

# Bibliography

- Ahmed, S. (1998a). An isothermal experimental investigation of turbulence transport through an abrupt axisymmetric expansion. *Experimental Thermal and Fluid Science*, 17:256–264.
- Ahmed, S. (1998b). Velocity measurements and turbulence statistics of a confined isothermal swirling flow. *Experimental thermal and fluid science*, 17:256–264.
- Armfield, S. and Fletcher, C. (1989). Comparison of  $k-\epsilon$  and algebraic reynolds stress models for swirling diffuser flow. *International Journal for Numerical Methods in Fluids*, 9:987–1009.
- Batchelor, G. and Gill, A. (1962). Analysis of the stability of axisymmetric jets. *Journal of Fluid Mechanics*, 14:529–551.
- Beale, J. and Majda, A. (1982). Vortex methods I: Convergence in three dimensions. *Mathematics of Computation*, 39:1–27.
- Bechert, D. (1980). Sound absorption caused by vorticity shedding, demonstrated with a jet flow. *Journal of Sound and Vibration*, 70(3):389–405.
- Bechert, D., Michel, U., and Pfizenmaier, E. (1977). Experiments on the transmission of sound through jets. *AIAA paper 77-1278*.
- Bender, C. and Orszag, S. (1978). *Advanced Mathematical Methods for Scientists and Engineers*. McGraw-Hill.
- Benjamin, T. (1962). Theory of the vortex breakdown phenomenon. *Journal of Fluid Mechanics*, 14(4):593–629.

- Biswas, D., Kawano, K., Iwasaki, H., Ishizuka, M., and Yamanaka, S. (1997). Three-dimensional computation of gas turbine combustors and the validation studies of turbulence and combustion models. *Proceedings of the IGTI 97-GT-362*.
- Butler, K. and Farrell, B. (1992). Three-dimensional optimal perturbations in viscous shear flow. *Physics of Fluids A*, 4(8):1637–1650.
- Cargill, A. (1982). Low-frequency sound radiation and generation due to the interaction of unsteady flow with a jet pipe. *Journal of Fluid Mechanics*, 121:59–105.
- Caruana, D., Despre, C., Mignosi, A., Correge, M., and LePourhiet, A. (2001). Buffet and buffeting active control with a flap actuator. *ICIASF Record, International Congress on Instrumentation in Aerospace Simulation Facilities*, pages 386–396.
- Cassidy, J. and Falvey, H. (1970). Observations of unsteady flow arising after vortex breakdown. *Journal of Fluid Mechanics*, 41(4):727–736.
- Chao, Y., Leu, J., and Hung, Y. (1991). Downstream boundary effects on the spectral characteristics of a swirling flowfield. *Experiments in Fluids*, 10:341–348.
- Chen, J. and Lin, C. (1999). Computations of strongly swirling flows with second-moment closures. *International Journal for Numerical Methods in Fluids*, 30:493–508.
- Chen, K. and Crighton, D. (1999). Large-scale instability of a fine-grained turbulent jet. *European Journal of Mechanics B/ Fluids*, 18(1):13–34.
- Chomaz, J., Huerre, P., and Redekopp, L. (1988). Bifurcations to local and global modes in spatially developing flows. *Physical Review Letters*, 60(1):25–28.
- Chung, J. and Blaser, D. (1980). Transfer function method for measuring in-duct acoustic properties. i. theory. *Journal of the Acoustical Society of America*, 68(3):907–913.

- Cohen, J. and Wygnanski, I. (1987b). The evolution of instabilities in the axisymmetric jet. part 1. the linear growth of disturbances near the nozzle. *Journal of Fluid Mechanics*, 176:191–219.
- Cohen, J. and Wygnanski, I. (1987a). The evolution of instabilities in the axisymmetric jet. part 2. the flow resulting from the interaction between two waves. *Journal of Fluid Mechanics*, 176:221–235.
- Coller, B. (2000). Vortex model for control of diffuser pressure recovery. *Proceedings of the 39th IEEE Conference on Decision and Control*, 2:1730–1735.
- Cooper, A. and Crighton, D. (2000). Global modes and superdirective acoustic radiation in low-speed axisymmetric jets. *European Journal of Mechanics /B Fluids*, 19:559–574.
- Cossu, C. and Chomaz, J. (1997). Global measures of local convective instabilities. *Physical Review Letters*, 78(23):4387–4390.
- Crighton, D. (1981). Acoustics as a branch of fluid mechanics. *Journal of Fluid Mechanics*, 106:261–298.
- Crighton, D. (1985). Kutta condition in unsteady flow. *Annual Review of Fluid Mechanics*, 17:411–445.
- Crighton, D. and Gaster, M. (1976). Stability of slowly diverging jet flow. *Journal of Fluid Mechanics*, 77(2):397–413.
- Crocker, D., Smith, C., and Myers, G. (1994). Pattern factor reduction in a reverse flow gas turbine combustor using angled dilution jets. *Proceedings of the IGTI 94-GT-406*.
- Crocker, M. and Waser, M. (1984). Introduction to the two-microphone cross-spectral method of determining sound intensity. *Noise Control Engineering*, 22(3):76–85.

- Dellenback, P., Metzger, D., and Neitzel, G. (1988). Measurements in turbulent swirling flow through an abrupt axisymmetric expansion. *AIAA Journal*, 26(6):669–681.
- Döbbeling, K. (1990). *Experimentelle und Theoretische Untersuchungen an Stark Verdrallten, Turbulenten Isothermen Strömungen*. PhD thesis, Universität Karlsruhe.
- Donohue, G., McLaughlin, D., and Tiederman, W. (1972). Turbulence measurements with a laser anemometer measuring individual realizations. *The physics of fluids*, 15(11):1920–1926.
- Froud, D., O’Doherty, T., and Syred, N. (1995). Phase averaging of the precessing vortex core in a swirl burner under piloted and premixed combustion conditions. *Combustion and Flame*, 100:407–412.
- GaGe (1999). *CompuScope 2125: Hardware Manual and Installation Guide*. GaGe. P/N 0045051.
- Garg, A. and Leibovich, S. (1979). Spectral characteristics of vortex breakdown flowfields. *Physics of Fluids*, 22(11):2053–2064.
- Gaster, M. (1962). A note on the relation between temporally increasing and spatially increasing disturbances in hydrodynamic stability. *Journal of Fluid Mechanics*, 14:222–224.
- Gaster, M., Kit, E., and Wygnanski, I. (1985). Large-scale structures in a forced turbulent mixing layer. *Journal of Fluid Mechanics*, 150:23–39.
- Gaster, M. and Roberts, J. (1977). The spectral analysis of randomly sampled records by a direct transform. *Proceedings of the Royal Society London A*, 354:27–58.
- Gharakhani, A. and Ghoniem, A. (1996). 3D vortex simulation of intake flow in an off-centered port and cylinder with a moving piston. *ASME Fluids Engineering Division Conference*, 238(3):13–24.

- Gillies, E. (1998). Low-dimensional control of the circular cylinder wake. *Journal of Fluid Mechanics*, 371:157–178.
- Goebel, S., Abuaf, N., Lovett, J., and Lee, C. (1993). Measurements of combustor velocity and turbulence profiles. *Proceedings of the IGTI 93-GT-228*.
- Gouldin, F., Depsky, J., and Lee, S.-L. (1985). Velocity field characteristics of a swirling flow combustor. *AIAA Journal*, pages 95–102.
- Gouldin, F., Halthore, R., and Vu, B. (1984). Periodic oscillations observed in swirling flows with and without combustion. *Twentieth Symposium (International) on Combustion*, pages 269–276.
- Gupta, A., Lilley, D., and Syred, N. (1984). *Swirl Flows*. Abacus Press.
- Gustavsson, L. (1991). Energy growth of three-dimensional disturbances in plane poiseuille flow. *Journal of Fluid Mechanics*, 224:241–260.
- Gutmark, E., Schadow, K., Sivasegaram, S., and Whitelaw, J. (1991). Interaction between fluid-mechanic and acoustic instabilities in combusting flows within ducts. *Combustion Science and Technology*, 79:161–166.
- Hald, O. (1979). The convergence of vortex methods, II. *SIAM Journal of Numerical Analysis*, 16:726–755.
- Hannemann, K. and Oertel, H. (1989). Numerical simulation of the absolutely and convectively unstable wake. *Journal of Fluid Mechanics*, 199:55–88.
- Harvey, J. (1962). Some observations of the vortex breakdown phenomenon. *Journal of Fluid Mechanics*, 14(4):585–594.
- Hassa, C., Voigt, P., Lehmann, B., Schodl, R., and Carl, M. (2002). Flow field mixing characteristics of an aero-engine combustor - part I: Experimental results. *AIAA Paper 2002-3709*.

- Holzäpfel, F., Lenze, B., and Leuckel, W. (1996). Swirl-induced intermittence: A novel effect modifying the turbulence structure of swirling free jets. *Twenty-sixth Symposium (International) on Combustion*, pages 187–194.
- Howe, M. and Liu, J. (1977). The generation of sound by vorticity waves in swirling duct flows. *Journal of Fluid Mechanics*, 81(2):369–383.
- Hsu, K.-Y., Goss, L., and Roquemore, W. (1998). Characteristics of a trapped vortex combustor. *Journal of Propulsion and Power*, 14(1):57–65.
- Huang, S., Brown, E., and Mutter, T. (1994). A phenomenological study of jet mixing: Insights from linear stability analysis. *AIAA Paper 94-0704*.
- Huerre, P. and Monkewitz, P. (1985). Absolute and convective instabilities in free shear layers. *Journal of Fluid Mechanics*, 159:151–168.
- Huerre, P. and Monkewitz, P. (1990). Local and global instabilities in spatially developing flows. *Annual Review of Fluid Mechanics*, 22:473–537.
- Hunt, R. and Crighton, D. (1991). Instability of flows in spatially developing media. *Proceedings of the Royal Society London B*, 435(1893):109–128.
- Hussain, A. and Reynolds, W. (1972). The mechanics of an organized wave in turbulent shear flow. part 2. experimental results. *Journal of Fluid Mechanics*, 54:241.
- Hussain, A. and Reynolds, W. (1970). The mechanics of an organized wave in turbulent shear flow. *Journal of Fluid Mechanics*, 41:291.
- Jackson, C. (1987). A finite-element study of the onset of vortex shedding in flow past variously shaped bodies. *Journal of Fluid Mechanics*, 182:23–45.
- Katta, V. and Roquemore, W. (1998). Study on trapped-vortex combustor - effect of injection on flow dynamics. *Journal of Propulsion and Power*, 14(3):273–281.
- Kelkar, K. and Patankar, S. (1992). Numerical prediction of vortex shedding behind a square cylinder. *International Journal for numerical methods in fluids*, 14:327–341.

- Keller, J., Egli, W., and Althaus, R. (1988). Vortex breakdown as a fundamental element of vortex dynamics. *Journal of Applied Mathematics and Physics*, 39:404–439.
- Keller, J., Egli, W., and Exley, J. (1985). Force- and loss-free transitions between flow states. *Journal of Applied Mathematics and Physics (ZAMP)*, 36:854–889.
- Khorrami, M. (1991). On the viscous modes of instability of a trailing line vortex. *Journal of Fluid Mechanics*, 225:197–212.
- Khorrami, M. (1995). Stability of a compressible axisymmetric swirling jet. *AIAA Journal*, 33(4):650–658.
- Khorrami, M. and Malik, M. (1989). Application of spectral collocation techniques to the stability of swirling flows. *Journal of Computational Physics*, 81(1):206–229.
- Kihm, K., Chigier, N., and Sun, F. (1989). Laser doppler velocimetry investigation of swirler flowfields. *Journal of Propulsion*, 6(4):364–374.
- Kim, I. and Pearlstein, A. (1990). Stability of the flow past a sphere. *Journal of Fluid Mechanics*, 211:73–93.
- Kinsler, L., Frey, A., Coppens, A., and Sanders, J. (1999). *Fundamentals of Acoustics*. John Wiley & Sons, 4th edition.
- Koch, W. (1985). Local instability characteristics and frequency determination of self-excited wake flows. *Journal of Sound and Vibration*, 99:53–83.
- Kribus, A. and Leibovich, S. (1994). Instability of strongly nonlinear waves in vortex flows. *Journal of Fluid Mechanics*, 269:247–264.
- Lee, W. and Taghavi, R. (1996). Excitation of helical instabilities in swirling jets by a novel mechanical device. *ASME Fluids Engineering Division*, 237(2):529–533.
- Legner, H. and Finson, M. (1980). On the stability of fine-scaled turbulent free shear flows. *Journal of Fluid Mechanics*, 100(2):303–319.

- Lehmann, B., Hassa, C., and Helbig, J. (1997). Three-component laser doppler measurements of the confined model flow behind a swirl nozzle. *Developments in Laser Techniques and Fluid Mechanics*, pages 383–398.
- Leibovich, S. and Kribus, A. (1990). Large amplitude wavetrains and solitary waves in vortices. *Journal of Fluid Mechanics*, 216:459–504.
- Leibovich, S. and Stewartson, K. (1983). A sufficient condition for the instability of columnar vortices. *Journal of Fluid Mechanics*, 126:335–356.
- Leschziner, M. and Rodi, W. (1984). Computation of strongly swirling axisymmetric free jets. *AIAA Journal*, 22(12):1742–1747.
- Lessen, M. and Paillet, F. (1974). Stability of a trailing line vortex - 2: Viscous theory. *Journal of Fluid Mechanics*, 65(4):769–779.
- Lessen, M., Sadler, S., and Liu, T.-Y. (1968). Stability of pipe poiseuille flow. *The Physics of Fluids*, 11(7):1404–1409.
- Lessen, M. and Singh, P. (1973). The stability of axisymmetric free shear layers. *Journal of Fluid Mechanics*, 60(3):433–457.
- Lessen, M., Singh, P., and Paillet, F. (1974). Stability of a trailing line vortex - 1: Inviscid theory. *Journal of Fluid Mechanics*, 63(4):753–763.
- Loiseleux, T., Chomaz, J., and Huerre, P. (1998). The effect of swirl on jets and wakes: Linear instability of the rankine vortex with axial flow. *Physics of Fluids*, 10(5):1120–1134.
- Loiseleux, T. and Delbende, I. (2000). Absolute and convective instabilities of a swirling jet / wake shear layer. *Physics of Fluids*, 12(2):375–380.
- Lomb, N. (1976). *Astrophysics and Space Science*, 39:447–462.
- Marasli, B., Champagne, F., and Wygnanski, I. (1989). Modal decomposition of velocity signals in a plane, turbulent wake. *Journal of Fluid Mechanics*, 198:255–273.



- Marple, L. S. J. (1987). *Digital Spectral Analysis*. Prentice-Hall Inc.
- MATLAB (1999). *Mathworks, Inc.*, 5.3 (r11) edition.
- Matovic, D. and Tropea, C. (1991). An adaptive spectral peak interpolation with application to LDA signal processing. *Laser Anemometry*, 2:653–663.
- Mayer, E. and Powell, K. (1992). Viscous and inviscid instabilities of a trailing vortex. *Journal of fluid mechanics*, 245:91–114.
- Michalke, A. (1965). Vortex formation in a free boundary layer according to stability theory. *Journal of Fluid Mechanics*, 22(2):371–383.
- Michalke, A. (1971). Instabilität eines kompressiblen runden Freistrahls unter Berücksichtigung des Einflusses der Strahlgrenzschichtdicke. *Zeitschrift für Flugwissenschaft*, 19:319–328. (English translation: NASA Technical Memorandum 75190 - 1977).
- Michalke, A. (1999). Absolute inviscid instability of a ring jet with back-flow and swirl. *European Journal Mechanics B: Fluids*, 18(1):3–12.
- Monkewitz, P. (1988). A note on vortex shedding from axisymmetric bluff bodies. *Journal of Fluid Mechanics*, 192:561–575.
- Monkewitz, P. (1989). Feedback control of global oscillations in fluid systems. *AIAA 89-0991*.
- Monkewitz, P. (1990). The role of absolute and convective instability in predicting the behaviour of fluid systems. *European Journal of Mechanics B: Fluids*, 9(5):395–413.
- Monkewitz, P. and Nguyen, L. (1987). Absolute instability in the near-wake of two-dimensional bluff bodies. *Journal of Fluids and Structures*, 1:165–184.
- Monkewitz, P. and Sohn, K. (1986). Absolute instability in hot jets and their control. *AIAA 86-1882*.

- Moore, C. (1977). The role of shear-layer instability waves in jet exhaust noise. *Journal of Fluid Mechanics*, 80(2):321–367.
- Morris, P. (1976). The spatial viscous instability of axisymmetric jets. *Journal of Fluid Mechanics*, 77(3):511–529.
- Munt, R. (1990). Acoustic transmission properties of a jet pipe with subsonic jet flow: I. the cold jet reflection coefficient. *Journal of Sound and Vibration*, 142(3):413–436.
- Nachtsheim, P. (1964). An initial value method for the numerical treatment of the orr-sommerfeld equation for the case of plane poiseuille flow. *Nasa TN D-2414*.
- Noack, B., Mezic, I., and Banaszuk, A. (2000). Controlling vortex motion and chaotic advection. *Proceedings of 39th IEEE Conference on Decision and Control*, 2:1716–1723.
- Orszag, S. (1971). Accurate solution of the orr-sommerfeld stability equation. *Journal of Fluid Mechanics*, 50:689.
- Panda, J. and McLaughlin, D. (1994). Experiments on the instabilities of a swirling jet. *Physics of Fluids*, 6(1):263–276.
- Panton, R. (1984). *Incompressible Flow*. John Wiley & Sons.
- Parekh, D., Kibens, V., Glezer, A., Wiltse, J., and Smith, D. (1996). Innovative jet flow control: Mixing enhancement experiments. *AIAA Paper 96-0308*.
- Paschereit, C. and Gutmark, E. (1998). Structure and control of thermoacoustic instabilities in a gas-turbine combustor. *Combustion Science and Technology*, 138:213–232.
- Paschereit, C., Gutmark, E., and Weisenstein, W. (1999). Coherent structures in swirling flows and their role in acoustic combustion control. *Physics of Fluids*, 11(9):2667–2678.
- Pierrehumbert, R. (1984). Local and global baroclinic instability of zonally varying flow. *Journal of atmospheric sciences*, 41:2141–2162.

- Plaschko, P. (1979). Helical instabilities of slowly divergent jets. *Journal of Fluid Mechanics*, 92(2):209–215.
- Pope, S. (2001). *Turbulent Flows*. Cambridge University Press, 1st edition.
- Press, W. and Rybicki, G. (1989). Fast algorithm for spectral analysis of unevenly sampled data. *The Astrophysical Journal*, 338:277–280.
- Press, W., Teukolsky, S., Vetterling, W., and Flannery, B. (1992). *Numerical Recipes in C - The Art of Scientific Computing*. Cambridge Univeristy Press, second edition.
- Ragab, S. and Wu, J. (1989). Linear instability waves in supersonic turbulent mixing layers. *AIAA Journal*, 27(6):677–686.
- Rediniotis, O., Ko, J., and Yue, X. (1999). Synthetic jets, their reduced order modeling and applications to flow control. *AIAA Paper 99-1000*.
- Reynolds, W. and Hussain, A. (1972). The mechanics of an organized wave in turbulent shear flow. part 3. theoretical models and comparisons with experiments. *Journal of Fluid Mechanics*, 54:263.
- Roberts, J., Downie, J., and Gaster, M. (1980). Spectral analysis of signals from a laser doppler anemometer operating in burst mode. *Journal of Physics E: Scientific Instrumentation*, 13:977–981.
- Roberts, J. and Gaster, M. (1980). On the estimation of spectra from randomly sampled signals: A method for reducing variability. *Proceedings of the Royal Society London A*, 371:235–258.
- Rusak, Z. and Judd, K. (2001). The stability of non-columnar swirling flows in diverging stream tubes. *Physics of Fluids*, 13(10):2835–2844.
- Rusak, Z., Judd, K., and Wang, S. (1997). The effect of small pipe divergence on near critical swirling flows. *Physics of Fluids*, 9(8):2273–2285.
- Rusak, Z., Wang, S., and Whiting, C. (1998). The evolution of a perturbed vortex in a pipe to axisymmetric vortex breakdown. *Journal of Fluid Mechanics*, 366:211–237.

- Saffman, P. and Schatzman, J. (1982). An inviscid model for the vortex-street wake. *Journal of Fluid Mechanics*, 122:467–486.
- Sarpkaya, T. (1971). On stationary and travelling vortex breakdowns. *Journal of Fluid Mechanics*, 45(3):545–559.
- Sattelmayer, T., Flechlin, M., Haumann, J., Hellat, J., and Styner, D. (1990). Second-generation low-emission combustors for ABB gas turbines: Burner development and tests at atmospheric pressure. *Journal of Engineering for Gas Turbines and Power*, 114:118–125.
- Sherman, F. (1990). *Viscous Flow*. McGraw-Hill.
- Shozo, K., Gutmark, E., Schadow, K., and Tubis, A. (1989). Initial development of noncircular jets leading to axis switching. *AIAA Journal*, 27(4):411–419.
- Shtern, V., Hussain, F., and Herrada, M. (2000). New features of swirling jets. *Physics of Fluids*, 12(11):2868–2877.
- Smith, B. and Glezer, A. (1998). The formation and evolution of synthetic jets. *Physics of fluids*, 10(9):2281–2297.
- Spall, R. (1993). Linear stability of swirling flows computed as solutions to the quasi-cylindrical equations of motion. *International Journal for Numerical Methods in Fluids*, 17(4):291–300.
- Spectraphysics, I. (1984). *Spectaphysics 2020 Series Argon Ion Laser System Manual*.
- Stewartson, K. and Stuart, J. (1971). A non-linear instability theory for a wave system in plane poiseuille flow. *Journal of Fluid Mechanics*, 48(3):529–545.
- Stone, C. and Menon, S. (2001). Combustion instabilities in swirling flows. *AIAA Paper 2001-3846*.
- Strahle, W., Muthukrishnan, M., and Neale, D. (1977). Experimental and analytical separation of hydrodynamic, entropy and direct combustion noise in a gas turbine combustor. *AIAA Paper 77-1275*, pages 1–10.

- Tao, J., Huang, X., and Chan, W. (1996). A flow visualization study on feedback control of vortex shedding from a circular cylinder. *Journal of Fluids and Structures*, 10:965–970.
- Trefethen, L. (1992). *Numerical Analysis 1991*, chapter Pseudospectra of matrices, pages 234–266. Longman.
- Trefethen, L., Trefethen, A., Reddy, S., and Driscoll, T. (1993). Hydrodynamic stability without eigenvalues. *Science*, 261:578–584.
- Tropea, C. (1987). Turbulence-induced spectral bias in laser anemometry. *AIAA Journal*, 25(2):306–309.
- Vandsburger, U. and Ding, C. (1993). A self-excited wire method for control of the evolution of a turbulent mixing layer. *AIAA paper 93-0443*.
- Vandsburger, U. and Ding, C. (1995). The spatial modulation of a forced triangular jet. *Experiments in Fluids*, 18:239–248.
- Wang, S. and Rusak, Z. (1996a). On the stability of an axisymmetric rotating flow in a pipe. *Physics of Fluids*, 8(4):1007–1016.
- Wang, S. and Rusak, Z. (1996b). On the stability of non-columnar swirling flows. *Physics of Fluids*, 8(4):1017–1023.
- Wang, S. and Rusak, Z. (1997). The dynamics of a swirling flow in a pipe and transition to axisymmetric vortex breakdown. *Journal of Fluid Mechanics*, 340:177–223.
- White, F. (1994). *Fluid Mechanics*. McGraw-Hill, Inc., 3rd edition.
- Wynanski, I. and Petersen, R. (1987). Coherent motion in excited free shear flows. *AIAA Journal*, 25(2):201–213.
- Zebib, A. (1987). Stability of viscous flow past a circular cylinder. *Journal of Engineering Mathematics*, 21:155–165.