

Chapter 9



Control and Navigation

Chapter 9: Control and Navigation

Stories From Real Life: Human Torpedoes and Midget Subs

Chapter Outline

1. **Introduction**
2. **Control Systems**
 - 2.1. Open-Loop Versus Closed-Loop Control
 - 2.2. The Human Role in Vehicle Control Systems
3. **Navigation**
 - 3.1. Specifying Position or Location
 - 3.2. Navigational Instruments
4. **A Basic Control and Navigation System**
 - 4.1. An Overview of Electric Switches
 - 4.2. Using a Manual SPST Switch to Turn a Light ON or OFF
 - 4.3. Using a Manual DPDT Switch to Control Motor Direction
 - 4.4. Limitations of Manual Switch Control
 - 4.5. Adding a Basic Set of Navigational Sensors
5. **Advanced Control Options: Moving Beyond SeaMATE**
 - 5.1. Do You Really Need Advanced Control?
 - 5.2. A Peek at the Possibilities
- 5.3. Microcontrollers
- 5.4. An Introduction to Electronic Signals and Communication
- 5.5. Analog Data Transmission
- 5.6. Digital Data Formats
- 5.7. Digital Data Transmission
- 5.8. Analog-to-Digital Conversion
- 5.9. Signal Multiplexing
- 5.10. Electronic Sensors and Sensor Circuits
- 5.11. Data Display Options
- 5.12. Using Transistors and Relays for Automated Power Control
- 5.13. Motor Controllers
- 5.14. Limiting Motor Travel
- 5.15. Feedback Control Algorithms
6. **Chapter Summary**

Chapter Learning Outcomes

- Give examples of control systems used in ROVs and AUVs. Discuss the advantages and disadvantages of open-loop versus closed-loop control and of simple versus complicated control systems.
- Explain the purpose and function of the navigational instruments and motor control switches used on a simple ROV like SeaMATE.
- Explain what a microcontroller is and what role it can play in the control systems used for ROVs or AUVs.
- Explain how a microcontroller can get commands from a pilot through buttons, knobs, and joysticks or from various navigational sensors.
- Explain how a microcontroller can operate thruster motors, video lights, gripper arms, and other systems on a vehicle.
- Give examples of common control algorithms; list some possible causes and solutions for common control system malfunctions.

Figure 9.1.cover: Piloting an ROV on an Offshore Oil Rig Mission

When an ROV is out of sight, working deep beneath the surface, control and navigation become major issues. A successful mission depends on accurate information about the ROV's position, effective remote control, and a skilled pilot.

In this photo, a pilot operates a VideoRay Deep Blue ROV on a natural gas rig in the middle of the Black Sea.

Image courtesy of Steve Van Meter, VideoRay LLC