James S. Uhlman, PhD

SENIOR PRINCIPAL SCIENTIST

Principal scientist with over thirty years' experience supporting a wide range of research and development programs with an emphasis on fluid dynamics and acoustics. The work has primarily focused on developing numerical tools, modeling and simulation and engineering analyses.

CAREER HIGHLIGHTS

Research Scientist, Hydrodynamics and Acoustics: Extensive experience supporting U.S. Navy S&T and R&D programs in the areas of computational and experimental methods in fluid dynamics. Primary areas include and computational fluid dynamics, propulsor hydrodynamics and hydroacoustics and supercavitating high-speed bodies. Has performed research in the areas of propulsor design and analysis, propulsor silencing and propulsor-inflow interactions as well as lifting surface and submerged vehicle cavitation, vehicle maneuvering and stability, laminar and turbulent vehicle drag reduction technologies and advanced integral equation and vorticity-based computational fluid dynamic methods.

Has worked on the development of advanced computational fluid dynamic methods employing an integral equation formulation of the Navier-Stokes equations and participated in the development of advanced, vorticity-based, unsteady Lagrangian computational fluid dynamic methods. These methods have been developed to address limitations of standard finite-difference methods. While at NUWC led a team which developed an advanced, integrated propulsor design capability, including preliminary and final blade hydrodynamics design, structural design, inflow interaction, noise optimization and rapid prototyping. Also led the design team that developed a radical propulsor for the Large Diameter Advanced Test Vehicle (LDATV) which demonstrated improved broadband noise reduction through passive methods. Has performed extensive development of nonlinear methods for the analysis of cavitating flows starting with his doctoral thesis and continuing in support of the ONR High Speed Weapons (HSW) and the DARPA Underwater Express programs. While at NUWC put together a Cooperative Research and Development Agreement (CRADA) which supported work in support of the SOCRATES program for the Federal Aviation Administration (FAA) by studying the aerodynamics and aeroacoustics of aircraft wing-tip vortices. Also participated in the Special Initiatives Assessment of the Mk 48 ADCAP torpedo propulsion upgrade and in the development of the advanced SSN-21 launcher pump.

While with the Ocean Systems Division of Gould, Inc., participated in the analysis of a variety of drag reduction technologies and developed models for forced transition of laminar boundary layers, analyzed the mechanism behind microbubble drag reduction and developed advanced propulsor analysis codes under sponsorship of the Navy.

AREAS OF EXPERTISE

Engineering

- Hydrodynamics
- Acoustics and Hydroacoustics
- Boundary Element Methods
- Numerical Methods
- Propulsor Design and Analysis
- Engineering Design and Analysis

Programming and Software

- Modern Fortran
- Integral Equation Methods
- Fast Multipole Methods
- GPU programming
- Numerical Methods
- Tecplot, Maple, Microsoft Office
- Windows and Mac

Applied Mathematics

- Advanced Calculus
- Complex Variable Theory

- Asymptotics and Perturbation Theory
- Partial Differential Equations
- Integral Equations
- Differential Geometry

PROFESSIONAL WORK HISTORY

New England Research & Development, LLC 2014-present
Chief Scientist and Managing Member

Alion Science & Technology Corporation 1999-2014
(Organization was Anteon Corporation until buyout in 2006,
and was Analysis and Technology until buyout by Anteon in 1999)
Manager, Hydrodynamics and Acoustics R&D Department 2010-2014
Manager, Hydrodynamic and Hydroacoustic Signatures Group 2004-2006
Senior Principal Scientist 1999-2014

Naval Undersea Warfare Center, Division Newport 1988-1999
Chief Scientist, Turbomachinery Fluid Dynamics 1988-1999

Westinghouse Corporation 1983-1988
(Organization was Gould, Ocean Systems Division until buyout in 1988)
Manager, Theoretical Hydrodynamics 1987-1988
Senior Ship Hydrodynamicist 1983-1987

DoD Secret Clearance since 1983 (currently inactive)

PROFESSIONAL EXPERIENCE

Principal Investigator – Future Platform Technologies Program (ONR sponsored)

- Oversaw and participated in the development and integration of numerical tools for the prediction of both propulsor acoustic signatures and flow-induced noise
- Oversaw integration of Large Eddy Simulation (LES) solver with structural acoustic solvers
- Oversaw development of Vortex Element Method (VEM) Euler solver and associated Boundary Element Method (BEM) solver.
- Technical lead for formulation and implementation of required Green's functions
- Technical lead for formulation and implementation of Fast Multipole Method (FMM)
- Technical lead for both software and GPU-based hardware acceleration
- Technical lead for the development of an Integral Equation based CFD method

Principal Investigator – Supercavitation Basic Research (ONR Sponsored)

- Technical lead for the prediction of the added mass and damping forces on supercavitating vehicles.
- Technical lead for the development of numerical tools for the prediction of supercavitating flows about slender bodies
- Technical lead for the analysis of the effect of the cavity on self-noise
- Technical lead for the analysis of the effect of free surface scattering on self-noise

Principal Investigator – Torpedo Propulsor Stealth Research (ONR Sponsored)

- Technical lead for the analysis of the effect of non-uniform blade spacing on propulsor noise
- Technical lead for the examination of trailing edge shaping for noise reduction
- Technical lead on the analysis of the interaction of propulsor silencing technologies

Principal Investigator – Friction Drag Reduction Program (DARPA sponsored)

- Technical lead for the development of tools for the analysis of bubble splitting as a mechanism for turbulent energy dissipation

Key Personnel – Underwater Express Program (DARPA sponsored, sub to EB)

- Performed the analysis for the preliminary design of the supercavitating vehicle, including vehicle size, cavitator configuration, fin configuration and propulsor.
- Technical lead for the design of cambered supercavitating control surfaces.
- Technical lead for the analysis of body forces experienced by supercavitating vehicles

Co-Principal Investigator – SOCRATES program (sub to Flight Safety Technologies Inc.)

- Developed model for the prediction of vortex noise in support of an effort to detect and localize aircraft trailing vortices

Principal Investigator – Integral Equation Navier-Stokes program (NUWC IR funding)

- Developed preliminary model for the numerical solution of the Navier-Stokes equations by an integral equation formulation.

Principal Investigator – PropTools Development program (NUWC Internal funding)

- Led the team that developed numerical tools for the design and analysis of torpedo propulsors, including hydrodynamic design, silencing design and optimization, structural design, inflow interaction and rapid prototyping
- Technical lead for the development of tools for the hydrodynamic and silencing design
- Designed a propeller for the Large Diameter Advanced Test Vehicle (LDATV) which demonstrated significant reduction in TI noise

Co-Investigator – Vortex Element Method Development (ONR sponsored)

- Participated in the development of methods for the implementation of boundary conditions
- Formulated and implemented tools for the prediction of forces by vortex methods

Co-Investigator – Mk 30 Mod II Propeller Development program

- Performed the silencing design for the Mk 30 Mod II propeller

Co-Investigator – Special Initiative Assessment program (NUWC Internal funding)

- Led the team that oversaw the experimental and prediction parts of the program to assess the propulsor noise of undersea weapons

Principal Investigator – Propulsor Analysis Tool program (NUWC NL funding)

- Developed a potential-based boundary element model for the prediction of unsteady propulsor forces

Co-Investigator – Microbubble Drag Reduction Research (Gould Ocean Systems IR)

- Performed analyses of bubble formation and splitting
- Developed models for bubble dynamics and radiation
- Developed model for particle induced transition to turbulence

EDUCATION

Ph.D., Naval Architecture, Massachusetts Institute of Technology, 1983

Ph.D. Thesis: "The Surface Singularity Method Applied to Partially Cavitating Hydrofoils"

M.S., Naval Architecture and Marine Engineering, Massachusetts Institute of Technology 1979
M.S. Thesis: "An Analysis of the Effect of a Leading Edge Vortex on a Partially Cavitating Hydrofoil"

B.S., Naval Architecture and Marine Engineering, Massachusetts Institute of Technology 1977
B.S. Thesis: "An Analysis of Partially Cavitating Hydrofoils of Finite Span by Expansion in Singular Integral Equations"

B.S., Mathematics, Massachusetts Institute of Technology, 1977

(Note: Began college at University of Michigan in 1972 and transferred to MIT in 1975)

AWARDS/HONORS

- Tau Beta Pi Honor Society, 1976
- Winner of the Fifth Lips Propeller Symposium International Student Paper Contest, Drunen, Holland, 1983
- Naval Underwater Systems Center Merit Step Increase 1989
- Naval Underwater Systems Center Performance Award 1989
- Naval Underwater Systems Center Performance Award 1991
- Naval Underwater Systems Center Performance Award 1993
- Naval Underwater Systems Center Performance Award 1994
- Naval Undersea Warfare Center Performance Award 1995
- Naval Undersea Warfare Center Performance Award 1996
- Naval Undersea Warfare Center Science Award 1996
- Naval Undersea Warfare Center Special Act Award 1997
- Naval Undersea Warfare Center Technical Innovation Award 1997
- Naval Undersea Warfare Center Special Act Award 1998

PROFESSIONAL ACTIVITIES

SNAME H-8 Propulsor Hydrodynamics Panel

MEMBERSHIP IN PROFESSIONAL SOCIETIES

- Society of Naval Architects and Marine Engineers (SNAME)
- American Society of Mechanical Engineers (ASME) (not current)
- Acoustical Society of America (ASA) (not current)
- American Institute of Aeronautics and Astronautics (AIAA) (not current)

PUBLICATIONS (partial list)

Uhlman, J.S., (2017), Singular Integral Equation Methods in Fluid Mechanics, (in progress under ONR funding)

Paul, B.S. and J.S. Uhlman, (2012), Development and Validation of Turbulence Ingestion Prediction Capability of TONBROD, *Internoise 2012*, IN12-109

Terentiev, A.G., I.N. Kirschner, J.S. Uhlman, (2011), The Hydrodynamics of Cavitating Flows, A. Tunik, editor, *Backbone Publishing Company*, Fair Lawn, NJ.

Paul, B., R. Martinez, D. Thompson, and J. Uhlman, (2009), Prediction methodologies for tonal and broadband noise from horizontal-axis wind turbines, *Paper 3aEa4, presented at the 157th Meeting of the Acoustical Society of America*, Portland, OR

Uhlman, J. and B. Paul, (2008), Investigation of non-uniform blade spacing for the reduction of blade rate tonals and turbulence ingestion noise in torpedo propulsors, *Journal of Underwater Acoustics*, U.S. Navy

Martinez, R., J. Uhlman, C. Ting, B. Paul, J. Anderson, M. Goody and D. Stewart, (2008), Understanding Roughness Noise: Progress in Analytical Modeling and Testing, Part 2: Comparison of Calculations to Data, NCAD2008-73091, presented at the *NoiseCon2008-ASME NCAD Conference*, July 28-30

Martinez, R., J. Uhlman, C. Ting, B. Paul, J. Anderson, M. Goody and D. Stewart, (2008), Understanding Roughness Noise: Progress in Analytical Modeling and Testing, Part 1: Shear Rapid Distortion Theory, presented at the *NoiseCon2008-ASME NCAD Conference*, July 28-30

Paul, B. and J. Uhlman, (2008), Analysis of a Delayed Stall Propulsor Concept for Underwater Applications, *Proceedings of the Alion Technology Symposium 2008*. [PROPRIETARY]

Uhlman, J.S., (2006), A Note on the Development of a Nonlinear Axisymmetric Reentrant Jet Cavitation Model, *Journal of Ship Research*, Vol. 50, No. 3, PP. 259-267.

Kirschner, I.N., J.S. Uhlman, and J.B. Perkins, (2006), Overview of High-Speed Supercavitating Vehicle Control, AIAA-2006-6442, *Proceedings of the AIAA Guidance, Navigation, and Control Conference and Exhibit,* American Institute of Aeronautics and Astronautics, Keystone, CO.

Varghese, A.N., J.S. Uhlman and I.N. Kirschner, (2005), Numerical Analysis of High-Speed Bodies in Partially Cavitating Axisymmetric Flow, *Journal of Fluids Engineering*, Vol. 127, pp. 41-54

Kirschner, I.N., J.R. Grant and J.S. Uhlman, (2004), High-Speed Projectile Behavior in the Bubbly Wake, *U.S. Navy Journal of Underwater Acoustics*, Vol. 54, No. 3, pp. 467-494

Grant, J.R., I.N. Kirschner, and J.S. Uhlman, (2004), High-Speed Motion in Bubbly Flow: Comments on Drag, *Proceedings of the 2004 High-Speed Hydrodynamics International Summer Scientific School (HSH2004),* Chuvash Academy of Science and Art, Cheboksary, Russia

Uhlman, J.S., (2003), Calculation of the Sound Generated by the Head-on Collision of Two Vortex Rings, *Second MIT Conference on Computational Fluid and Solid Mechanics*, pp. 1172-1176.

Kirschner, I.N., D.C. Kring, A.W. Stokes, N.E. Fine, and J.S. Uhlman, (2002), Control Strategies for Supercavitating Vehicles, *J. of Vibration and Control,* 8 2, Sage Publications, London, England.

Uhlman, J.S., (2001), An Integral Equation Formulation of the Navier-Stokes Equations, *First MIT Conference on Computational Fluid and Solid Mechanics*, pp. 1008-1010.

Uhlman, J.S., N.E. Fine and D.C. Kring, (2001), Calculation of the Added Mass and Damping Forces on Supercavitating Bodies, *Fourth International Symposium on Cavitation (CAV2001), Pasadena, CA*

Kring, D.C., N.E. Fine, J.S. Uhlman, and I.N. Kirschner, (2000), A Time-Domain Cavitation Model using a Three-Dimensional, Boundary-Element Method, *Applied Hydromechanics,* 2 74-3, Institute of Hydromechanics, Ukrainian National Academy of Sciences, Kiev, Ukraine (in Russian)

Uhlman, J.S., A.N. Varghese, and I.N. Kirschner, (1998), Boundary-Element Modeling of Axisymmetric Supercavitating Bodies, *Proceedings of the 1st Symposium on Marine Applications of Computational Fluid Dynamics,* Hydrodynamics/Hydroacoustics Technology Center, Naval Surface Warfare Center Carderock Division, Carderock, MD

Savchenko, Y.N., V.N. Semenenko, Y.I. Naumova, A.N. Varghese, J.S. Uhlman, Jr., and I.N. Kirschner, (1997), Hydrodynamic Characteristics of Polygonal Contours in Supercavitating Flow, *Proceedings of the Third*

International Symposium on Performance Enhancement for Marine Applications, T.A. Gieseke, editor, Naval Undersea Warfare Center Division, Newport, RI.

Varghese, A.N., J.S. Uhlman, Jr., and I.N. Kirschner, (1997), Axisymmetric Slender-Body Analysis of Supercavitating High-Speed Bodies in Subsonic Flow, *Proceedings of the Third International Symposium on Performance Enhancement for Marine Applications,* T.A. Gieseke, editor, Naval Undersea Warfare Center Division, Newport, RI.

Grant, J.R., S.A. Huyer & J.S. Uhlman, (1995), Solution of the vorticity equation on a Lagrangian mesh using triangularization: computation of the Biot-Savart integral in three dimensions, *Forum on Vortex Methods for Engineering Applications Papers,* Sandia National Laboratory, Albuquerque, NM.

Uhlman, J.S., (1995), An Examination of the Frequencies of the Unsteady Harmonic Forces Generated by Propulsors, NUWC-NPT Technical Report 10,470.

Uhlman, J.S. and W.P. Krol, (1994), A Generalized Propulsor/Turbomachinery Description Standard: Introduction and User's Manual, NUWC-NPT Technical Report 10,376.

Huyer, S.A., J.R. Grant & J.S. Uhlman, (1994), A vortex element representation of two-dimensional unsteady separated flow fields. *AIAA 32nd Aerospace Sciences Meeting,* paper no. 94-0075, Reno

Huyer, S.A., J.R. Grant & J.S. Uhlman, (1994), Computation of unsteady separated flow fields past an oscillating airfoil using discrete vortex elements, *AIAA 25th Fluid Dynamics Conference,* paper no. 94-2257

Kirschner, I.N., P.J. Corriveau, J.D. Muench, J.S. Uhlman, Jr., and W.P. Krol (1993), Validation of an In-air Acoustic Radiation Model Using Wind-Tunnel Measurements, *Proceedings of the ASME Symposium on Flow Noise Modeling, Measurement, and Control,* NCA 15, FED 168, T.M. Farabee, W.L. Keith, and R.M. Lueptow, editors, New Orleans, LA

Uhlman, J.S. and J.R. Grant, (1993), A New Method for the Implementation of Boundary Conditions in the Discrete Vortex Element Method, *ASME 1993 Fluids Engineering Division Spring Meeting*, Washington, D.C.

Huyer, S.A., J.R. Grant and J.S. Uhlman, (1993), Numerical Simulation of Three-Dimensional Unsteady Flow Past a Wing Using a Discrete Vortex Element Algorithm, *ASME 1993 Fluids Engineering Division Spring Meet*ing, Washington, D.C.

Uhlman, J.S. and J.R. Grant, (1993), A new method for the implementation of boundary conditions in the discrete vortex element method, *ASME Fluids Engineering Spring Meeting,* Washington, D.C.

Uhlman, J.S., (1992), An Integral Equation Formulation of the Equations of Motion of and Incompressible Fluid, NUWC-NPT Technical Report 10,086

Meng, J. & Uhlman, J.S., (1998), Microbubble formation and splitting in a turbulent boundary layer for turbulence reduction. In *Proceedings of the International Symposium on Seawater Drag Reduction*, Vol. 22, pp. 341-355

Uhlman, J.S., (1989), An Examination of Axisymmetric Propeller-Hull Interaction Effects and their Impact on the Design of Propeller-Vehicle Systems, *Proceedings of the 22nd American Towing Tank Conference*, St. John's, Newfoundland.

Uhlman, J.S., (1989), The Surface Singularity or Boundary Integral Method Applied to Fully Cavitating Hydrofoils, *Journal of Ship Research*, Vol. 33, No. 1.

McEligot, D.M. and J.S. Uhlman, (1988), Metal Transfer in Gas Metal Arc Welding, Report Westinghouse-O/NPT-723-HYDRO-CR-88-01

Uhlman, J.S., (1987), The Surface Singularity Method Applied to Partially Cavitating Hydrofoils, *Journal of Ship Research*, Vol. 31, No. 2.

Meng, J.C.S., and J.S. Uhlman, (1986), Theoretical analysis and numerical simulation of bubble formation dynamics in a turbulent boundary layer, Tech. report, Gould-OSD-771-HYDRO-CR-86-04.

Uhlman, J.S., (1983), The Surface Singularity Method Applied to Partially Cavitating Hydrofoils, *Proceedings of the Fifth Lips Propeller Symposium*.

Van Houten, R.J., J.E. Kerwin and J.S. Uhlman, (1983), Numerical Solutions of Lifting Surface Sheet Cavitation - A Review of Research at M.I.T., *Proceedings of the 20th American Towing Tank Conference*, Hoboken, New Jersey, 1983 (with R.J. Van Houten and J.E. Kerwin).

Uhlman, J.S., (1978), A Partially Cavitated Hydrofoil of Finite Span, *Journal of Fluids Engineering, Trans. ASME*, Vol. 100, No. 3, pp. 353-354

Uhlman, J.S. and C.W. Jiang, (1977), Experiments on a Partially Cavitating Plano-Convex Hydrofoil with Comparison to Theory, *M.I.T. Dept. of Ocean Engineering, Report No. 83481-2*

PATENTS

Huyer, S.A., J.R. Grant and J.S. Uhlman, (1996), Apparatus and Method for Predicting Flow Characteristics, Patent No. US 6,424,923

Krol, W.P., J.S. Uhlman, C.P. Cho and R.A. Bedingfield, (1997), Combination Motor and Pump Assembly, Patent No. US 5,649,811

Cho, C.P., R.A. Bedingfield, W.P. Krol and J.S. Uhlman, (1997), Integrated Motor/Marine Propulsor with Permanent Magnet Blades, Patent No. US 5,607,329

Huyer, S.A., J.R. Grant, J.S. Uhlman and J.S. Marshall, (2002), Method for Computing Three Dimensional Unsteady Flows by Solution of the Vorticity Equation on a Lagrangian Mesh, Patent No. US 6,424,923

Varghese, A.N. and J.S. Uhlman, (2005), Non-Linear Axisymmetric Potential Flow Boundary Model for Partially Cavitating High-Speed Bodies, Patent No. US 6,865,523

Kirschner, I.N. and J.S. Uhlman, (2007), Device for Stabilizing Re-Entrant Cavity Flows past High-Speed Underwater Vehicles, Patent No. US 7,226,325

Kirschner, I.N., D.T. Lerro, L. Freeman, R. Martinez,and J.S. Uhlman, (2008), Cavitating Body Sonar System and Process, Patent No. US 7,453,769

Krol, W.P. and J.S. Uhlman, (2011), Adaptive Material Actuators for Coanda Effect Circulation Control, Patent No. US 7,861,977