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## Education:

B.A., Harvard University, *cum laude*, 1981
Engineering and Applied Science / Electrical Engineering

Yale University, Special Student in Mathematics, 1986-1987

M.S., Massachusetts Institute of Technology, 1994
Ocean Engineering
O.E., Massachusetts Institute of Technology and
Woods Hole Oceanographic Institution, 1994
Oceanographic Engineering
Thesis (for dual degree): System Identification and State Reconstruction for Autonomous Navigation of an Underwater Vehicle in an Acoustic Net

Ph.D., Massachusetts Institute of Technology and
Woods Hole Oceanographic Institution, 1997
Oceanographic Engineering
Dissertation: Development of the BASS Rake Acoustic Current Sensor: Measuring Velocity in the Continental Shelf Wave Bottom Boundary Layer

## Qualifications:

- 40 years of diverse professional engineering experience.
- 25 years of experience in the fields of oceanographic engineering, instrumentation, underwater vehicles, physical and biogeochemical oceanography, coastal engineering, sediment transport, and near-shore processes.
- Real-time oil rig based current measurement systems, including launch and recovery gantries; instrumentation; and data acquisition, processing, archiving, analysis, and visualization.
- Real-time moorings and bottom installations for harbors, coastal areas, and the deep ocean.
- Instrument systems and software for physical oceanography, biogeochemical investigations, and fisheries research.
- Experience with a range of current measurement technologies.
- Acoustic differential travel time instrumentation to study the velocity structure of the continental shelf wave bottom boundary layer.
- Interactive and expert system software and communications circuitry to provide real-time display and interpretation of dynamic fishnet behavior.
- Interactive model data extraction and plotting software to support protected species research and by-catch analysis.
- Analysis of collected measurements, including the development of software tools.
- Assembly and higher level (e.g., C, MATLAB) languages for microprocessor control, data collection, data analysis, numerical calculations, and simulations.

## Employment History:

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| 2009-2020 | Woods Hole Group, Inc., Senior Ocean Engineer<br>Offshore Metocean Monitoring Systems and Support Services Manager<br>Design, development, installation, and maintenance of real-time oceanographic measurement systems, system manuals and documentation, professional papers, software, data analysis and data mining, customer support. |
| 2000-Present | Nobska Development, Inc., Senior Engineer / Vice President for Engineering<br>Design and development of software and electronics for the MAVS acoustic velocity sensor, ancillary sensors and output devices, equipment manuals, professional papers, real-time and post-processing data analysis software, customer support. |
| 2006-2007 | Webb Research Corp., Senior Engineer<br>Design and development of test equipment, software, and advanced simulators for Apex floats. |
| 2003-2009 | Integrated Statistics, Inc., Oceanographic Engineer<br>Design, development, and deployment of interactive and expert system software and communications circuitry to provide real-time display and interpretation of dynamic fishnet behavior for National Marine Fisheries Service Research Vessels.<br>Design and development of interactive model data extraction and plotting software to support protected species research and by-catch analysis. |
| 1998-2003 | McLane Research Laboratories, Inc., Senior Engineer for Electronic Systems<br>Design and Development of time-series oceanographic sampling and environmental monitoring systems: software, electronics, hydrodynamics, oceanographic science, equipment manuals, professional papers, website, customer support. |
| 1997-2010 | Woods Hole Oceanographic Institution, Visiting / Guest Investigator<br>Development and use of the BASS Rake wave bottom boundary layer acoustic current sensor. Development of data processing GUIs. |
| 1981-1986 | Raytheon Service Company, Field Engineer / Senior Field Engineer from 1985<br>Shipboard installation, repair, and testing of missile fire control radars operated by the United States and allied navies. Security clearance level: Secret |

## Professional Affiliations and Activities:

- Member of the Institute of Electrical and Electronic Engineers (IEEE) since 1995
  - Senior Member of IEEE since 2005
- Member of the IEEE Oceanic Engineering Society (OES) since 1995
  - OES Administrative Committee 2000-2015 (Governing Body of the Society)
  - OES Current, Waves, and Turbulence Measurement Technology Committee (CWTM)
  - OES Webmaster 2001-2009
  - IEEE/OES/MTS OCEANS Conference Webmaster 2003-2015
  - OES Constitution and Bylaws Committee 2004-2005
  - OES Distinguished Service Award 2008
  - OES Vice President of Conference Operations 2011-2014
- Massachusetts Informal Educator of the Year 2000, Massachusetts Marine Educators

## Research and Professional Interests:

- Instrument design and development for oceanographic research and environmental monitoring
- Velocity and sediment concentration measurement, particularly in boundary layers
- System engineering and design, including electronic, software, mechanical, and power design
- Hydrodynamics and control theory applied to underwater vehicles
- Teaching and public outreach
- Customer support and collaboration

I enjoy the challenge of designing and developing new instrumentation for research, particularly for ocean science. I find satisfaction in this pursuit because it is often the creation of new observational capabilities that leads to an improved or new understanding of the natural world. I have developed instrument systems and software for biogeochemical and physical oceanographic investigations, fisheries research, and medical monitoring. I specialize in current measurement technology and I remain interested in the behavior of continental shelf bottom boundary layers, especially their interaction with the sediment bed and their role in sediment entrainment and transport. To study these phenomena, I have designed and deployed instruments capable of making spatially detailed velocity measurements through the steady and wave bottom boundary layers. I also continue to be interested in the operation and use of unmanned vehicles for underwater research. My work in this field has focused on characterizing the hydrodynamic behavior of these platforms and the application of control theory to the problems associated with precisely following a planned trajectory. More recently I have focused on the real-time measurement of current speed and direction profiles from oil platforms and moorings, data processing, quality assurance, and visualization of these measurements, and operational user interfaces. Another area of significant importance to me is teaching. This includes discussing my research and other interests with students in a regular classroom setting as well as lecturing to more general audiences. I am currently the author or co-author of more than 50 publications, including papers in the fields of oceanographic instrumentation, current measurement, biogeochemical sampling, and underwater vehicles.

I have 40 years of diverse professional experience and a broad range of skills and knowledge to apply to engineering challenges. A partial list of these talents includes analog and digital electronic design and fabrication, mechanical design and fabrication, structural mechanics and the behavior of materials, and hydrodynamics, particularly boundary layer flows and the interactions of fluids and structures. I regularly write and work with assembly and higher level (e.g., C, MATLAB) languages for microprocessor control, data collection, data analysis, data visualization, numerical calculations, simulations, and user interfaces. I am an experienced, safety qualified, offshore worker. I depend on that broad base of knowledge and skills in my work because I feel that it is important to integrate rather than compartmentalize the instrument and system design processes. Better sensors and better systems result when the electrical, mechanical, software, and human interface portions are holistically designed from the beginning to complement each other. This approach is particularly important when considering the interaction of the sensor or system with the environment. For example, experience in hydrodynamics allows me to characterize the flow around the structure of a current sensor or a mooring and improve the accuracy of the measurement.

## Selected Projects:

**Real-Time Wave and Current Monitoring System for the Port of Altamira, Mexico, WHG Project Manager**

The Port of Altamira, one of the busiest in Mexico, required real-time information about currents and waves crossing the entrance channel. The data would be key factors in the decision to open or close the harbor to cargo vessels. The Altamira system we designed and installed consisted of a bottom mounted current profiler reporting acoustically to a surface buoy. The surface buoy in turn communicated by radio modem to the Port Authority's harbor control and operations tower. The measurements and derived quantities, such as significant wave height, were displayed in real-time on computers accessible to Port Authority personnel.

**Launch and Recovery System for Current Measurement from the Pacific Santa Ana Drill Ship, Gulf of Mexico, WHG Project Manager**

To comply with regulatory requirements and to support drilling operations, the Pacific Santa Ana (PSA) required real-time current profiles to a depth of 1000 meters and specified a location on the outer hull normally reserved for an ROV. The PSA Launch and Recovery System (LARS) we delivered and installed was comprised of a current profiler mounted in a protective sled frame that was deployed along rails to the curve of the bilge. The rails, approximately 25 meters in height, were secured to the side of the hull. The sled was controlled with a hydraulic winch and an electro-mechanical cable that carried power, control signals, and data. The winch and other system components were supported by a fixed frame mounted to the deck at the top of the rails.

**Wave, Current, and Marine Mammal Monitoring for Garden State Ocean Energy, WHG Project Manager**

Our customer required a baseline study of physical oceanographic characteristics and marine mammal activity at the site of a proposed offshore wind farm. The bottom mounted equipment we provided was internally recording with quarterly servicing, data harvesting, and analysis/reporting. The system successfully delivered a full year of data, including a high-quality record of one of the most severe storms of the past several decades.

**Analysis and Quality Control of Gulf of Mexico Deepwater Current Measurements for the DeepStar Research Consortium, Database Search Tools, WHG Developer**

DeepStar is a consortium of oil companies operating in the Gulf of Mexico. Since 2005 BOEM and BSEE (formerly MMS), US Government regulatory agencies, have required deep water operators to provide real-time current profiles to an archive at the National Data Buoy Center (NDBC). WHG was contracted to perform a complete analysis and QA/QC of the data archived from 2005 through 2010, to construct a database of clean data with consistent formatting, to identify any particularly energetic events in the data, and to construct search and visualization tools for the clean database.

**Rig-Based Real-Time Current Measurement Systems for BP and Noble from DS3 (Deep Ocean Ascension), DS4 (Deep Ocean Clarion), West Auriga, West Vela, West Capricorn, Helix Q5000, Noble Bob Douglas, WHG Project Manager and Developer**

These rigs required real-time current profiling systems, providing current speed and direction measurements from the near-surface to 1000 meters depth, to meet regulatory requirements and to support safe daily operation. WHG designed systems, delivered over several years with several design variations, that provided measurements in real-time to the vessel and to the National Data Buoy Center. Upward and downward looking ADCPs were mounted on a sled suspended from electro-mechanical cables positioned with hydraulic winches on an articulated A-frame. The systems, which were largely automatic, provided power and control signals to the instruments, collected, processed, and distributed data, and provided real-time displays to operators over the on-board CCTV network.

**Ross Ice Shelf Real-Time Mooring for Woods Hole Oceanographic Institution (WHOI), WHG Team**

To support a planned through and under ice mooring, WHOI required a real-time automated controller, logger, and satellite telemetry node that could "winter over" in Antarctica at an isolated and exposed location. Temperatures were expected to regularly drop below -40C, well below the operating range of the required electronics. We designed, constructed, tested, and delivered, within a window of a few weeks, a heavily insulated node, with heaters and control and communications electronics integrated in a shipping crate and with a calculated endurance of 14 months at prevailing ice shelf temperatures.

**Hudson Canyon Oceanographic Measurement Program for ExxonMobil Blue Ocean Energy Offshore LNG Terminal, WHG Data Analysis**

Two locations in the upper Hudson Canyon were instrumented with bottom and mooring mounted current, wave, temperature, and conductivity sensors. The client had a general interest in characterizing the surface gravity wave and current environment as part of a feasibility design study for a proposed offshore floating LNG terminal. However, the client was also concerned about differential excitation of the characteristic frequencies of the terminal or the LNG carrier and localized strong shear flows. Therefore, we also successfully addressed a technically challenging requirement to detect and characterize infragravity waves (periods from 50 to 150 seconds), high frequency internal waves (solitons), and internal tides.

**Automated Model Database Search Tools National Marine Fisheries Service (NMFS), WHG Project Manager and Developer**

Investigators in the Protected Species Branch of the NMFS were searching for a statistical link between oceanographic characteristics and sea turtle by-catch to guide possible regulatory action. In the absence of regular, broad scale measurement programs that could be compared to known by-catch events, ocean characteristics were mined from National Oceanic and Atmospheric Administration (NOAA) model data archives. The software tools that I designed and developed supported both directed and automated search, extraction, and visualization. The automated capability, which supported list queries for ocean characteristics at more than 100,000 temporally and spatially (3D) random locations in a single run, successfully enabled the required statistical analysis.

**Infragravity Wave Sensor, WHG Project Manager and Developer**

To support the internal development of an infragravity wave sensor, I acquired a month-long pressure time-series from the United States Army Corps of Engineers (USACE) and developed post-processing time domain and frequency domain software tools and algorithms to isolate, visualize, and identify wave energy in the infragravity band, 30s-300s. My subsequent analysis put limits on the parameter space, allowing further refinement of the algorithms, such that they could reasonably be run in a low-power embedded controller, thus enabling the possibility of long-duration *in situ* detection of infragravity waves with low bandwidth real-time reporting.

**Real-Time FishNet Evaluation Tool (FNET) for NOAA Fisheries, Integrated Statistics Developer**

The Survey Branch of the Northeast Fisheries Science Center (NEFSC) of NOAA required real-time visualization and recording of tow net motion and behavior during survey transects. I developed software tools that interacted with the shipboard computing system to provide the required functionality. I also designed and fabricated a combination hardware and software module that received, interpreted, and translated the incompatible serial data stream from the commercially sourced net sensors and passed it to the shipboard computing system at acceptable voltage levels and in a compatible message structure.

**MAVS (Modular Acoustic Velocity Sensor), Nobska Project Manager and Developer**

I designed, developed, and tested the first four generations of MAVS firmware, encompassing multiple hardware configurations, a variety of auxiliary sensors, and diverse deployment platforms, including active profilers. I also wrote the operator manuals and am providing some oversight for the ongoing fifth generation development. To support and collaborate with customers, I have developed data analysis and visualization tools, most significantly a full-featured directional wave package, MWAVES, for both post-processing and real-time analysis and visualization of the directional wave field.

**OCEANS Web Tools, IEEE/OES and MTS Project Manager**

I managed and guided the development of advanced web-based conference and *Proceedings* management tools for the IEEE/OES and MTS OCEANS Conference series. I provided significant oversight for and assistance to approximately 30 conferences, symposia, and workshops that used the management tools.

## Publications and Presentations:


Morrison, A. T., III, "The West Falmouth Spill: A Scientific Inquiry", *SierraAtlantic Magazine*, October-November 1978, Vol. 5, No. 5, pp. 5 and 8.

Morrison, A. T., III, Yoerger, D. R., "Determination of the Hydrodynamic Parameters of an Underwater Vehicle During Small Scale, Nonuniform, 1-Dimensional Translation", *Proceedings OCEANS '93*, IEEE/OES, October 1993, Vol. II, pp. 277-282.

Morrison, A. T., III, Williams, A. J., 3rd, Martini, M., "Calibration of the BASS Acoustic Current Meter with Carrageenan Agar", *Proceedings OCEANS '93*, IEEE/OES, October 1993, Vol. III, pp. 143-148.

Morrison, A. T., III, "System Identification and State Reconstruction for Autonomous Navigation of an Underwater Vehicle in an Acoustic Net", MS/OE thesis, Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program in Oceanographic Engineering, February 1994.

Morrison, A. T., III, Williams, A. J., 3rd, "STRESS II BASS Data Archive", CD-ROM, NetCDF binary and ASCII files, MATLAB binary and ASCII files, December 1994.

Morrison, A. T., III, "A New Technique for Detailed Acoustic Current Profiles in the Continental Shelf Wave Bottom Boundary Layer", *Proceedings of the IEEE Fifth Working Conference on Current Measurement*, IEEE/OES, February 1995, pp. 220-225.

Morrison, A. T., III, "Multiplexer Design for the BASS Rake Acoustic Transducer Array", *Proceedings OCEANS '95*, MTS/IEEE/OES, October 1995, Vol. III, pp. 1528-1532.

Morrison, A. T., III, "Low Impedance Multiplexer for the BASS Rake Transducer Array", *Sea Technology*, May 1996, Vol. 37, No. 5, pp. 15-21.

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Williams, A. J., 3rd, Thwaites, F. T., Morrison, A. T., III, “Transducer Supports for Acoustic Travel-Time Current Meters - Flow Sampling, Wake, and Potential Flow Distortion Considerations", *Proceedings Microstructure Workshop*, Mount Hood, OR, 1996.

Morrison, A. T., III, “Development of the BASS Rake Acoustic Current Sensor: Measuring Velocity in the Continental Shelf Wave Bottom Boundary Layer”, Ph. D. thesis, Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program in Oceanographic Engineering, June 1997.

Morrison, A. T., III, “Results from the First Deployment of the BASS Rake Field Prototype”, *Proceedings OCEANS '97*, MTS/IEEE/OES, October 1997, Vol. I, pp. 518-523.

Morrison, A. T., III, Williams, A. J., 3rd, “Near Bottom Velocity Profile Measurement Using the Field Prototype of the BASS Rake Wave Bottom Boundary Layer Sensor”, *Proceedings WAVES '97*, CZF/ASCE, November 1997, Vol. II, pp. 1088-1102.

Morrison, A. T., III, “Near Bottom Velocity Measurement”, *Sea Technology*, March 1998, Vol. 39, No. 3.

Morrison, A. T., III, “The Single Axis Sample Volume of the BASS Rake Acoustic Current Sensor”, *Proceedings OCEANS '98*, IEEE/OES, September 1998, Vol. I, pp. 239-243.

Morrison, A. T., III, Cowen, E. A., Liu, P. L.-F., “Velocity Profile Measurements in the Crest of a Breaking Wave Using the BASS Rake Acoustic Velocity Sensor”, *Proceedings of the IEEE Sixth Working Conference on Current Measurement*, IEEE/OES, March 1999, pp. 221-226.

Morrison, A. T., III, Williams, A. J., 3rd, “Location and Recovery of Lost Instruments Using Acoustic Targets”, *Proceedings OCEANS '99*, MTS/IEEE/OES, September 1999, Vol. III, pp. 1429-1434.

Morrison, A. T., III, Billings, J. D., Doherty, K. W., Toole, J. M., “The McLane Moored Profiler: A Platform for Physical, Biological, and Chemical Oceanographic Measurements”, *Proceedings OCEANOLOGY International 2000*, March 2000, pp. 397-414.

Morrison, A. T., III, Billings, J. D., Doherty, K. W., "The McLane Moored Profiler: An Autonomous Platform for Oceanographic Measurements", *Proceedings OCEANS 2000*, MTS/IEEE/OES, September 2000, Vol. I, pp. 353-358.

Morrison, A. T., III, Billings, J. D., Doherty, K. W., "The McLane Zooplankton Sampler: An Autonomous, Time-Series, Zooplankton Sampling Instrument", *Proceedings OCEANS 2000*, MTS/IEEE/OES, September 2000, Vol. II, pp. 841-845.

Morrison, A. T., III, Billings, J. D., Doherty, K. W., "The McLane WTS-LV: A Large Volume, High Accuracy, Oceanographic Sampling Pump", *Proceedings OCEANS 2000*, MTS/IEEE/OES, September 2000, Vol. II, pp. 847-852.

Morrison, A. T., III, Toole, J. M., Lukas, R., Worrilow, S. E., Doherty, K. W., "Results from the First Successful Field Deployment of the McLane Moored Profiler", *Proceedings OCEANS 2001*, MTS/IEEE/OES, November 2001, Vol. II, pp. 949-955.

Morrison, A. T., III, Williams, A. J., 3rd, Waterbury, A. C., Tierney, C. M., “Analog Output from a Differential Travel-Time Current Meter", *Proceedings OCEANS 2002*, MTS/IEEE/OES, October 2002, pp. 708-712.

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Morrison, A. T., III, "MWAVES – Software for Calculating the Directional Spectra and Statistical Properties of the Wave Field From MAVS-3 Triplet Measurements", *Proceedings of the IEEE Seventh Working Conference on Current Measurement*, IEEE/OES, March 2003, pp. 128-134.

DiMassa, D. E., Piskura, J., Morrison, A. T., III, "Flow-Generated Power for Autonomous Instruments", *Proceedings of the IEEE Seventh Working Conference on Current Measurement*, IEEE/OES, March 2003, pp. 282-286.

Williams, A. J., 3rd, Morrison, A. T., III, "Electronic Crosstalk and Linearity in the Acoustic Travel-Time Current Meter, MAVS", *Proceedings OCEANS 2003*, MTS/IEEE/OES, September 2003, pp. 1510-1515.

Pfitsch, D. W., Morrison, A. T., III, "Performance of Large Volume Water Transfer Systems During *In-Situ* Water Sampling", *Proceedings OCEANS 2003*, MTS/IEEE/OES, September 2003, pp. 2242-2246.

Williams, A. J., 3rd, Terray, E. A., Morrison, A. T., III, "Bottom Stress Measurements in Shallow Water Under Waves", *Proceedings of the First US-Baltic International Symposium*, IEEE/OES, June 2004.

Taylor, C. D., Doherty, K. W., Molyneaux, S. J., Morrison, A. T., III, Engstrom, I. B., Pfitsch, D. W., "Autonomous Microbial Sampler (AMS): Device for the Uncontaminated Collection of Microbial Samples from Submarine Hydrothermal Vents and Other Aquatic Environments", *Dark Energy – The Deep Oceanic Biosphere Workshop*, Deep Ocean Exploration and Ocean Life Institutes of the Woods Hole Oceanographic Institution, October 2004.

Morrison, A. T., III, Brown, R. W., Politis, P. J., DeAlteris, J. T., "Measurement of Net-Relative Flow During a Bottom Trawl Survey", *Proceedings OCEANS 2004*, MTS/IEEE/OES, November 2004, pp. 449-452.

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Morrison, A. T., III, Williams, A. J., 3rd, Lorang, M., "Waves and Seiches in Flathead Lake Montana, Measurements of a Quiet Lake by Acoustic Travel-Time Current Measurements", *Proceedings OCEANS 2005 MTS/IEEE Washington*, MTS/IEEE/OES, September 2005.

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