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1. Qualifications and Background

Dr. Thomas C. Corke is the Clark Chair Professor of Engineering in the Aerospace and Mechanical Engineering Department at the University of Notre Dame. He is the Founding Director of the Notre Dame Center for Flow Physics and Control (FlowPAC), and the Director of the Notre Dame Hessert Laboratory for Aerospace Research. FlowPAC involves 22 faculty in the College of Engineering at Notre Dame. It performs basic research for most branches of the DoD including the Air Force, Army, Navy and DARPA, for NASA at Langley and Glenn Research Centers, and for the Department of Energy. In addition, it has research involving 24 companies, five of which are small businesses. This includes the three major U.S. jet engine manufacturers (G.E.-Aviation, P&W, and Honeywell), the major U.S. commercial airframe manufacturer (Boeing), three of the major military airframe manufacturers (Boeing, Northrop-Grumman and Bell Helicopter-Textron), the largest U.S. manufacturer of wind turbines (G.E.-Energy), three of the major world automobile manufacturers (G.M., Chrysler, and Honda), and one of the major scientific sensor manufacturers (Teledyne). Through Dr. Corke's leadership, FlowPAC has built its research budget to an average annual amount of $10M. FlowPAC is designated as a G.E.-Aviation "University Strategic Alliance" (USA) member, a "Master Agreement Member" with Honeywell, and one of two university groups in the U.S. designated to be a "Research and Development Group" with Boeing. Through its research, FlowPAC supports 75 Ph.D. students, the majority of which are majoring in Aerospace Engineering. It maintains a large number of facilities including newly developed transonic compressor and turbine facilities, and a Mach 0.6 wind tunnel with a 1 m-square test section. These facilities were developed to bridge the gap between standard university facilities and "flight conditions" in order to more effectively transition its research to application. Dr. Corke was instrumental in designing all three facilities. Over the past few years, FlowPAC has averaged five patents per year that stem from research involving its industry partners. He is an Associate Fellow of AIAA, and a Fellow of ASME and of APS. He was the recipient of the University of Notre Dame's 2007 "President's Research Achievement Award", and the 2009 "R.T. Davis Memorial Lecture Award" from the University of Cincinnati.

Dr. Corke joined the University of Notre Dame in 1999. Previously he was on the faculty in the Mechanical and Aerospace Engineering Department at the Illinois Institute of Technology since 1983. At IIT he was a member of the Fluid Dynamic Research Center, and an instrumental part of that groups 5-year DoD Center of Excellence designation. He was the principle designer of the National Diagnostic Facility Wind Tunnel at IIT that has become one of the major low-disturbance high-speed wind tunnels in the U.S.

His research experience is unusually diverse. It ranges from hydrodynamic stability and transition to turbulence, to fully turbulent flows. It involves an equally diverse range of flow fields including boundary layers, wakes, and jets. This has been applied to an exceedingly broad range of applications including aerodynamic performance enhancement, flight control,

the internal flow of gas-turbine engines, acoustic noise control, and wind flows around buildings and structures. He has extensive experimental experience over the full range of Mach numbers from incompressible to hypersonic. His research also includes computational fluid dynamics especially with regard to acoustic receptivity, and in support of his pioneering research on Dielectric Barrier Discharge (DBD) plasma actuators. His research has made him a highly sought speaker for specialist conferences and by industry.

Dr. Corke has been a highly respected teacher for more than 25 years. His activities involving experiments and new facility development have given him a special interest in the methodology of engineering design. He applied this interest in a text book published in 2002 by Prentice-Hall Publishers on the "Design of Aircraft." The book stresses the need to examine the sensitivity to design decisions, with an eye towards optimization. The book is unique in that it includes a series of spread sheets that provide students with immediate feed-back of performance outcomes produced by their design choices. This allows an efficient framework where students can examine a large design space and learn the implications and connections of seemingly diverse elements of an aircraft design. The book has been very well received. It has been adopted by numerous Aerospace Engineering programs in the U.S. and abroad.

Throughout his career, Dr. Corke has developed a number of original experimental approaches that have come to be accepted as *"standard tools"* for experimentalists around the world. These include the "counter-jet technique" for developing thick turbulent boundary layers used in atmospheric boundary layer simulations in wind tunnels, the "smoke wire" now used as a standard method for low-speed flow visualization, the "Large-eddy Break-up Device" (LEBU) used to suppress large scale motions in turbulent boundary layers with the initial application of reducing viscous drag and a more recent application of boundary layer control for aero-optics, and the "Single-dielectric Barrier Discharge" (SDBD) plasma actuator for active flow control.

Dr. Corke was recognized for his development of LEBUs by a 1982 NASA Achievement Award "for outstanding research contributions in the area of turbulence control and viscous drag reduction." This was the first of two NASA awards. The second came in 1995 "for the development of important insights into basic fluid mechanics phenomena and theoretical analysis tools which have contributed to major advances in flow prediction and control including laminar flow control."

Dr. Corke has been working on SDBD plasma actuators for approximately 15 years, starting with its use to introduce disturbances in boundary layers in supersonic flows to study instabilities leading to turbulence transition. It has since grow into a device that has been adopted by a growing number of U.S. universities, government laboratories, and companies, as well as laboratories and companies around the world including Germany, France, England, Netherlands, Russia, Japan and China. A measure of the impact of the SDBD plasma actuators is evident from the recent 4th AIAA Flow Control Conference that included four dedicated sessions and 34 papers.

A new measurement technique developed by Dr. Corke, that is soon to be adopted worldwide, is the "plasma sensor." This is an outgrowth of his plasma actuator expertise that addressed the need for a mass-flux sensor that could withstand the harsh environment in hypersonic high-enthalpy flows, and have a frequency response of 1 MHz. A commercial

version of the sensor that met these requirements was developed with a small business and patented. Dr. Corke has extended this design for velocity measurements in low-speed flows, as well as a sensor suite to measure pressure, temperature, heat flux and gas concentrations. A version of this has been developed as a stall pre-cursor sensor in gas turbine engines in a collaboration with G.E.-Aviation. Bell Helicopter is collaborating with Dr. Corke on its use as a stall sensor on helicopter rotors.

In addition to the development of different experimental tools, Dr. Corke has made a number of ground breaking research contributions. These include the first experiments that validated the secondary instability prediction of spanwise wavenumber dependence of the subharmonic resonance mechanism in boundary layer transition, the first experimental verification of a triad resonance of cross-flow instability modes that was theoretically predicted to occur in 3-D boundary layers, the first experimental validation of a parametric resonance mechanism in the far wake of 2-D bodies, the first experimental observation of subharmonic oblique-wave interaction in supersonic boundary layers, and the first experimental validation of the role of the absolute instability of cross-flow modes in rotating disk boundary layers. All of these required unique approaches for introducing complex controlled disturbances.

Dr. Corke has made significant contributions to the engineering profession, through his involvement with AIAA, ASME and the Fluid Dynamics Division of the APS. He was a member of the ASME Applied Mechanics Division of the Fluid Mechanics Committee for 9 years, chairing the committee for the last 5 years of that term. With ASME he organized numerous technical sessions. Of particular note was a 1997 Symposium on "Fluid-Structure Interaction, Aeroelasticity, Flow Induced Vibration and Noise" that was published (ISBN-10: 0791818217) with Dr. Corke as a co-Editor. He has been a member of several organizing committees for international meetings including the 4th World Conference on Experimental Heat Transfer in Brussels in 1997, the 6th International Congress on Fluid Mechanics in Cairo in 1997, and the 11th International Symposium on Flow Visualization at Notre Dame in 2004. He also developed a NASA/ICASE short course on "Transition to Turbulence." The course notes were published by ICASE.

Dr. Corke has been a member of AIAA for more than 25 years. He was part of the organizing committee of the 1997 Summer Fluid Dynamics conference in Snowmass, CO. He has been a regular session organizer and chairman at the Aerospace Sciences Meetings, Theoretical Fluid Mechanics Meetings, Plasmadynamics and Laser Meetings and Flow Control Meetings.

In recognition of his long contributions to aerospace research and support of NASA, he was invited to be a member of the 2006 National Academy of Engineering Decadal Survey of Civil Aeronautics that developed a 10 year plan for the NASA Aeronautics. The 212 page report was published by the National Academy (ISBN-10: 0-309-10158-1). The 10 year plan was accepted by Congress in 2007.

2. Education Background

B.S.	1974	Illinois Institute of Technology (Magna cum Laude)
M.S.	1976	Illinois Institute of Technology
Ph.D.	1981	Illinois Institute of Technology

3. Professional Record

University of Notre Dame	2004 - Present	Director, Hessert Laboratory for Aerospace Research
University of Notre Dame	2002 - Present	Founding Director, Center for Flow Physics and Control
Aerospace and Mechanical Engineering Department University of Notre Dame	1999 - Present	Clark Chair Professor of Engineering
Mechanical and Aerospace Engineering Department Illinois Institute of Technology	1991 - 1999	Professor
Mechanical Engineering Department, Ohio State University	1991-1992	Visiting Professor
Dynaflow, Inc., Columbus OH		Visiting Scientist
Mechanical and Aerospace Engineering Department, Illinois Institute of Technology	1987 - 1991	Associate Professor
Mechanical and Aerospace Engineering Department, Illinois Institute of Technology	1983 - 1987	Assistant Professor
Mechanical and Aerospace Engineering Department, Illinois Institute of Technology	1982 - 1983	Visiting Assistant Professor
Mechanical and Aerospace Engineering Department, Illinois Institute of Technology	1979 - 1981	Instructor

Mechanical and Aerospace Engineering Department, Illinois Institute of Technology	1974 - 1979	Graduate Assistant
Sargent-Lundy Engineers	1973 (Summer)	Intern, Piping Systems Group

4. Honors and Awards

NASA Langley Research Center	1982	NASA Langley Achievement Award
Illinois Institute of Technology	1985	Milligan Award for Faculty Research
Illinois Institute of Technology	1986	Galvin Award for Faculty Research
International Aluminum Extrusion Design Competition	1988	1st Place Award
International Aluminum Extrusion Design Competition	1990	1st Place Award
NASA Langley Research Center	1995	NASA Langley Achievement Award
AIAA	1995	Associate Fellow
Illinois Institute of Technology	1998	Research Institute Fellow
Illinois Institute of Technology	1998	Educational and Research Initiative Fund Award
University of Notre Dame	1999	Clark Chair Professor of Engineering
University of Notre Dame	2002	Founding Director, Center for Flow Physics and Control
University of Notre Dame	2004	Director, Hessert Laboratory for Aerospace Research
ASME	2005	Fellow
APS	2006	Fellow
National Academy of Engineering	2006	Member, Decadal Survey of

		Civil Aeronautics
University of Notre Dame	2007	President's Research Achievement Award
University of Cincinnati	2009	R.T. Davis Memorial Lecture Award

5. Publications

5.1 Books:

"Transition to Turbulence - Experiment, Computation and Theory" ed. T. Corke, G. Erlebacher and M. Hussaini, ICASE Short Course, 1995.

"Fluid-Structure Interaction, Aeroelasticity, Flow Induced Vibration and Noise" ed. M. Paidoussis, A. Bajaj, T. Corke and T. Farabee, ASME Publishers, 1997.

"Design of Aircraft", Prentice-Hall Publishers, 2002.

"Proceedings of the 12th International Symposium on Flow Visualization", ed. T. Mueller, R. Nelson and T. Corke, 2004.

5.2 Published Articles:

Dr. Corke has over 230 publications. The following are some of the recent publications that express his contributions to Aerospace Engineering.

1. "Stationary-Traveling Cross-flow Mode Interactions on a Rotating Disk," with K. Knasiak, *J. Fluid Mech.*, 355, 285-315, 1998.
2. "Boundary Layer Receptivity to Freestream Sound on Parabolic Bodies," with O. Haddad, *J. Fluid Mech.*, 368 1-16 1998.
3. "Boundary Layer Receptivity to Free Stream Sound on Elliptic Leading Edges of Flat Plates," with J. Wanderley, *J. Fluid Mech.*, 429, 1-21, 2001.
4. "Boundary Layer Leading Edge Receptivity to Sound at Incidence Angles," with E. Erturk, *J. Fluid Mech.*, 444, 383-407, 2001.
5. "Boundary Layer Instability on Sharp Cone at Mach 3.5 with Controlled Input," with D. Cavalieri and E. Matlis, *AIAA J.*, 40, 5, 1015, 2002.
6. "Mechanisms and Responses of a Single Dielectric Barrier Plasma Actuator: Plasma Morphology," with C. L. Enloe, T. McLaughlin, R. VanDyken, K. Kachner and E. Jumper, *AIAA J.*, 42, 3, 589, 2004.

7. "Mechanisms and Responses of a Single Dielectric Barrier Plasma Actuator: Geometric Effects," with C. L. Enloe, T. McLaughlin, R. VanDyken, K. Kachner, E. Jumper, M. Post and O. Haddad. *AIAA J.*, 42, 3, 595, 2004.

8. "Separation Control On High Angle Of Attack Airfoil Using Plasma Actuators,", with M. Post, *AIAA J.*, 42, 11, p. 2177, 2004.

9. "Separation Control On High Angle Of Attack Airfoil Using Plasma Actuators, with M. Post, *AIAA J.*, **42**, 11, p. 2177, 2004

10. "Laminar Incompressible Flow Past Parabolic Bodies at Angles of Attack," with E. Erturk and O. Haddad, *AIAA J.*, **42**, 11, p. 2234, 2004.

11. "Acoustic Receptivity of Boundary Layer Over Parabolic Bodies at Angles of Attack," with O. Haddad and E. Erturk, *J. Fluid Mech.*, 536, 377-400, 2005.

12. "Experimental Investigation of Absolute Instability of a Rotating-Disk Boundary Layer," with H. Othman, *J. Fluid Mech.*, **565**, pp. 63-94, 2006.

13. "Plasma Actuators for Separation Control of Low Pressure Turbine Blades", with J. Huang and F. Thomas, *AIAA J.*, **44**, 1, pp. 51-58, 2006.

14. "Unsteady Plasma Actuators for Separation Control of Low-Pressure Turbine Blades", with J. Huang and F. Thomas, *AIAA J.*,**44**, 7, pp. 1477-1487, 2006.

15. "Plasma Enhanced Aerodynamics: Concepts, Optimization and Applications," *Prog. Aero. Sci.*, **43**, Oct-Nov., 2007.

16. "Aerodynamic Control Using Windward-Surface Plasma Actuators on a Separation Ramp," *AIAA J. Aircraft*, **44**, No. 6, 2007.

17. "Scaling Effects of an Aerodynamic Plasma Actuator," *AIAA J. Aircraft*, **45**, No. 1, 2008.

18. "Plasma Actuators for Cylinder Flow Control and Noise Reduction," **AIAA J.**, **46**, 8, 2008.

19. "Single dielectric barrier discharge plasma enhance aerodynamics: physics, modeling and applications," *Exp. Fluids*, **46**, pp 1-26, 2009

20. "Dielectric Barrier Discharge Plasma Actuators for Flow Control," To appear *Ann. Rev. Fluid Mech.* 2010.

6. Thesis Advisor and Postgraduate-Scholar Sponsor

Graduate Students Advised (present):	14
Total number of graduate students advised:	48
Postdoctoral Scholars Sponsored (present):	3
Total number of Postdoctoral Scholars Sponsored:	10

7. Services to AIAA

Member	National Committee on Aerospace Education	1989
Member	Organizing Committee Summer Fluid Dynamics Conference, Snowmass, CO	1997
Symposium Chair	"Flow Control Applications of Weekly Ionized Plasma Actuators," Aerospace Sciences Meeting	2002
Regular Session Chair	Aerospace Sciences Meeting Flow Control Meeting, Aerospace Sciences Meeting, Theoretical Fluid Mechanics Meeting, Plasmadynamics and Laser Meetings	2000-Present

8. Services to Other Professional Societies

Member	Fluid Mechanics Committee of the Applied Mechanics Division of ASME, 1991-Present.	1991-2000
Co-organizer	1 week short course on "Transition to Turbulence," NASA Langley Research Center	1993
Session Organizer	Society of Engineering Science National Meeting.	1994
Session Organizer	Symposium on "Fluid-Structure Interactions," ASME Winter Annual Meeting.	1995
Chair	Fluid Mechanics Committee of the Applied Mechanics Division of ASME, 1991-Present.	1995-2000
Lead Scientist	4th World Conference on Experimental Heat Transfer, Fluid Mechanics and Thermodynamics; Brussels, Belgium.	1997
Member, International Scientific Committee	6th International Congress on Fluid Mechanics; Cairo, Egypt.	1997
Co-editor and organizer	Symposium on "Fluid-Structure Interactions," ASME Winter Exposition.	1997

Member	Nomination Committee, American Physical Society, Fluid Dynamics Division	2003-2005
Co-chairman	11th International Symposium on Flow Visualization	2004
Member	National Academies Decadal Survey of Civil Aeronautics	2006
Guest member	Annual Reviews of Fluid Mechanics Editorial Committee	2007