

# CHARLES (LEE) FREY

President & Chief Engineer  
Blue Turtle Engineering, LLC  
140 Tomahawk Dr. Unit 122, Indian Harbour Beach, FL. 32937  
Tel: +1.321.917.1624 (M) Email: [lee@blueturtleengineering.com](mailto:lee@blueturtleengineering.com) Web: [www.blueturtleengineering.com](http://www.blueturtleengineering.com)

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## OVERVIEW

Mr. Frey is an experienced engineer and project manager. He has technical expertise in the areas of electromechanical systems engineering, robotics, mechatronics, embedded controls, sensors, data acquisition, and hardware-software integration, particularly applied to the marine environment. Over the years, he has worked on the development and operation of various manned and unmanned underwater vehicle and instrumentation systems, in a multitude of capacities as an electrical engineer, software engineer, mechanical engineer, and project manager. Lee also has extensive field operations experience, having organized and lead over 25 at-sea research expeditions around the world. He is a certified manned submersible pilot, and has logged dives down to 1000m (3300ft). As a manager, he has authored proposals and lead high-budget projects for agencies such as The Office Of Naval Research, NOAA, NSF, The Waitt Institute, The Dalio Ocean Foundation, and others. He holds an active DoD-Secret security clearance.

## EDUCATION

**M.S. (2002)** Ocean Engineering (Robotics & Control Systems) – Florida Institute of Technology, Melbourne, FL. Thesis Research: **“Development of an Autonomous Underwater Vehicle for Sub-Ice Environmental Monitoring in Prudhoe Bay, Alaska”**

**B.S. (1999, Summa Cum Laude / High Honors)** Ocean Engineering - Florida Institute of Technology, Melbourne, FL.

## PROFESSIONAL EXPERIENCE

04/14 – Present Senior Engineer – **Woods Hole Oceanographic Institution**, Department of Applied Ocean Physics & Engineering, Oceanographic Systems Laboratory, Woods Hole, MA.

### • Duties:

- Function as senior electrical and systems engineer, specializing in design and development of REMUS-class Autonomous Underwater Vehicles.
- Assist in proposal writing and project management for various AUV-related R&D projects.
- Conduct offshore AUV operations with varying mission goals.

### • Selected Projects:

- **REMUS Core Electronics Redesign** – Senior Electrical Engineer on next-generation core electronics design for the REMUS-600 AUVs, based on a Xilinx Zync 7020 processor with embedded FPGA.
- **Deep Sea Manganese Nodule Survey** - Expedition Leader for several deep-sea (4000m+) surveys of Manganese Nodule sites in the Clarion-Clipperton Fracture zone, utilizing REMUS 6000 AUV technology.
- **R6000LE** - Design and development of a second-generation 6000m REMUS AUV for long-endurance missions and low-power, long-range transits.

06/11 – Present President and Chief Engineer - **Blue Turtle Engineering, LLC**, Melbourne Beach, FL

- Founded in 2011, BTE is an engineering services firm, specializing in the design, development, and at-sea operations of underwater systems, including manned and unmanned underwater vehicles and oceanographic instrumentation.

### • Selected Clients & Projects:

- **M/V Alucia** - Manned Submersible Pilot and Systems Engineer aboard M/V Alucia. Operate Deep Rover 2 and Triton 3300/3 (“Nadir”) manned submersibles for scientific exploration and documentary filmmaking, as part of 4-man ops team. Develop and integrate new sensors and collection tools to enhance submersible operations capabilities. Serve as Surface Officer, overseeing submersible dive operations and topside support.
- **The Australian Oceanographic Foundation (AOF)** - Function as Chief Engineer and Submersible Crew for AO’s manned DeepWorker underwater vehicle and oceanographic technology development programs.

- University of Queensland, Australia - Developed unique laboratory-based and diver-held field instrumentation for coral reef, deep sea, and marine vision/optics research
- Ocean Research & Conservation Association (ORCA) - Co-develop and operate unmanned lander and instrumentation systems for deep sea observing and research.
- SeaROV Systems, LLC - Design, develop, and operate robotic remotely operated vehicles (ROVs) for use in offshore oil drilling support.

03/02 – 10/11 Senior Ocean Engineer and Project Manager – Harbor Branch Oceanographic Institute  
Fort Pierce, FL.

• **Selected Projects:**

- ***DRONE Autonomous Swarm Vehicles*** – Served as Principal Investigator and Lead Engineer on two Office of Naval Research projects to develop a series of unmanned autonomous swarming surface vehicles (USVs), designed to perform distributed coastal monitoring tasks.
- ***Panther & Nemesis ROVs*** – Lead engineer, software developer, and project manager, on two unmanned Remotely Operated Vehicles designed for heavy offshore work, deep sea science, and manned submersible rescue.
- ***WID Catalyst Program*** – Expedition and program manager for the Waitt Institute for Discovery Catalyst I & II expeditions. These expeditions utilized two deep-water AUVs to conduct scientific research on deep coral reefs, seafloor mapping, midwater science, and archaeological searches in the Atlantic and Equatorial Pacific Oceans. Over 5 months of at-sea operations were conducted, resulting in the largest continuous unmanned hydrographic survey ever performed, mapping over 2500 square nautical miles of seafloor.
- ***Medusa Deep Sea Landers*** – Lead engineer and project manager for the development of a series of 2000m-rated deep sea autonomous video and instrumentation landers. In 2012, a Medusa Lander became the first device to ever film the legendary Giant Squid alive in its natural habitat.
- ***HIDEX and LoLAR*** – Lead engineer, software developer, and project manager on three projects to develop extremely sensitive bioluminescence (light) measurement instruments for the US Navy, which can be deployed from both ships and underwater vehicles.

**TECHNICAL PROFICIENCIES**

- **Electrical Engineering:** Electronic circuit design, schematic layout, PCB layout, hardware-software integration, prototyping, and automated test.
  - Circuits & Systems: mixed-signal systems, automation & control, power-regulation, amplifier and AA filters, environmental sensor interfaces, embedded and COTS A/D and D/A converters, PWM controllers, BLDC motor controllers, RF, satellite, and WiFi transceivers, digital FIR filters, embedded microprocessors, digital communications, optoelectronics (PMTs, photodiodes, scanning lasers, LED illumination, fiber optics)
  - Microprocessors: PIC, dsPIC, ARM, TMS320 DSPs, Rabbit, Omron & Siemens PLCs, BasicSTAMP, Arduino
  - Communications Protocols: Ethernet, WiFi, RS232/485/422, USB, I2C, SPI, CAN, ModBus, BlueTooth, DSL
  - Applications: Eagle, Cadence, ExpressPCB
- **Software Engineering:** Skilled in embedded and application-side programming and GUI design
  - Languages: C/C++, C#, LabVIEW, Java, Objective C (iPhone & iPad), MATLAB, Ladder, StarLogo, JavaScript, Python, HTML.
  - IDEs: Eclipse, NetBeans, MS Visual Studio, MPLAB, XCode, CX-One, LabVIEW
  - Operating Systems: Windows, Mac OSX, iOS, Linux, MicroC OS-II
- **Mechanical Engineering:**
  - Mechanism and structural design, pressure vessels & housings, motors and actuators, materials analysis, corrosion control, propulsion, control systems, hydrodynamics, static & dynamic analysis
  - CAD: Autodesk Inventor 3D (including FEA and dynamic analysis), SolidWorks, MasterCAM, UnderPressure
- **Other Applications:** 20-20, Hypack, ArcGIS, MS Office (Word, Excel, Outlook, PowerPoint), MS Project, iWork, Visio, OpenOffice, Adobe Photoshop, RapidWeaver.

**CERTIFICATIONS & RATINGS**

- Manned Submersible Pilot - Deep Worker 2000, Deep Rover 2, Triton 3300/3
- SCUBA Diving - PADI and NAUI advanced, IANTD Nitrox
- FAA Private Pilot - airplane, single-engine land (current)
- DAN/American Red Cross CPR, 1st Aid, Oxygen Certified
- ASA 103 sailing certification

**SECURITY CLEARANCE**

- Active - DoD Secret

## EXPEDITIONS

- 28 at-sea research expeditions, 22 as lead engineer, 16 as expedition manager, to the North Atlantic, Gulf of Mexico, Florida Straits, Caribbean, Australian Coast, and the Equatorial Pacific Ocean.
- Dives logged to 1000m. deep in the Johnson-Sea-Link I & II, Deep Worker 2000, Deep Rover, and Triton 3300 manned submersibles.

## PROFESSIONAL AFFILIATIONS

- Marine Technology Society (MTS)
- IEEE Oceanic Engineering Society
- Tau Beta Pi

## PUBLICATIONS

- Karlsson, C., Frey, C.L., et. al. (2011). Physicomimetics for Distributed Control of Mobile Aquatic Sensor Networks in Bioluminescent Environments. Spears, W. and Spears, D., *Physicomimetics: Physics-Based Swarm Intelligence* (pp. 147-194). New York: Springer-Verlag.
- Frey, C.L., Marshall, N.J., and Sherrell, A.J. (2011). Designing Modular Unmanned Landers to Better Observe Life in the Deep Ocean. **Sea Technology** 52(2): 11-15
- Frey, C.L., Sherrell, A.J., and Marshall, N.J. (2011). Compact Unmanned Landers for Deep Sea Research. Marine Technology Society, in **Proceedings of Underwater Intervention 2011**, New Orleans, Feb. 2011.
- Raymond, E. H., E. A. Widder, C. L., Frey, C. T. Cimaglia and M. Hoover. Assessment of bioluminescent sources and potential in a tidal inlet. (in prep.)
- Widder, E.A., E. Raymond, C.L. Frey and D.C. Smith (submitted) Eye-in-the-sea: a deep sea observatory for unobtrusive observations. **Deep-Sea Research**.
- Frey, C.L., D. Zarzhitsky, D. Spears (2009). Management of Autonomous Surface Swarms. **Sea Technology** 50(3): 15-20
- Frey, C.L., D. Zarzhitsky, W. Spears, et. al. (2008). A Physicomimetics Control Framework for Swarms of Autonomous Surface Vehicles. **Marine Technology Society of the IEEE, Oceans 2008**.
- Davis, J.W., Thosteson, E.D., Widder, E.A., & C.L. Frey. Examination of Bioluminescent Excitation Response using Empirical Orthogonal Function Analysis. **Marine Technology Society of the IEEE, Oceans 2005**.
- Widder, E.A., C.L. Frey and J.R. Bowers (2005). Improved bioluminescence measurement instrument. **Sea Technology** 46(2): 10-16
- Widder, E.A., C.L. Frey and L.J. Borne (2003) HIDEX Generation II: A New and Improved Instrument for Measuring Marine Bioluminescence. **Marine Technology Society of the IEEE, Oceans 2003**, 4:2214-2221
- Frey, C.L and S.L. Wood (2003) Development of an Autonomous Underwater Vehicle for Sub-Ice Environmental Monitoring in Prudhoe Bay, Alaska. **Marine Technology Society of the IEEE, Oceans 2**:1161-1173
- Frey, Charles L. Development of an Autonomous Underwater Vehicle for Sub-Ice Environmental Monitoring in Prudhoe Bay, Alaska. Master's Thesis, **Florida Institute of Technology**, 2002.

### Selected Outreach & Public Lectures:

- 2009 HBOI Research Colloquium Series – Speaker: “Mobile Robotic In-Situ Sensing Networks”
- 2009 PBS Documentary “Changing Seas”. Episode #103: “Corals of the Deep”. Various interviews and commentary. Produced by WPBT-2, Miami, FL.
- 2008 HBOI Ocean Science Lecture Series – Speaker: “Intelligent Swarms: The Next Evolution in Marine Robotics”
- 2007 HBOI Ocean Science Lecture Series – Speaker: “Eye In The Sea on MARS: A Real-Time Window Into the Deep”
- 2006 Florida Tech DMES Lecture Series – Speaker: “Eye In The Sea on MARS: A Real-Time Window Into the Deep”
- Little, Jane B. “Eye In The Sea”. **Popular Mechanics**, May 2006: 40-43.