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Computation, Modeling and Control of Transitional and Turbulent Flows

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ADVANCES IN COMPUTATION, MODELING AND CONTROL OF TRANSITIONAL AND TURBULENT FLOWS

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Preface

The *IUTAM Symposium on Advances in Computation, Modeling and Control of Transitional and Turbulent Flows* was held in Goa, India, during December 15–18, 2014. The aim of the symposium was to bring together renowned experts from fluid dynamics, computational science, dynamical systems and control to share results from the latest developments in the field and to foster further progress by interaction and exchange of ideas. Following the long-standing IUTAM tradition the symposium was organized with a single track of technical sessions so as to provide ample opportunity for scientific dialogue and discussion, and especially to expose young scientists to the cutting-edge of research.

The scientific program of the symposium included 10 technical sessions presenting 56 contributed papers, a poster session with 11 posters, a panel discussion, and 8 invited keynote lectures delivered by internationally renowned scholars. A review panel selected these papers and posters from a larger list of abstracts submitted. The symposium attracted participation by delegates from 19 countries with approximately half of the contributed papers from India.

Authors of the papers presented at the symposium, including keynote speakers, were invited to submit a technical paper to these Proceedings, based on their presentations at the symposium. The papers received were reviewed by an expert review panel and edited for this volume. We hope that the papers capture the scientific excitement of the symposium. Several keynote speakers and most other speakers contributed to the volume, in some cases by including results updated after the symposium. The full scientific program of the symposium is included at the end of this volume.

We hope that these technical papers provide a glimpse of the new ideas and results discussed at the symposium and that they will foster further research and collaboration. The reader may note the broad range of themes represented in the papers, from careful assessment of numerical algorithms, fundamental studies of transition and instabilities, flow control, aeroacoustics and environmental flows, to dynamo theory and astrophysics. Included are papers on the need for simplified models capable of describing flow physics in diverse regimes or conditions.

The choice of Goa as the venue was not accidental: the famous D. D. Kosambi, an originator of the so-called Kurhunen-Loeve expansion, or the Proper Orthogonal Decomposition, was born here and his birthday is celebrated as the science day in the state of Goa. A short sketch of his life and times is included as an appendix. The choice of the subject for the conference was due to its timely interest in the scientific firmament, including many from the host country. Everyone agreed that the richness and beauty of the fluid phenomena discussed in these proceedings paralleled the stunningly enthralling Goa, the meticulous organization of the symposium, and the warm hospitality of the local organizing committee.

Color Plates

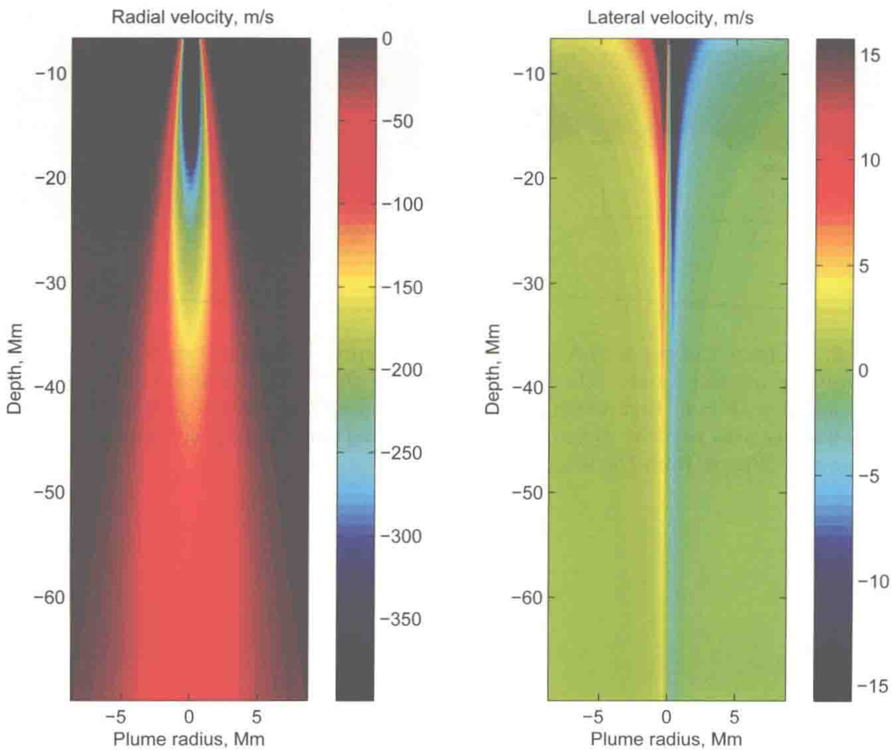

Fig. 1. (Figure 3 of paper 2) Velocity profile obtained from a model of plumes[23]. The plume gradually grows in size as it descends (left panel, radial velocity) and the degree of entrainment (right panel, horizontal or lateral velocity). Despite the increasing degree of entrainment, the diameter of the plume grows slowly. If the plumes entrains sufficiently, it will destabilize and mix into the ambient, resulting in overturning convection. However, in the weakly mixing mechanism described here, the increasing density stabilizes descending plumes, preventing them from breaking up (Courtesy, M. Rieutord).

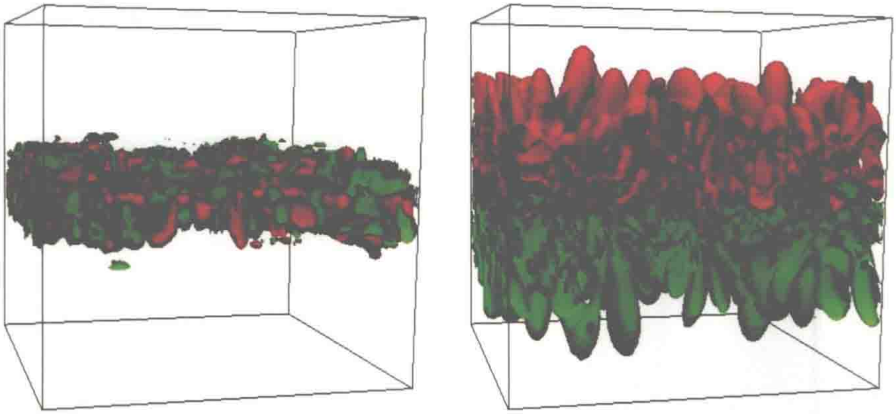

Fig. 2. (Figure 2 of paper 3) A slab of turbulence spreads in a rotating fluid ($Ro = 0.1$) by emitting inertial waves. The left-hand panel is the initial condition and the right-hand one is at $\Omega t = 6$. Red marks negative helicity and green positive helicity. Evidently wave packets with negative helicity travel upward and those with positive helicity travel downward. (Figure from Davidson, 2013[2].)

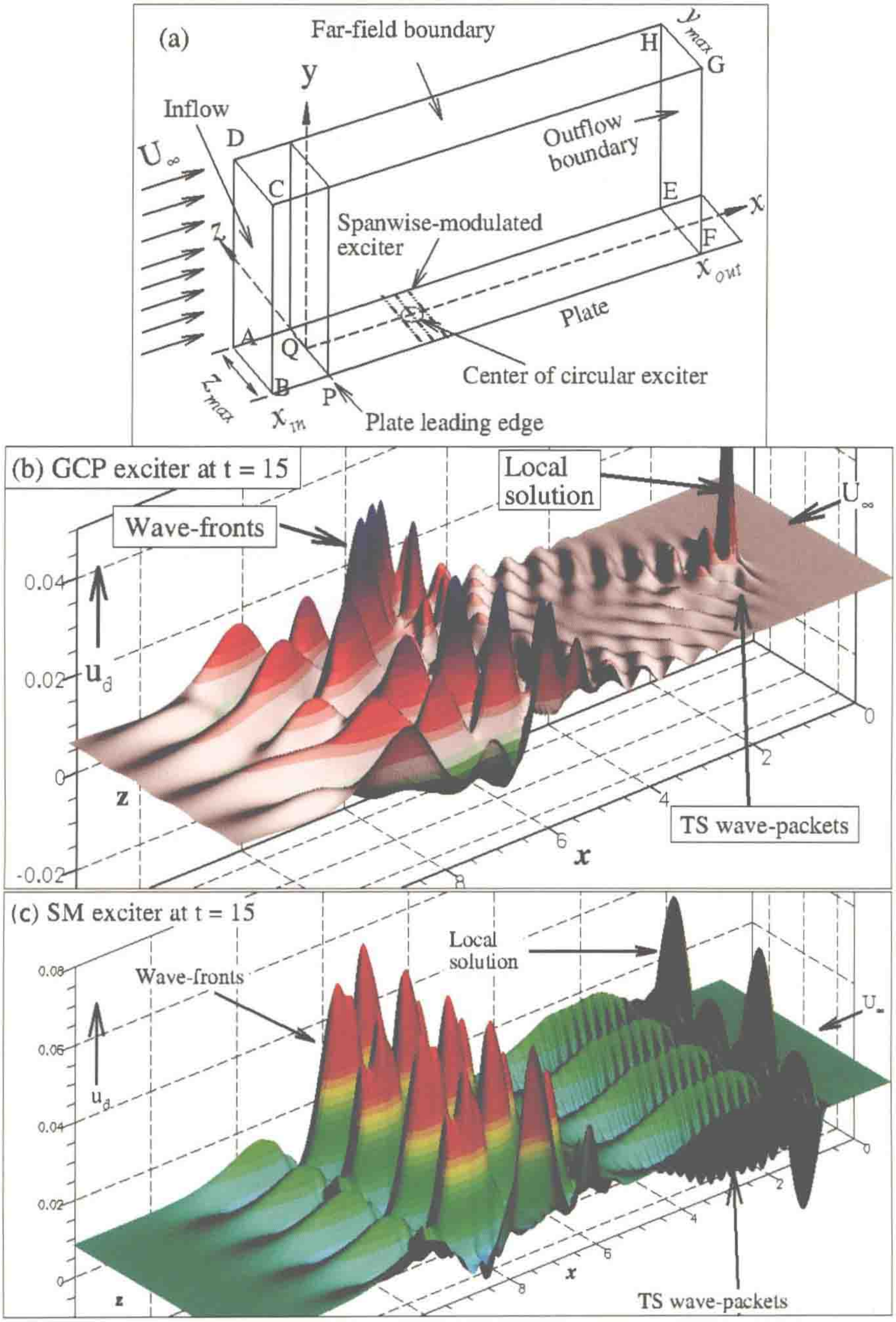

Fig. 3. (Figure 2 of paper 5) Perspective plot of u_d at a fixed height shown for (a) GCP and (b) SM exciters. The frequency of excitation is $F = 2\pi\nu f/U_\infty^2 = 0.5 \times 10^{-4}$; ν is kinematic viscosity and f is frequency in Hz.

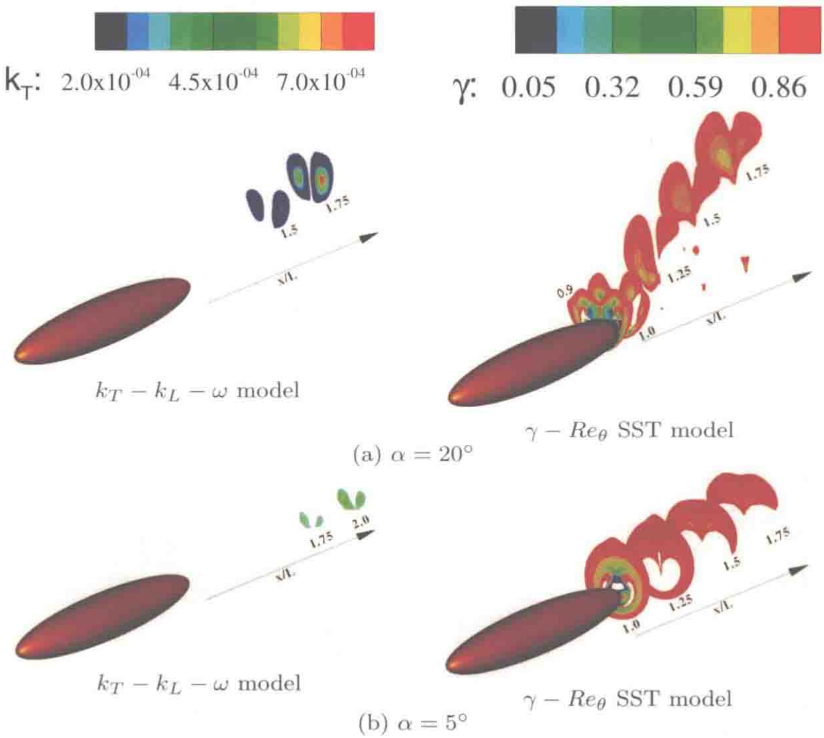

Fig. 4. (Figure 7 of paper 9) Kinetic energy (left) and gamma (right) contours at $\alpha = 20°$ for prolate spheroid.

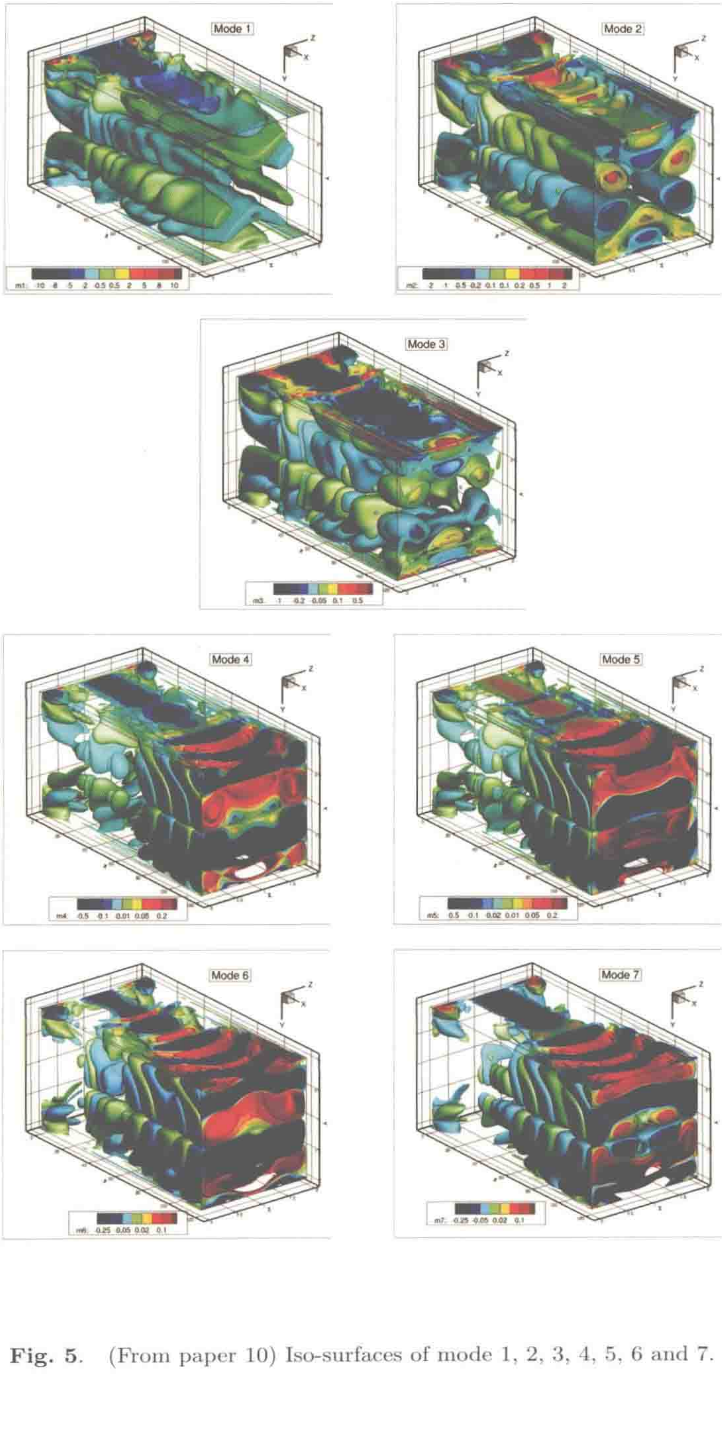

Fig. 5. (From paper 10) Iso-surfaces of mode 1, 2, 3, 4, 5, 6 and 7.

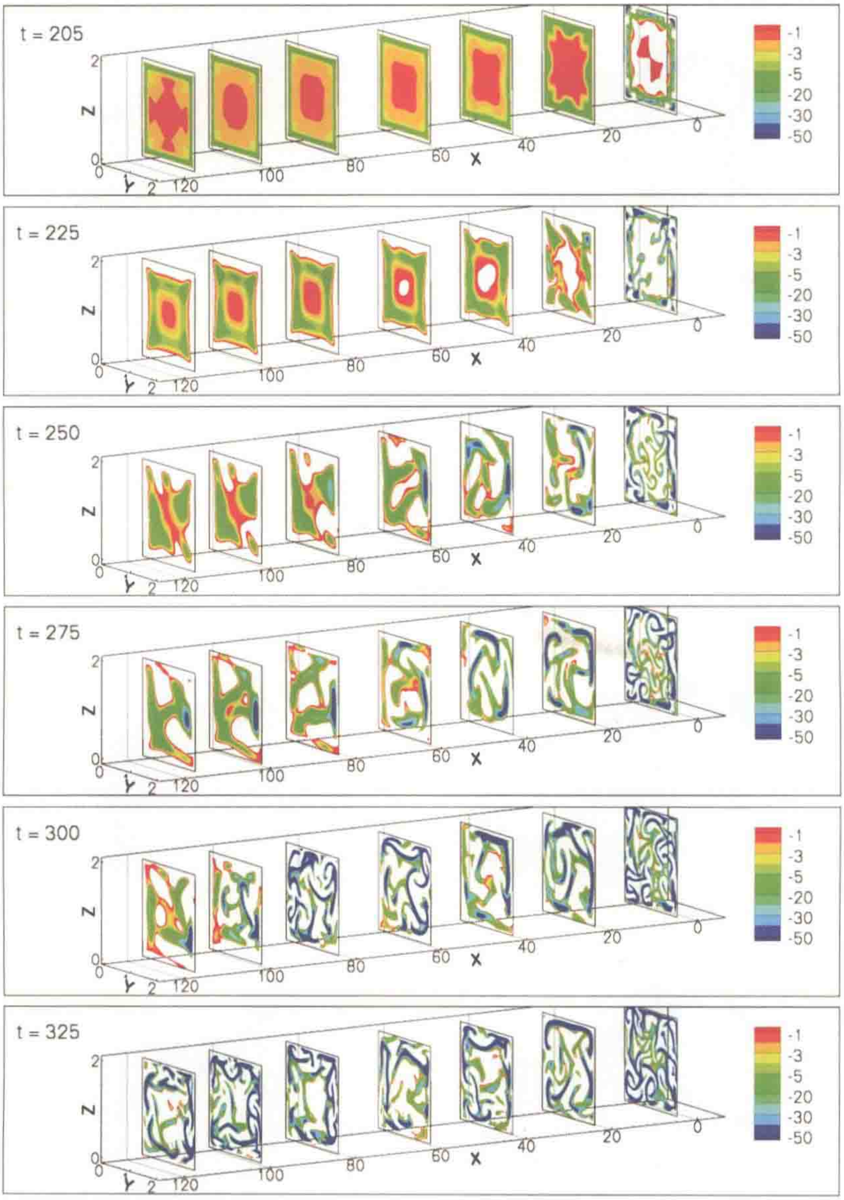

Fig. 6. (From paper 10) Disturbance energy (E_d) contours at different planes and indicated times.

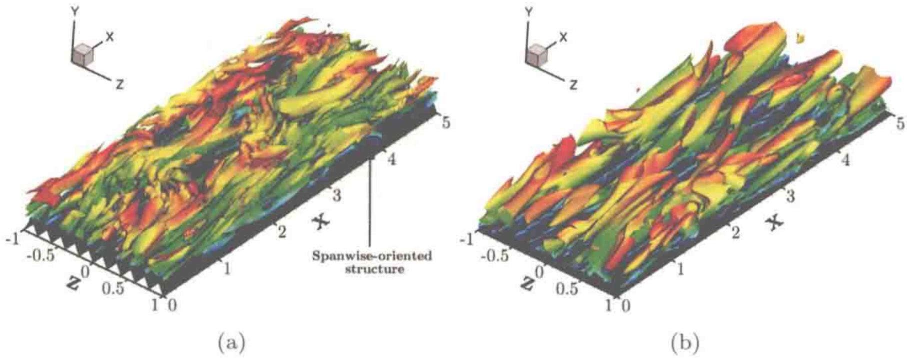

Fig. 7. (Figure 4 of paper 13) Near-wall vortical structures deduced using the Q-criterion, where Q is measured in wall units: (a) V-groove riblets, and (b) Thin blade riblets. The arrow in Fig. 4(a) points out one of the spanwise-oriented structures responsible for causing the flow reversal at the corresponding location depicted in Fig. 3(a).

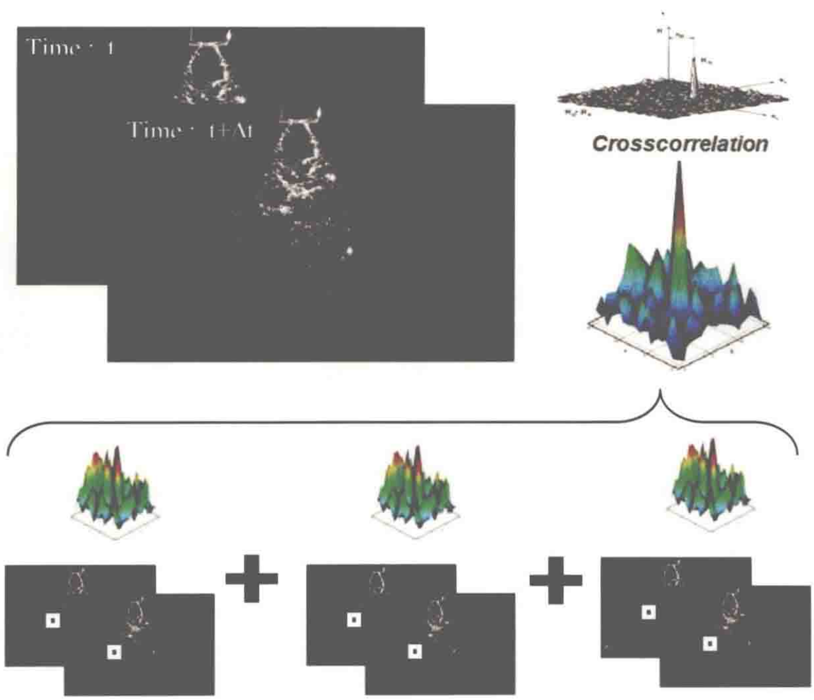

Fig. 8. (Figure 5 of paper 21) Ensemble correlation technique for PIV.

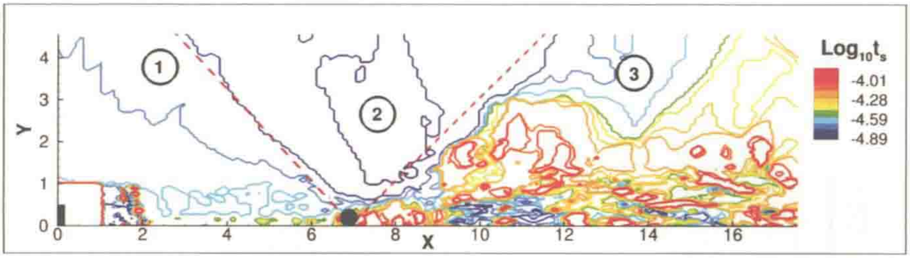

Fig. 9. (Figure 9 of paper 36) Integral timescale of the perturbation boost field for Case A obtained from the autocorrelation of pressure perturbation boost. The dot indicates the source location. The dashed lines demarcate three major timescale regions in the nearfield as identified by the circled numbers.

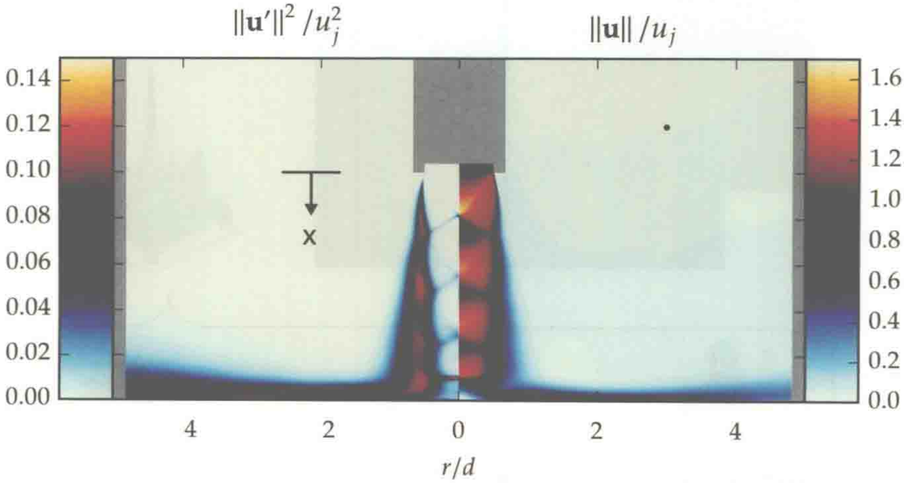

Fig. 10. (Figure 3 of paper 38) Mean of the velocity magnitude (right half) and mean square of the velocity fluctuation (left half).

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