ROVs 101

An introduction to ROV structure & the basics behind designing & building your very own underwater vehicle

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What is an ROV?

Remotely Operated Vehicle – “underwater robot”

Remote: The pilot is not in the vehicle

Operated: The vehicle is controlled by a person

Vehicle: It is a self contained, integrated system
All Shapes and Sizes

- ROVs come in many shapes and all sizes
  - Small observation vehicles may only have a camera and be the 30 to 40 cm long
  - Large work vehicles can be the size of a house or semi-truck and have complex tools
  - Lots of vehicles in between
## Think of ROVs in Terms of Systems

<table>
<thead>
<tr>
<th>System</th>
<th>Relevant Emergent Property</th>
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<tr>
<td>Structure/Frame</td>
<td>Holds all of the ROV parts in a functional spatial arrangement.</td>
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<td>Buoyancy</td>
<td>Adjusts tendency of ROV to float or sink.</td>
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<td>Propulsion (thrusters)</td>
<td>Provides propulsive forces needed to move ROV through water.</td>
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<td>Power (battery or other)</td>
<td>Provides power to the ROV and associated equipment.</td>
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<td>Control</td>
<td>Allows pilot to control the thrusters, tools, cameras, lights, or other subsystems on the vehicle.</td>
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<td>Navigation Sensors (camera, etc.)</td>
<td>Provide pilot with information about where the ROV is and what it’s doing.</td>
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<tr>
<td>Payload</td>
<td>Gripper for picking up things, a set of tools for working underwater, whatever capabilities are called for by the mission.</td>
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<td>Tether</td>
<td>Transmits data and power between the ROV and the surface.</td>
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We are going to be dealing with all of these systems this week.
2 ROVs

Do each of these vehicles have the same systems?
ROVs are used in a variety of fields...

- Scientific research
- Underwater archaeology
- Oil & gas drilling support
- Homeland security
- Crime Scene Investigation
- Search and Recovery
- Pipeline inspections
- Telecommunications
- Underwater construction
- Student Learning & Competitions!
ROVs go where it is too dangerous, too deep, too dark, too dirty or too undesirable to go.

- Deep water (beyond a few hundred feet)
- Inside nuclear reactors
- Modern ROVs can do any task a diver can do. They can go deeper, stay down longer and do not need any life support systems.
ROVs are designed with a mission in mind, but sometimes must do other tasks:

- Rescue a disabled ROV trapped inside *Titanic* 2003
- Cap an oil well / oil field work 2007/2011/2015
- Explore the ocean on Jupiter’s moon Europa 2006/2016 (2020)
- Install an ocean observatory, including instruments 2005/2010/2013
- Collect organisms from under the polar ice cap 2006/2007
- Catalog data from a deep sea hydrothermal vent 2008/2010
- Rescue trapped submariners 2009
- Catalog diversity of a national marine sanctuary 2004
- Explore and identify shipwrecks 2004/2012/2014
Product demonstration goals

• On Saturday, you are going to be demonstrating your ROV in the MPC pool. You should design and build a vehicle with tools that can:
  – Pick up crabs and urchins from the sea floor
  – Remove a corroded section of pipe and replace it with a new one
  – Use a manual pump to fill a lift bag to assist in retrieving rock samples from the sea floor
Pick up crab and urchins

- Remove as many urchins and crabs as possible from the sea floor and return them to the surface, side of the pool.
Replace a corroded section of pipeline

• Design a tool to grab the U-bolt on the pipeline and remove it from the stand it is resting on. Then replace a new segment of pipe onto the stand.
Retrieve a weighted sensor from the seafloor

- Use a manual pump (hand or foot) to fill a lift bag and bring a 2-lb weight to the surface.
- MATE will provide the pump.
Other objectives

- Try some other vehicle designs. Fly some other vehicles and compare to your own design.

- Be creative. Think about how you could do something differently. Consider how you would do it if you had more technology and how you could get something done with less technology.

- Have fun.