REMOTELY OPERATED VEHICLES (ROVs)

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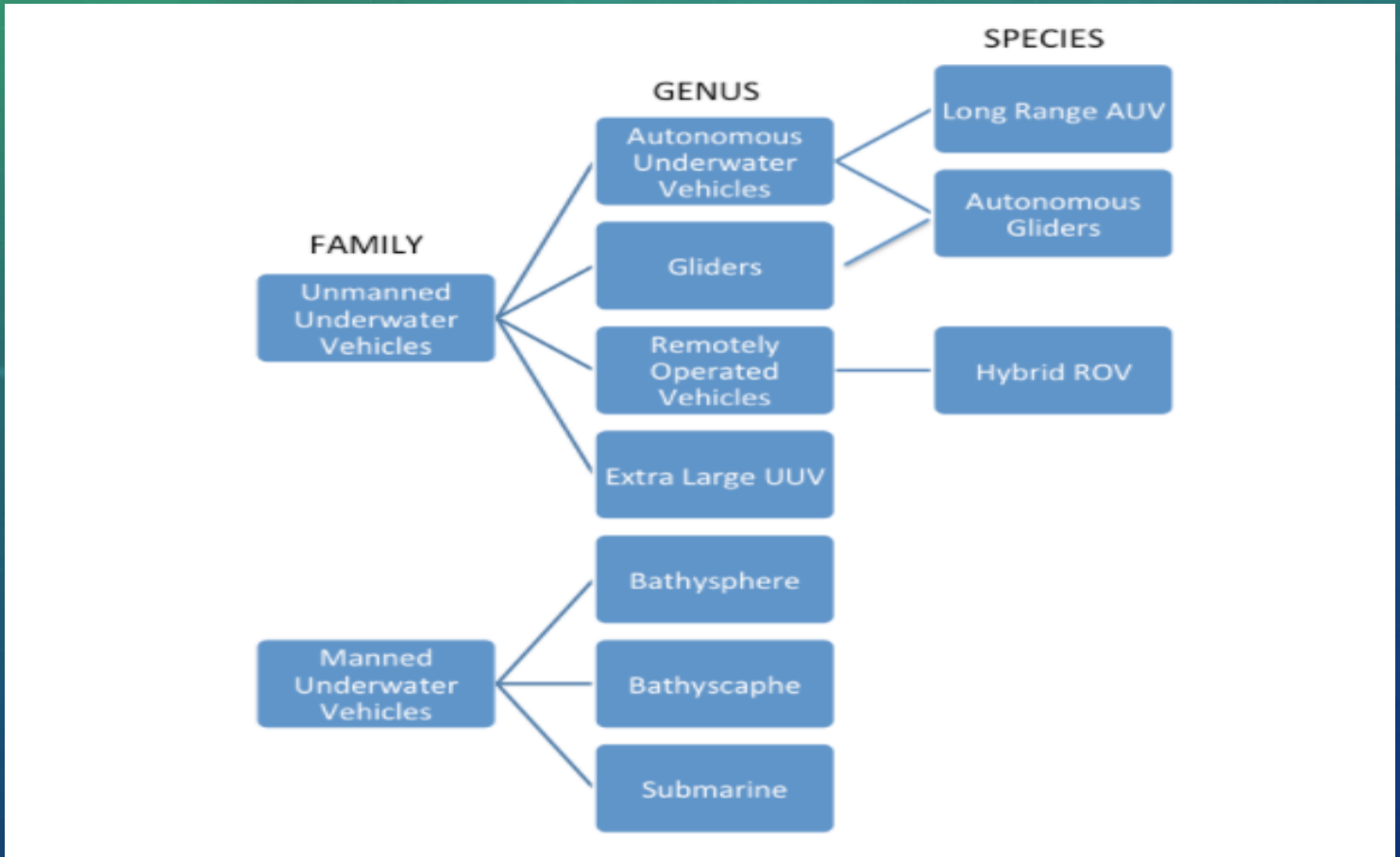
INTRODUCTION

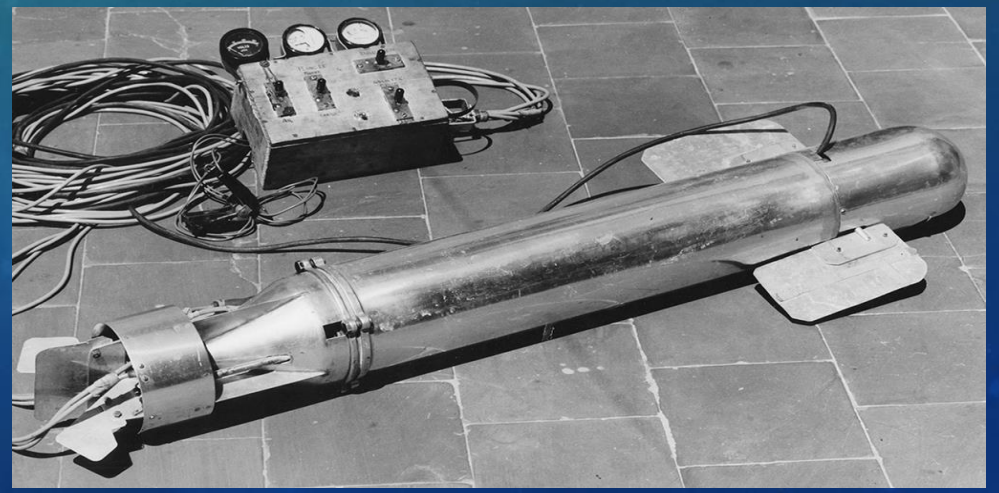
- ROV stands for remotely operated vehicle which is an underwater vehicle (sometimes referred as underwater drone or underwater robot) that is unmanned and usually tethered to the operator.
- It works wirelessly or through a wired connection and the latter is more common.

CLASSIFICATION OF UNDERWATER VEHICLE



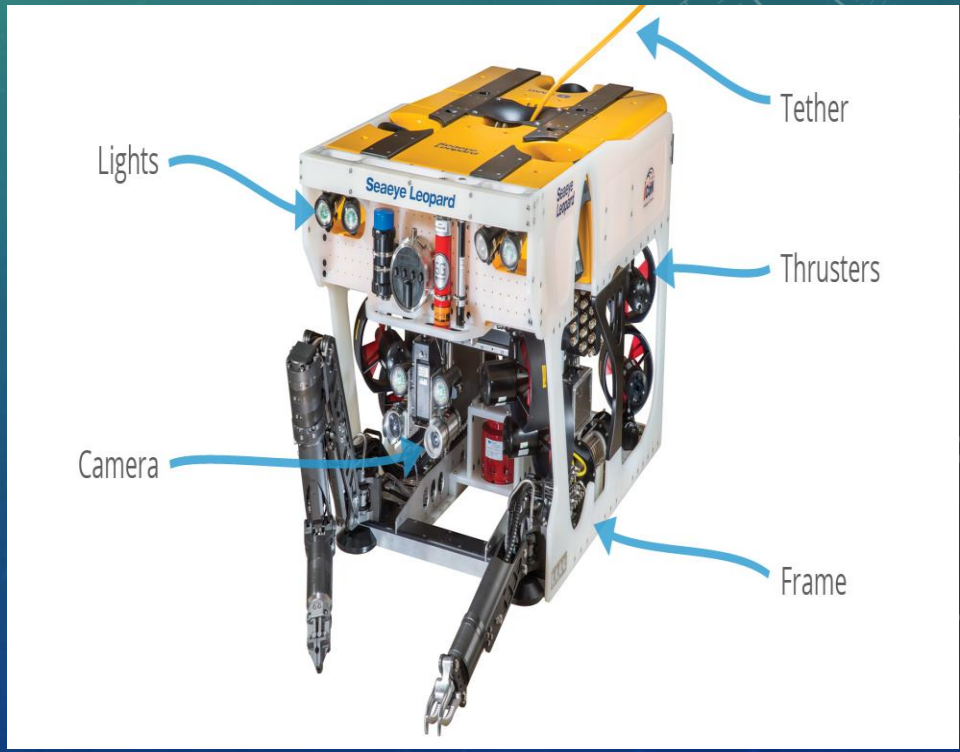
BRIEF HISTORY OF ROV

- The first ROV ever built was the Poodle made in 1953 by Dimitri Rubinoff. The Poodle was an unmanned adaptation of his dive scooter with a tether and surface controls.
- The U.S. Navy started using ROVs in the 1960s for recovery of underwater equipment and continued to advance the technology.
- By the 1980s there were more than 500 ROVs around the world, many of them being used in commercial applications.



ROV PHYSICAL DESIGN

- ROVs come in different shape and sizes which mostly depends on the application that is used for. Nevertheless, they generally share common element.
- These elements are seen mostly in all ROVs.

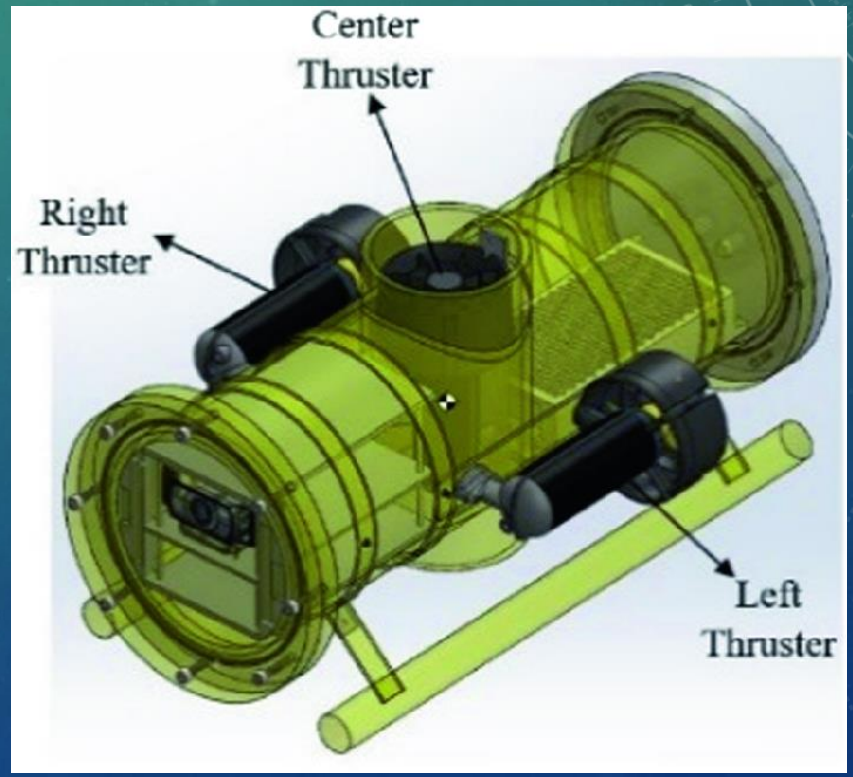


ROVs MAIN COMPONENTS

- **Thrusters:** The thrusters are electrically or hydraulically powered propellers used to maneuver the vehicle.
- **Camera:** operator eye inside the water. This camera must be able to provide an image with low-latency.
- **Lights:** The lights provide illumination for the camera underwater.
- **Tether:** Nearly all ROVs have a tether that carries electrical power and/or signals to the surface so that the pilot can control the vehicle and see the camera.
- **Frame: I**t is the part of ROV that everything else is attached to. Most ROVs are built with an open rectangular frame that makes it easy to build and modify.
- **Pilot Controls:** The surface controls (either through control room or even using smart phone) provide a physical interface for the operator to control the vehicle and a display of feedback from the vehicle including the camera view.

LOMOCATION SYSTEM AND ACTUATORS

- The propulsion system for ROVs is achieved using thrusters which are mostly powered by electric motor
- These thrusters allow motion and maneuverability for the vehicle in different direction depends on the placement of the thruster in the vehicle.
- Vertically placed thruster is used to move the vehicle up or down while horizontally placed thrusters are used to move the vehicle forward, backward and turning and most of the time the number of horizontally placed thrusters is oven which mostly two or four to keep the balance and stability for the vehicle.



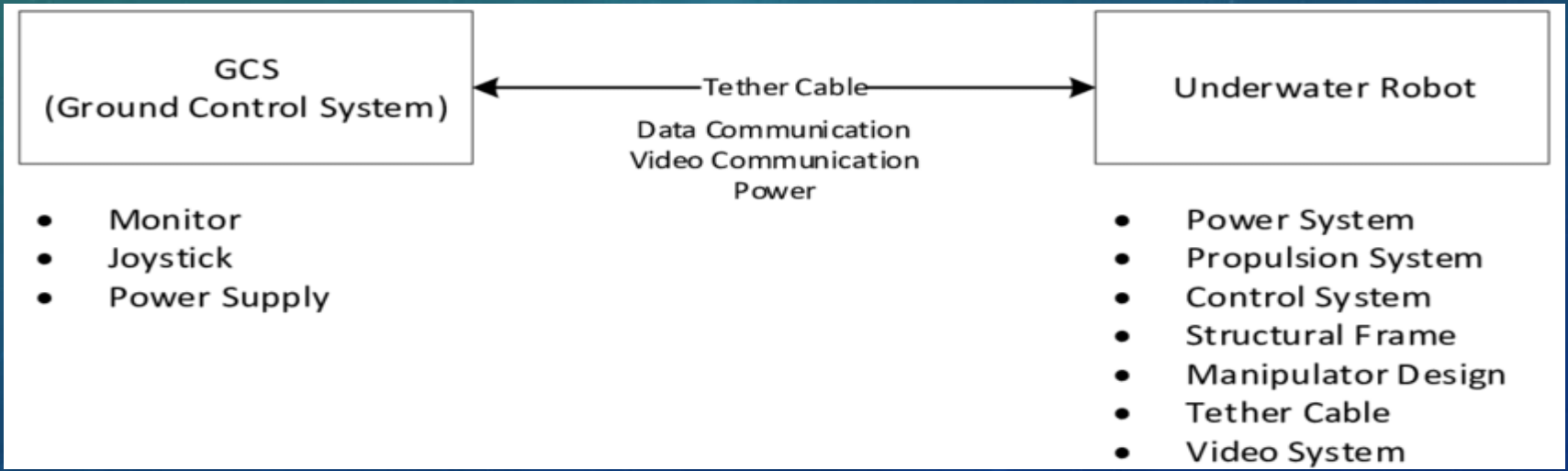
NAVIGATION SYSTEM AND SENSORS

- The navigation system is more concern when it come to AUVs (autonomous underwater vehicles) and there are different methods used rather than GPS which is unavailable in an unstable environment deep inside the water. Alternative methods such as acoustic positioning systems, Inertial Navigation Systems (INS), and the geophysical navigation approach are used for UUV navigation.
- Most common sensors used in ROVs are:

1. Radiation sensors
2. CTD (conductivity/temperature/depth) sensors
3. Pressure-sensitive depth transducer
4. Magnetic flux gate compass module
5. Slaved or rate gyro for heading stabilization
6. Imaging sonar
7. Acoustic positioning
8. Digital cameras
9. Multi-parameter environmental sensors (e.g. turbidity, chlorophyll, DO, pH, and ORP sensors)

DATA TRANSMISSION AND COLLECTION

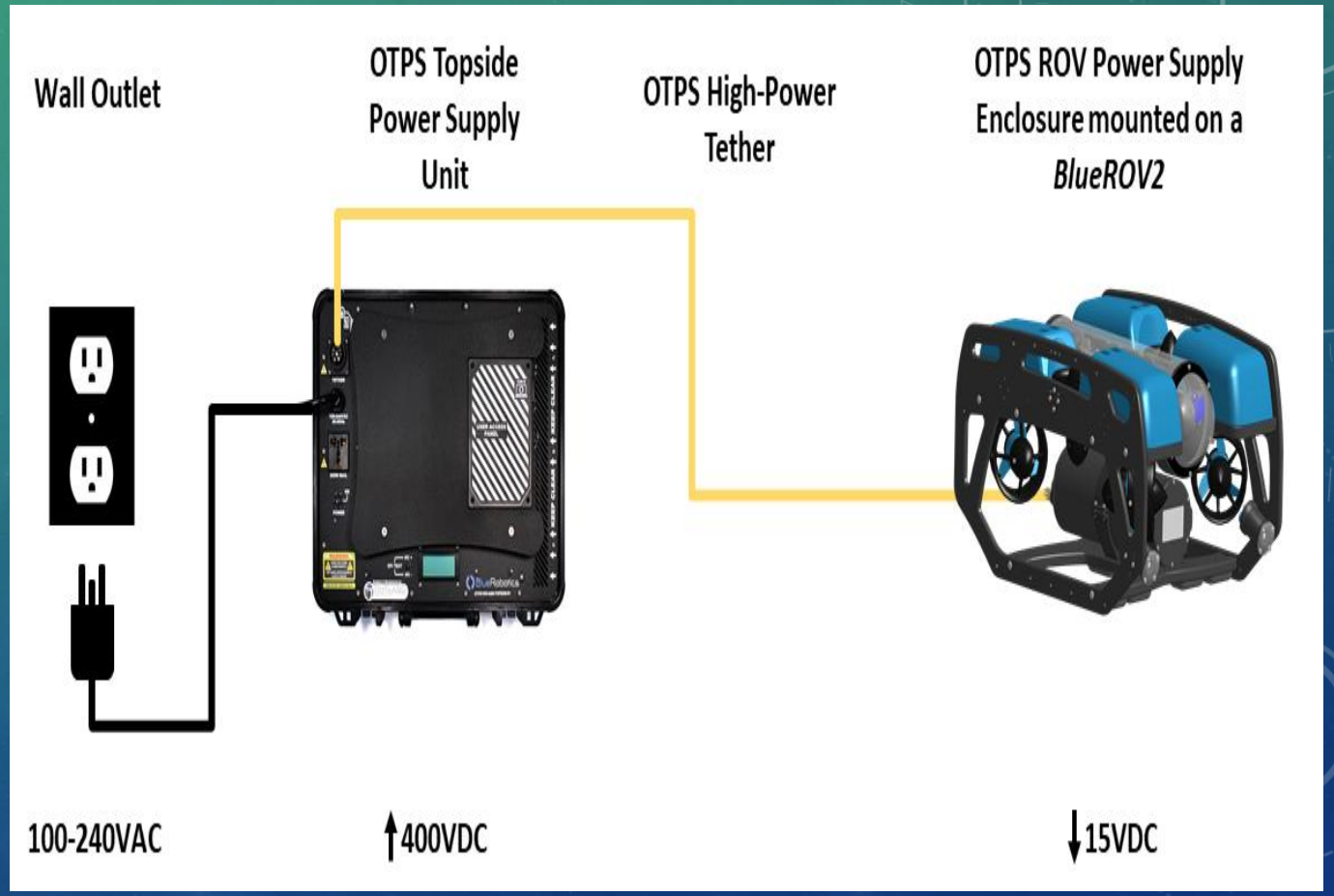
- Data is collected from the environment through different sensors and then it is sent to the internal and external control system for processing.
- For data transmission, the power signal and the instructions which will be giver by the operator through the remote control (external control system) is sent to the on-board control system (internal control system) and then it will be processed in a desired way and do the change in the system actuators.



POWER MANAGEMENT

- With extremely high speed thrusters, needing to maintain stability against high water currents, ROVs demand lots of power.
- A connecting umbilical cord, sometimes 4-6km longs, transmits power, commands, and other data to and from the ROV.
- The type of power delivered to the submersible is a trade-off of cost, safety, and needed performance.
- To operate most of ROVs, 15 DC V is supplied to the vehicle.

- A long tether with small wires, like that used on most ROVs, has an electrical resistance that causes a voltage drop proportional to the amount of electrical current passing through the wires. The best way to overcome this challenge is to transfer the power at a high voltage and low current, minimizing power losses.
- The Outland Technology Power Supply does exactly this by converting normal household power (100-240 VAC) to 400 volts DC to transfer through the tether. Once it reaches the ROV, the 400 volt power is converted down to the 15 volts needed to power the ROV.



Power system for most famous ROV which is BlueROV2