

Moog UnderSea Integrated Control Interface And Navigation System

Product Guide

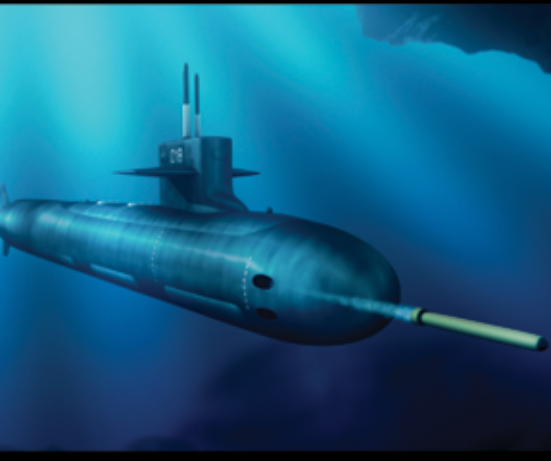


Photo credit to Bluefin Robotics



Moog UnderSea Integrated Control Interface And Navigation System (MUSICIANS™) is a navigation and control system for unmanned underwater vehicles:

- Offers Remotely Operated Vehicle (ROV) and Autonomous Underwater Vehicle (AUV) operators unmatched, leading-edge capability not available elsewhere
- Tightly integrated navigation and control architecture deploys efficiently and offers unmatched flexibility, scope and scalability
- Six standard MUSICIANS product variants support work class, survey and inspection class ROV as well as any AUV
- All product variants provide the same core engine for sensor fusion, navigation, vehicle control, payload control and chart plotting integration
- The standard MUSICIANS product variations provide varying levels of integration and navigational accuracy from the MEMs IMU based OEM version to the FOG IMU based fully integrated housing with a DVL

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Navigation and Control System

MUSICIANS™ is an accurate, robust and independent navigation system for unmanned underwater vehicles built on an inertial core engine. Using any available sensor data on the vehicle for aiding measurements (USBL, GPS, depth sensor, DVL, Gyro, altimeter), MUSICIANS outputs a fully integrated navigation and attitude solution for the vehicle. MUSICIANS is more than another navigation instrument, it is a complete control solution providing thrust vector control, autopilot interfaces and even direct actuator control for waypoint navigation, positioning and attitude control. Through its flexibility and support of most UUV sensors, it delivers an unparalleled value to vehicle developers, integrators and system operators.

The MUSICIANS Graphical User Interface allows operators to configure the MUSICIANS system for the specific vehicle installation by selecting sensors for the navigational solution, output devices, control nodes and architectural settings. MUSICIANS then configures itself to offer the best possible navigation solution for the given sensor mix. When a sensor is changed, the user simply updates the system setup and MUSICIANS adapts its navigational solution to include the new sensor. Optimization is accomplished via MUSICIANS sensor fusion software and flexible Kalman filter which determines at any point in an operation which sensor (or set of sensors) to believe and how to weigh outputs from multiple sensors with differing solutions. From this fused data a navigation solution is calculated.

More than a navigation sensor, the MUSICIANS system provides operators a turn-key vehicle control and autopilot solution. Based on its precision navigation, MUSICIANS can provide attitude, maneuvering, positioning and waypoint navigation solutions in the form of a simple “helmsman” interface or a fully integrated interface such as direct actuator control. The MUSICIANS architecture includes interfaces to many common motor controllers, thruster controllers, actuators and feedback sensors. Customization options for MUSICIANS can provide advanced autopilot solutions using modern optimal and robust controllers for accurate and low-cost total vehicle control out of the box.

Product Options

- 2 Inertial Measurement Unit (IMU) sensor options:
 - High accuracy Fiber Optic Gyro (FOG) IMU
 - Low cost Microelectromechanical System (MEMs) IMU
- Available as OEM board level solution or packaged in a subsea pressure housing
- Available in pressure housing with fully integrated DVL and high-accuracy depth sensor
- Meets requirements of all classes of ROVs and AUVs
- MUSICIANS GUI is configurable for the user's personal display
- Several data output and interface options
- Integrated GPS options available

Supported Sensor Interfaces

MUSICIANS interfaces to most common underwater navigation aiding sensors. Operators configure the system for aiding sensors through the intuitive system configuration dialog provided by the GUI. Sensors supported by the MUSICIANS system include:

- Two core IMU options (others on a custom basis)
- Most compass types
- Most common depth sensors
- Analog instrumentation
- Most altimeters
- General purpose IO
- Doppler Velocity Logs (DVLs)
- GPS
- USBL / LBL systems
- Subsea mapping and chart plotting tools

Software / GUI

The MUSICIANS Graphical User Interface application provides operators a rich navigation interface, a mission planning utility and a 3D enhanced visualization environment. The GUI also enables operators to configure the system through an intuitive system configuration dialog.

MUSICIANS uses the advanced vehicle navigation and control architecture by GreenSea Systems, Inc. (www.greenseainc.com).



MUSICIANS – USER version includes:

- Pressure housing with connector
- Doppler Velocity Log (DVL)
- Pressure sensor
- Inertial Measurement Unit (IMU)
- Attitude Heading Reference System (AHRS)
- Embedded processor



MUSICIANS – OEM version includes:

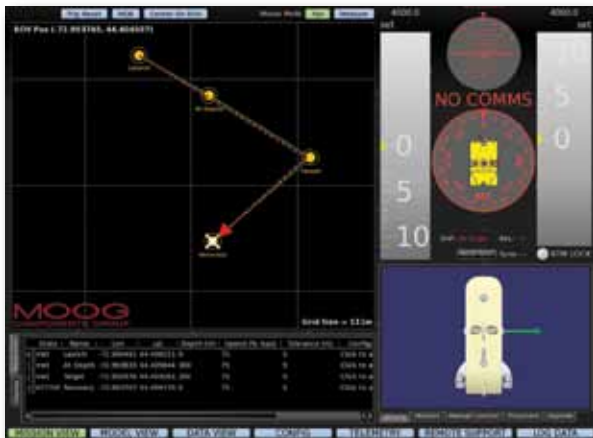
- Inertial Measurement Unit (IMU)
- Attitude Heading Reference System (AHRS)
- Embedded processor



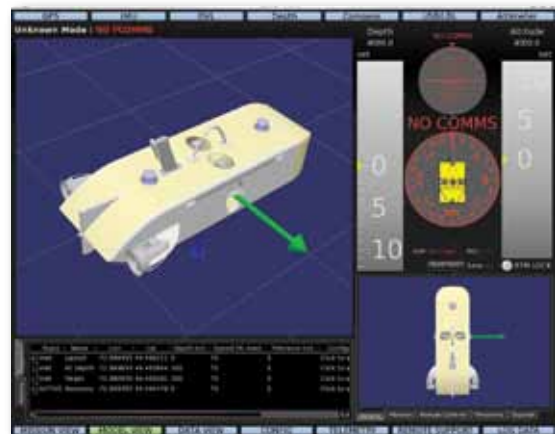
Navigation and Control System

Software Modules

- **Vehicle Heading and Attitude Module:** Calculates vehicle heading and attitude (high resolution and filtered) from the primary IMU device aided by any available third-party sensors on the vehicle.
- **Relative Navigation Module:** Calculates navigational solution in the relative navigation frame of reference (X, Y, and Z). Coordinates are computed from on-board sensors via custom kalman filter.
- **Absolute Navigation Module:** Calculates navigation solution in the Earth navigation frame of reference (Latitude and Longitude). Coordinates are computed from on-board sensors via custom a kalman filter. Initial reference is GPS fix.
- **Thrust Vector Control Module:** Provided heading, attitude, depth, altitude, or waypoint commands the unit will output a vectored thrust solution to achieve the control inputs. The controller can be configured generically as a helmsman display or specifically for the vehicle for closed loop integration.
- **Direct Drive Closed-loop Navigation Control Module:** Provided heading, attitude, depth, altitude, or waypoint commands the unit will output control commands to the thrust actuators to achieve the control inputs. This module requires integration to the thruster control system and a full understanding of the host vehicle.
- **General Purpose IO Module:** Provides for analog and digital inputs and outputs. Discrete signals can be mapped to alarms, signals, or GUI display fields.
- **Navigation Output Module:** Output strings to support third-party mapping program integration (Winfrog, SeaScape, and Hypack). Initially standard format strings or NMEA outputs will be supported. Future upgrade will include proprietary Moog strings.
- **Standard Output Module:** “Canned” outputs strings for any data signal in the device to support auxiliary devices such as NMEA devices, data loggers, chart recorders, video overlay units, or remote navigation stations.
- **Mirror Display Module:** Network distribution of navigation data to any instance of the Moog GUI on the Local Area Network.
- **Data Logging Module:** Internal data logging on the Moog GUI. Data logging is also possible in the device itself for autonomous applications.



MUSICIANS Mission View with Waypoints



MUSICIANS Model View



MUSICIANS Serial Configuration



MUSICIANS Integration

Specifications and information are subject to change without prior notice. Photo credit to Bluefin Robotics for the Autonomous Underwater Vehicle (AUV) image.
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PRODUCT OFFERING										
	AHRS	FOG	DVL	Housing	Pressure Vessel	Pressure Tolerant Connector	Sensor Fusion Engine	Power Supply Unit (UPS)	Depth Sensor	Connectors and Cables
MEMS System Unpackaged	✓			✓			✓	✓		✓
MEMS System Packaged	✓			✓	✓	✓	✓	✓		✓
MEMS System, Packaged Complete with DVL and Pressure	✓		✓	✓	✓	✓	✓	✓	✓	✓
FOG System Unpackaged		✓					✓	✓		✓
FOG System Packaged		✓		✓	✓	✓	✓	✓		✓
FOG System, Packaged Complete with DVL and Pressure		✓	✓	✓	✓	✓	✓	✓	✓	✓

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