UNH Remotely Operated Vehicle (ROV)

The development of an unmanned underwater ROV

Team Members: Jarrett Linowes, Nathanial Cordova, Sayward Allen, Shaun Hespelein, Gerald Rosati, Sathya Muthukkumar, Alex Dzengeleski, Jianqing Ye, Zhuo Xu

Project Advisors: Professor May-Win Thein, Professor M. Robinson Swift; Graduate Advisor: Firat Eren

MATE ROV Competition

- International colligate competition held annually around the world
- Arctic themed life-like mission task simulations
- ROV design constraints:
  - 75x75 cm size constraint
  - Power tether to surface carrying 48 Volts
  - Visual guidance from ROV perspective
  - Ability to manipulate objects and the environment underwater

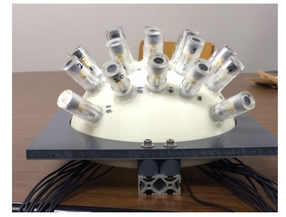
http://www.subseaexpo.com/wp-content/

ABSTRACT

UNH ROV is an interdisciplinary engineering team focused on designing, fabricating, and competing with an underwater Remotely Operated Vehicle (ROV). The design incorporates a high degree of modularity by accounting for constraints defined by the international MATE ROV Competition as well as PhD research specifications involving autonomous Unmanned Underwater Vehicle (UUV) control. Each part of the design was conceived using 3D modeling software, analyzed using finite element simulation packages, and verified through a prototyping and testing process. By using cutting-edge methods in team dynamics, analytic tools, and engineering design, UNH ROV is able to maintain continued success in developing underwater robotic systems used for various different platforms for research and competition.

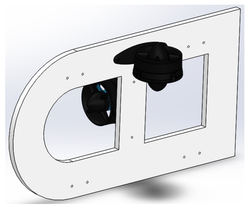
Research

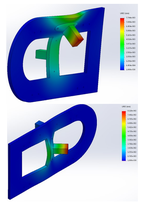
- Platform for research in optic based pose detection in a leader-follower system of multiple UUVs
- Third ROV in a fleet that will be developed for the research project funded by the Naval Engineering Education Center
- Algorithm developed to detect image invariants from the mounted light sensor array

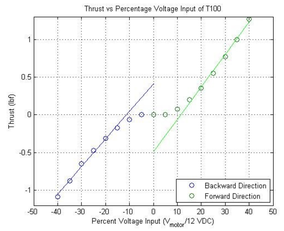


Propulsion Design

- 6 thruster configuration
- 5 degrees of freedom — X, Y, Z, Yaw, Pitch
- Compared Seabotix BTD 150 (brushed) vs **Blue Robotics T100 (brushless)** thrusters
  - 5.2 pound-force, operating voltage of 12 Volt and maximum amperage of 11.5 Amps







Human Interface Devices

- Tethered control using intuitive input for precision control of the ROV
- Xbox 360 controller using the Xinput API as primary input device for drive control
- Leap Motion controller paired with Leap SDK for precision drive and mechanical manipulator arm control
  - Drive control using reduced thrust
- Manipulator control by mapping digital representation of your hand to servos.

LEAP MOTION

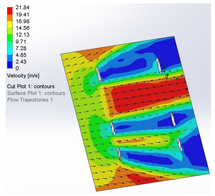
http://froont.com/leaptomax/z43u13/_static-uploads/images/thumbnail/leap-

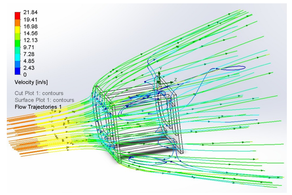
XBOX

http://pulp365.com/wp-content/uploads/2014/06/

Frame Design

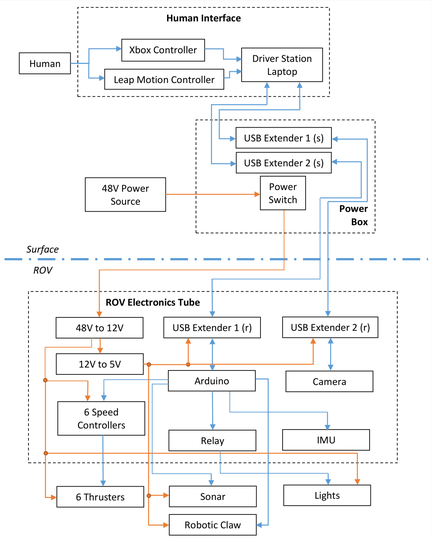
- Modular and open frame designed with fluid dynamics and buoyancy in mind
- Polycarbonate, aluminum, and acrylic for a high strength to weight ratio
- Slightly positive buoyancy for emergency retrieval during potential system failures





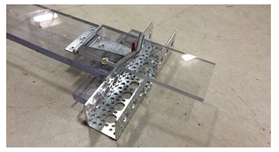
Systems Diagram

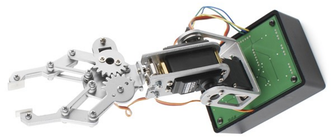
- Power box that provides a "universal hub" for all power and data cable transfers
- 48 V power source stepped down to 12 V and 5 V
- Camera and video feed utilize isolated USB extender to ensure high bandwidth data transfer
- Internal/external forward/backward component communication between the surface, and ROV
- Speed controllers feature custom BlueRobotics firmware specifically written for brushless forward/reverse movement



Manipulators

- Static and dynamic solutions for manipulation of objects and the environment
  - Mechanical, 2 DOF manipulator controlled using the Leap Motion controller
  - Static manipulator arms designed for specific loading and guidance tasks
- Manipulators will be used to complete mission tasks defined by the MATE ROV Competition

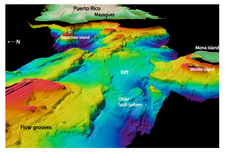




http://www.robot-italy.com/media/catalog/product/cache/3/image/

Capabilities

- Underwater measurements of objects (including distances, width and height)
- Precision manipulation of objects and the environment underwater
- Modular design allowing various uses as a platform for scientific applications
- Swarm control of multiple UUVs
- Threat detection of ice bergs and other large objects
- Sea floor mapping capabilities



http://soundwaves.usgs.gov/2007/05/MonaSW1LG.jpg

Sensors

- Pressure sensor for altitude feedback and control
- 6 DOF IMU for orientation feedback, stabilization, and leveling of the ROV
- Sonar sensor for underwater target measurement
  Objects measured by a pixel-based system using distance and visual feedback
- All data will be displayed in real-time on HUD style user interface
- Mounting points and USB interface ready for research based optical feedback sensors for pose control
- Available mounting space for onboard computer

http://www.olimex.cl/images/MCI-SEN-01311_MCI-SEN-01311.jpg

Special Thanks: Dr. Martin Renken, Tara Hicks Johnson, Scott Campbell, Kevin Maurer