Barnaby Wainfan

Aerodynamicist & Vehicle Designer

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90267

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Extensive experience in vehicle design, configuration and integration, with background in aerodynamics and design of airplanes, missiles, ground vehicles, and watercraft.

Expertise in configuration synthesis, wing design, transonic aerodynamics, high-lift systems, automotive aerodynamics, and general aviation.

Experienced in all phases of project management from conception through flight testing.

EDUCATION

M.S. Aerospace Engineering
University of Michigan, Ann Arbor, Dec. 1978

B.S. Mechanical and Aerospace Engineering
Cornell University: 1977

EMPLOYMENT HISTORY

Technical Fellow for Aerodynamics Design and Analysis (NG Fellow 2)
Northrop Grumman Aerospace Systems

Dec 1990 - Present

Responsibilities:

- Configuration development and aerodynamic design of advanced military aircraft. I have led several configuration-design and aero-design teams.
- Recognized Northrop Grumman corporate expert in aerodynamic design.
- Innovative aerodynamic technology development and development of aerodynamic design methodology to support ongoing design efforts.

- Test planning, engineering, and management of wind-tunnel tests. Wind-tunnel model design and fabrication.
- Management of aerodynamic design Integrated Product Teams. Development of manpower plans, program schedules and budgets.

Unclassified Assignments:

- Aerodynamics lead for US Navy Unmanned Combat Air System Demonstrator (UCAS-D) (winner of the 2013 Robert J. Collier Trophy): Responsible for X-47B air vehicle aerodynamic design, testing, analysis and database development.
- Design of advanced fighter aircraft.
- Design of wing for Block 2 Firebird air vehicle.
- Aerodynamic design and stability and control for Grey Wolf low-cost cruise missile.
- Aerodynamic design for DARPA TERN VTOL UAV.
- Aerodynamics design, wing design, and wind-tunnel testing for T-X program
- Flight mechanics lead for US Air Force Hybrid Launch Vehicle program. Responsible for aerodynamic design, aerodynamic analysis, and trajectory analysis for re-usable launch vehicle booster.
- Aerodynamic consultant to the F-35 program addressing issues concerning abrupt wing stall (AWS) and high-speed flying qualities.
- Wind tunnel testing and control effector design for Northrop Grumman X-47A Pegasus UAV
- F/A-18 E/F Transonic flying qualities enhancement. Diagnosed aerodynamic cause of "wing drop" abrupt stall problem, and designed wing modifications to cure the problem. Aerodynamic devices developed during this effort are incorporated on the operational F/A-18G Growler.
- NASA Space launch Initiative aerodynamics and vehicle concept development.
- Aerodynamics/Aerothermal IPT Lead for the SA-1 airbreathing space-launch vehicle demonstrator.
- Led team that designed and tested in sub-scale form an advanced ram-wing scout vehicle.
- Configuration team co-leader for AFX concept development. Aerodynamic design, configuration synthesis and wind-tunnel testing of Northrop AFX concept.
- Aerodynamic wing design for MALD (Miniature Air-Launched Decoy) vehicle. Wing design lead for the Tier II+ high-altitude long-endurance UAV.
- Aerodynamic design and testing of configurations and control effectors for the JAST/ Joint Strike Fighter

- Configuration synthesis, aerodynamic design and wind tunnel testing of the ALF/ ASTOVL light fighter. Innovative aerodynamic concepts research leading to 14 U.S. Patents
- Aerodynamic design and wind tunnel testing of enhanced-performance HSCT configuration.
  High angle-of-attack aerodynamic control effector development.

✳ The details of my other assignments during my employment at Northrop Grumman are classified.

Chief of Aerodynamics
Edison2 LLC
2008-2012

- Responsible for the aerodynamic design of the Edison2 "Very Light Car": Winner of the Progressive Insurance Automotive X Prize. (See www.edison2.com, and U.S. Patent D614,083)
- The 4-seat VLC has demonstrated over 100Mpge fuel mileage on a combined city, urban, and highway cycle and over 129 Mpge highway mileage in official X prize trials powered by an internal combustion engine. An electric version of this car achieved 315 Mpge in tests at an EPA certified laboratory and in road test.
- In testing in the General Motors Full-Scale Wind tunnel the ICE powered VLC demonstrated a CD of less than 0.16 and a CDA of 2.85 square feet in roadworthy condition.

Chief Engineer
Microflap Incorporated
1999-2008

Microflap, Inc. was a start-up company that developed a wing modification that produced substantial fuel savings for transport-category aircraft. The modification was based on US Patent 4,867,396: "A Micro Flap Trailing Edge Device for an Aircraft Wing", which discloses a fuel-burn reduction wing modification I invented while employed at Lockheed (see below). We secured the IP, formed a partnership with a major air carrier, and completed Phase 1 flight testing to validate fuel savings.

✳ My activities as Microflap Chief Engineer were concurrent with my employment at Northrop Grumman.

Senior Engineer

ACA Industries, Inc. Torrance, CA

Oct 1986-Sep 1990

- Program Manager of AIWS Air Vehicle Aerodynamic Design under contract to McDonnell Douglas Missile Systems.
- Program Manager of preliminary design of a new type of Unmanned Air Vehicle with VTOL capability under contract to McDonnell Douglas Missile Systems Company. The vehicle was based on a concept I invented, which is the subject of a U.S. Patent.
- Aerodynamic modification, structural proof testing, and flight-test support of the U.S. Navy LAURA long- endurance unmanned air vehicle. Supervised the pre-flight structural proof-loading of the aircraft, and supported the subsequent successful flight testing of the vehicle.
- Aerodynamic and structural design of a very-high-altitude airplane capable of flying 6,000 nmi. at or above 100,000 feet for atmospheric research. This work was done under NASA contract NAS2-13156 and the results were published as a NASA Contractor Report.
- Configuration definition and aerodynamic design of an Army battlefield UAV for the U.S. Army Missile Command.
- Performed studies of the aerodynamic, aeroelastic and structural design of advanced tiltrotor aircraft under NASA contract. Results were published in NASA CR-177543.
- Responsible for aerodynamic analysis, testing and structural design of the NASA Joined Wing Research Aircraft.
- Development of computer programs for preliminary design, stress analysis and weight predictions of joined and cantilever wings.
- Configuration studies of advanced cruise missiles.

Engineering Specialist

Northrop Advanced Systems Division

Nov 1981-Oct 1986

Responsibilities:

- Aerodynamic design and configuration development of advanced military aircraft including Tacit Blue and ATA (for the US Navy)

Computational Aerodynamics Department: Aerodynamics Engineer

Lockheed California Company

Jan 1979-Nov 1981

Assignments:

- Developed and implemented aerodynamic prediction and design methods with emphasis on computational fluid dynamics.
- Development of parametric transonic as well as low speed (high lift) drag prediction methodologies
- Design of modifications of the L-1011 wing to reduce cruise drag (see patents, below), and design of high lift systems for projected L-1011 derivatives.

Student Engineer

Aircraft Research Laboratory, University of Michigan, Ann Arbor, MI

1977 and 1978

Assignments:

- NASA-funded "General Aviation Cooling Drag Reduction" program: designed and constructed wind tunnel models, supervised wind tunnel testing
- Flight Test Engineer on a NASA-funded stall/spin prevention program

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CONSULTING & PERSONAL ACTIVITIES

Aircraft:

- "Facetmobile": Designed, constructed, and flight-tested an unconventional light airplane which won the Special Award for Innovative Design at the 1994 Experimental Aircraft Association convention. Innovations include: a faceted, lifting-body configuration for easy construction and benign stall characteristics, outstanding visibility, and very large volume. The Facetmobile has been featured in 20 publications from 5 countries, including the covers of 3 US national magazines. A two-seat follow-on aircraft is presently under construction. Additional information on these is available at facetmobile.com.
- "Lightbeam": Designed and flight-tested a FAR Part 103-compliant ultralight airplane designed for low-cost automated manufacture.

- NASA STTR NNL05AB23P "Personal Air Vehicle Research Project": developed and validated structural design of an extremely low-cost and low-aspect ratio personal aircraft.
- Rihn Aircraft "One Design" DR107: Airfoil design and stress analysis for the Rihn Aircraft "One Design" DR107 competition aerobatic aircraft. Over 350 sets of plans for this aircraft have been sold, and at least 100 aircraft of this type are currently flying.
- Rihn Aircraft "One Design" DR109: Airfoil design for the Rihn Aircraft model 109 two-seat aerobatic aircraft. Kits for this airplane have been available since 1996. Three examples of this type were flying as of 10/98.
- "Mark 3 Xtra": Designed the Kolb "Mark 3 Xtra" 2-seat light sport airplane that is currently produced in kit form; performed design and flying qualities consultations for Kolb Aircraft.
- Atair Aerospace "Exo Wing": Aerodynamic design and wind-tunnel testing of the Atair Aerospace "Exo Wing" personal flight system.
- Design of a new wing for a utility-class kit airplane for a major kit airplane manufacturer.
- Preliminary design studies for several racing aircraft for proprietary customers. These included a Sport Biplane, Formula 1 and Unlimited class aircraft.
- Aerodynamic redesign of the tail surfaces of the Parker JP-350 racing airplane to cure high-speed directional oscillations.
- Development of a highly efficient propeller design for light aircraft, for a major propeller manufacturer.

Aviation Journalism:

- KITPLANES: Since 1988 I have been a contributing editor of Kitplanes Magazine, writing over 350 monthly columns on aerodynamics and airplane design, and a series of articles on airfoil design which have since been published in book form.
- Contributing Editor: Flight Journal.

Legal:

- Expert witness for cases involving aerodynamics, aircraft design and aviation-related intellectual property. I have worked on several cases for nationally-known law firms.

Automotive:

- Aerodynamic improvements for the AUDI R-10 American LeMans series LMP1 race car.

- Aerodynamic consulting for Robertson Racing's Doran-Ford GT2 American LeMans series race car. Aerodynamic consulting for World Motorsports Scion tC Time Attack race car.
- Aerodynamics consulting for Craig Breedlove's "Spirit of America 3" land speed record car.

Marine:

- Design and dynamic-stability analysis of a hydrofoil sailboat prototype for a major manufacturer of personal watercraft.
- Conceptual development and analysis of an advanced semisubmerged hull form for fast ferry vessels for Navatek Ships, Ltd.
- Design and construction of a race-winning 14-foot stand-up paddle board ("SUP").

Other Activities:

- Private pilot, with single-engine and glider ratings.
- Free-flight model airplane competition. National Champion in 1984.
- Aerodynamic design, analysis, and wind-tunnel testing of a vertical axis wind turbine.
- Design of flying toy for girls (customer proprietary).

ADDITIONAL PROFESSIONAL & EDUCATIONAL

- I am a regular forum speaker at the Experimental Aircraft Association convention at Oshkosh, WI. Subjects of my fora have included: wing design, light airplane drag reduction, safety implications of airplane modifications, sport airplane design, and low-aspect ratio configurations.
- Adjunct Professor of Aeronautical Engineering: University of Michigan: 2010-2012
- Visiting Scientist in Aerodynamics at Caltech GALCIT Laboratory: 2008-2011
- Member of review board for University of Michigan / AFRL Collaborative Center for Aeronautical Science. (2009 and 2010)
- Instructor for California Polytechnic University at Pomona teaching graduate level "Aerospace Vehicle Design" and "Flight Mechanics" courses.
- Instructor for UCLA Extension: Taught short course in aircraft design: Spring 2003

- Member of Cal Poly Pomona Industry Advisory Council; an industry group that advises the university on curriculum and engineering education from the industry perspective. I have been an active member of this committee for 27 years.
- Advisor to student groups at Cal Poly Pomona competing in the AIAA "Design Build Fly" competition and the AUVS autonomous vehicle competition.
- Industry Judge assisting the Aerospace Vehicles Design course and competition at Cal Poly Pomona.
- Instructor in Aerodynamics and Configuration for Northrop Grumman "Low Observables University" continuing education program.
- Northrop's representative on the AIAA Multidisciplinary Design Optimization Technical Committee (1994-1995).

HONORS & AWARDS

Aerodynamics lead for X-47B US Navy Unmanned Combat Air System Demonstrator (UCAS-D) which received the 2013 **Robert J. Collier Trophy**.

Responsible for the aerodynamic design of the Edison2 "Very Light Car" which won the **Progressive Insurance Automotive X Prize**.

2011 Winner Personal Aircraft Design Academy (PADA) Trophy for **Lifetime Contribution to Personal Aircraft Design**.

Special Award for Innovative Design for Facetmobile (N117WD): EAA Airventure 1994

Academy of Model Aeronautics (AMA) 1984 **P-30 Class National Champion**

PATENTS

- "A Micro Flap Trailing Edge Device for an Aircraft Wing": U.S. Patent 4,867,396: 1989
- "Airplane With Variable-Incidence Wing": U.S. Patent 5,086,993: 1992
- "Aircraft": U.S. Patent D342,717: 1993

- “High Lift Device for Aircraft”: U.S. Patent 5,366,180: 1994
- “Airplane”: U.S. Patent D365,545: 1995
- “Tactical Aircraft Decoy”: U.S. Patent D377326: 1997
- “Tactical Aircraft Decoy: Conjugal Tandem Design”: U.S. Patent D381938: 1997
- “Aerodynamic Control Effector”: U.S. Patent 5,961,068: 1999
- “Ram Wing Vehicle”: U.S. Patent 5,860,620: 1999
- “Aircraft Engine Air Intake System”: U.S. Patent 6,138,950: 2000
- “Supersonic Aircraft”: U.S. Patent D471,854: 2003
- “Unmanned Air Vehicle”: U.S. Patent D508,013: 2005
- **“**Process For Recovering A Spacecraft First Stage” U.S. Patent 7,834,859: 2010
- “Automobile”: U.S. Patent D614,083: 2010
- “Deployable Propeller:” U.S. Patent 9,937,999: 2018
- “Collapsible Ducted Fan Unmanned Aerial System”: U.S Patent 9,975,633: 2018

PUBLICATIONS

Wainfan, B.S. and Neubert, H.: Feasibility Study of the Low Aspect Ratio All-Lifting Configuration as a Low-Cost Personal Aircraft: NASA LARC NAG-1-03054 Task 01 Final Report, 2004

Wainfan, B.S. and Wolkovitch, J. "A Study of Very-High-Altitude Aircraft With Joined Wings" For NASA Ames Research Center: Contract NAS2-13156. July, 1990 :NASA Contractor Report.

Wainfan, B.S., and Wolkovitch, J.: "Aerodynamic Design of Wings for the AIWS Air Vehicle." ACA Report No. 146-1, for Mcdonnell Douglas Missile Systems Co., MDMSC P.O. No. Y9E186, March, 1990.

Wolkovitch, J., Wainfan, B.S., et al: "Application of the Joined Wing to Tiltrotor Aircraft" NASA CR- 177543, November, 1989.

Wainfan, B.S., and Wolkovitch, J.: "Tiltbody VTOL Unmanned Air Vehicle: Final Report" ACA Report No. 145-1, for Mcdonnell Douglas Missile Systems Co., MDMSC P.O. No. Y9E016, June 1989.

Larabee, E.E, Wolkovitch, J. and Wainfan, B.S.: "Solutions to the Stability and Control Problems of the TALD Vehicle": ACA Report 137-1, for Brunswick Corporation, Brunswick Consulting Agreement No. 72731-C, May, 1987.

Larabee, E.E, Wainfan, B.S., and Wolkovitch,J.: "Data Package for a Baseline Joined-Wing Unmanned Air Vehicle", ACA Report No. 141-1, for U.S. Army Missile Command, P.O. 88P-0971, December 1987.

Wainfan, B.S., and Wolkovitch, J.: "Army Unmanned Air Vehicle Study: Final Report" ACA Report No. 138-2, for U.S. Army Missile Command, PAN: RDV 90-7, September 1987.

"Wind Tunnel": A monthly column on aerodynamics and airplane design in KITPLANES magazine. This series has been ongoing every month for 30 years.

"Airfoil Selection: Understanding Airfoils for Light Aircraft": self-published monograph.

"Aerodynamics of Airplanes With Cambered Tail Surfaces", 1986 Symposium of the National Free Flight Society.

"Design of Free Flight Airfoils for Minimum Sink", 1984 Symposium of the National Free Flight Society.

A.P. Hays, Wainfan, B.S., et. al., "Integrated Technology Wing Design Study", NASA CR-3586, August 1982.

"PERTDRAG: A Parametric Method for the Prediction of Aircraft Drag", Lockheed Aircraft Report LR- 29703, September 1981.

"The Akima Subroutines: Nonlinear Interpolation by Local Polynomial Fit", Lockheed Aircraft Report LR- 29244, October 1979.

"Computer Analysis of Anti-HBs Determination by the AUSAB Procedure", Computer Programs in Biomedicine, Vol. 3, No. 6, 1976.