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Direct numerical simulations of turbulent flow in a conical diffuser. (English) Zbl 1273.76207

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Summary: Direct numerical simulations (DNS) were carried out to investigate the turbulence statistics and coherent structures in a fluid flow through a conical diffuser, called an Azad diffuser, for three opening angles of 2°, 4°, and 8°. The adverse pressure gradient affected the axisymmetric flow such that the streamwise component of the turbulence intensity was significantly increased in the outer region of the diffuser. The maximum Reynolds shear stress increased as the opening angle increased. The premultiplied energy spectra showed that the most energetic wall-normal height and its wavelength increased when the opening angle increased. Time-resolved instantaneous flow fields and two-point correlation functions provided evidence for the streamwise merging of low-speed streaking structures. The outer vortical structures shifted toward the diffuser axis as the flow passed the diffuser throat. The swirling motions of the individual hairpins in the outer region were stronger in the diffuser flow than in the straight pipe flow.

MSC:

76F65 Direct numerical and large eddy simulation of turbulence

Keywords:

conical diffuser; direct numerical simulation; turbulent structure; adverse pressure gradient

Full Text: DOI

References:

[1] DOI: 10.1007/s10494-007-9091-5 · Zbl 1258.76104 · doi:10.1007/s10494-007-9091-5
[2] DOI: 10.1146/annurev.fl.23.010191.003125 · doi:10.1146/annurev.fl.23.010191.003125
[3] DOI: 10.1017/S0022112073001369 · doi:10.1017/S0022112073001369
[4] DOI: 10.1007/BF00266297 · doi:10.1007/BF00266297
[5] DOI: 10.1063/1.857425 · Zbl 1222.76001 · doi:10.1063/1.857425
[6] DOI: 10.1016/S0894-1777(96)00091-X · doi:10.1016/S0894-1777(96)00091-X
[7] DOI: 10.2514/3.10144 · doi:10.2514/3.10144
[8] DOI: 10.1007/BF02487158 · doi:10.1007/BF02487158
[9] DOI: 10.1007/s11771-008-0342-y · doi:10.1007/s11771-008-0342-y
[10] DOI: 10.1016/0045-7930(91)90060-U · doi:10.1016/0045-7930(91)90060-U
[11] Gatski T. B., J. Fluid Mech. pp 254, 59– (1993)
[12] Obi, S., Aoki, K. and Masuda, S. Proceedings of the Ninth Symposium on Turbulent Shear Flows, Kyoto, Japan.Experimental and computational study of turbulent separating flow in an asymmetric plane diffuser,
[13] DOI: 10.1017/S0022112099005054 · Zbl 0983.76042 · doi:10.1017/S0022112099005054
[14] DOI: 10.1017/S0022112005008116 · Zbl 1222.76062 · doi:10.1017/S0022112005008116
[15] DOI: 10.1017/S0022112009007940 · Zbl 1183.76054 · doi:10.1017/S0022112009007940
[16] DOI: 10.1017/S0022112009007423 · Zbl 1183.76036 · doi:10.1017/S0022112009007423
[17] DOI: 10.1017/jfm.2011.361 · Zbl 1241.76255 · doi:10.1017/jfm.2011.361
[18] DOI: 10.1017/S0022112093002575 · Zbl 0800.76296 · doi:10.1017/S0022112093002575
[19] DOI: 10.1006/jcph.1995.1078 · Zbl 0823.65120 · doi:10.1006/jcph.1995.1078
[20] Akselvoll K., Large eddy simulation of turbulent confined coannular jets and turbulent flow over a backward facing step (1995)
[21] DOI: 10.1017/S0022112095001984 · doi:10.1017/S0022112095001984
[22] DOI: 10.1063/1.869451 · doi:10.1063/1.869451
[23] DOI: 10.1016/0894-1777(94)00083-K · doi:10.1016/0894-1777(94)00083-K

[24] DOI: 10.1002/fld.1650150402 · doi:10.1002/fld.1650150402

[25] DOI: 10.1023/A:1009934906108 · Zbl 0949.76044 · doi:10.1023/A:1009934906108

[26] DOI: 10.1016/j.ijheatfluidflow.2008.01.016 · doi:10.1016/j.ijheatfluidflow.2008.01.016

[27] DOI: 10.1017/S0022112009990814 · Zbl 1183.76767 · doi:10.1017/S0022112009990814

[28] Clauser F. H., AIAA J. 21 pp 91– (1954)

[29] DOI: 10.1063/1.2991433 · Zbl 1182.76112 · doi:10.1063/1.2991433

[30] DOI: 10.1016/0020-7225(83)90104-0 · Zbl 0512.76035 · doi:10.1016/0020-7225(83)90104-0

[31] DOI: 10.1115/1.2903754 · doi:10.1115/1.2903754

[32] DOI: 10.1016/S0142-727X(98)10013-9 · doi:10.1016/S0142-727X(98)10013-9

[33] DOI: 10.1080/14685248.2010.496786 · doi:10.1080/14685248.2010.496786

[34] DOI: 10.1017/S0022112094004489 · doi:10.1017/S0022112094004489

[35] DOI: 10.1017/S0022112002002173 · Zbl 1026.76029 · doi:10.1017/S0022112002002173

[36] DOI: 10.1016/j.ijheatfluidflow.2009.06.007 · doi:10.1016/j.ijheatfluidflow.2009.06.007

[37] DOI: 10.1017/S0022112003005251 · Zbl 1063.76514 · doi:10.1017/S0022112003005251

[38] DOI: 10.1063/1.2717527 · Zbl 1146.76307 · doi:10.1063/1.2717527

[39] DOI: 10.1017/S002211209900467X · Zbl 0946.76030 · doi:10.1017/S002211209900467X

[40] DOI: 10.1017/S0022112001003512 · Zbl 1008.76029 · doi:10.1017/S0022112001003512

[41] DOI: 10.2514/3.61241 · doi:10.2514/3.61241

[42] Moin, P., Adrian, R. J. and Kim, J. Proceedings of the Sixth Turbulent Shear Flow Symposium, Toulouse, France.Stochastic estimation of organized structures in turbulent channel flow,