for the transition of the flow in a pipe, much progress has been made in transition research. Over the past 4 decades, the e^n method for the prediction of the transition location has been very popular in the aerodynamic design of airfoils and wings. In the past few years some new ideas and concepts have come up, which are very promising, and are expected to have an influence on design methods in the next decade. For example, there is now considerable interest in receptivity, which describes how environmental disturbances enter the boundary layer and are transformed into unstable waves. Also the Parabolized Stability Equations (PSE) have been introduced. The nonlinear PSE contain much more physics than the e^n method (which is fully based on linear theory), but still much needs to be done to make it available for designers. The availability of supercomputers enables to perform Direct Numerical Simulations (DNS) for all stages of the transition process. The resulting data bases contribute to the fundamental understanding of the transition process. Although the capabilities of PSE and DNS are quite impressive, accurate experimental data remain required for their validation. The experiments are particularly important for the receptivity process. The experiments can also reveal new (primary and higher order) instability mechanisms, not yet captured by the physical models. A remarkable improvement of the experimental techniques over the last years is the use of sophisticated disturbance generators, which can introduce two-dimensional or oblique waves of a prefixed frequency and wavelength.

In view of the fast scientific progress, on the one hand, and the strong need for improved prediction methods by industries, on the other hand, a 3-day Colloquium (6-8 December 1995) on *Transitional Boundary Layers in Aeronautics* was organized in the historical building of the Royal Netherlands Academy of Arts and Sciences in Amsterdam, The Netherlands. The Colloquium had the subtitle *State-of-the-art and Future Directions of Research.* The state-of-the-art was covered by 14 invited speakers, coming from universities, research institutes, and industries. In fact all speakers of our first choice did accept the invitation. Following a call-for-papers, 23 technical presentations were selected (out of double the number of submitted abstracts). These presentations give a valuable overview of current and future research on transition with aeronautical applications. The Colloquium was attended by 50 invited participants, coming from 12 countries: Australia (1), Belgium (1), France (1), Germany (13), India (1), The Netherlands (9), Portugal (1), Russia (5), UK (7), Sweden (1), Switzerland (1), and USA (9).

The Colloquium was concluded with a general discussion on the future directions of research. It became very clear that the collaboration between the developers of transition theory ('the scientists') and the end users of transition-prediction tools in aircraft industries ('the engineers') should be further strengthened. Industries want tools that can be used by an engineer, without the need to have a thorough knowledge of all the details of transition theory. Therefore industries very much like the simple e^n method, though the limitations for extension to 3D are realized. The scientists emphasize that the physics of transition are not simple, and therefore hard to capture in engineering methods. We think that the present Colloquium will help to bridge the gap between the engineering and the scientific world.

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