Multi-Project!

Multi-Discipline!

Remotely Operated Sea Crawler (ROSCo IV)

M. Corbet, T. Hackett, S. Houser, C. Kesselring, P. Liljegren, K. McKaige, M. Pumphrey

Advisor: Dr. Wood, Ocean Engineering, Florida Institute of Technology

OBJECTIVE

The objective of this project was to continue the **multidisciplinary** design of a durable sea crawler system that would be able to undertake seafloor missions where divers are not able to explore due to physical limitations. The remotely operated vehicle (ROV) allows for the use of variable attachments for the collection and retrieval of both large and small artifacts from the seafloor. The ROV features a buoyancy control system which allows vertical movement through the water column.

DESIGN CRITERIA

The design of the multidisciplinary system had the following requirements :

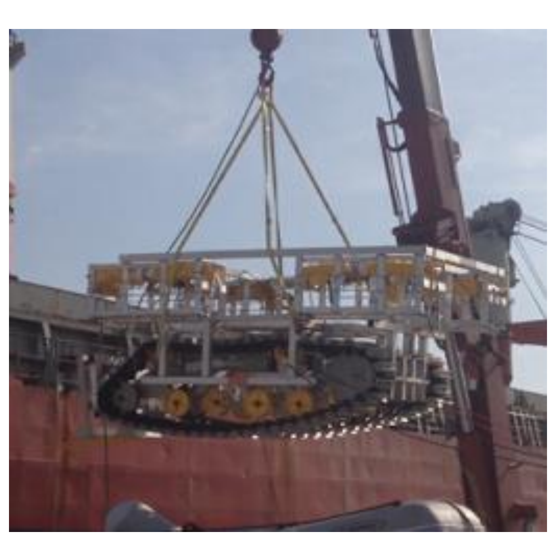
- Fully operable to 100 ft. depth
- An operational buoyancy system
- Functioning manipulator arm
- Opportunities for expansion

SYSTEM DESIGN: MECHANICAL

The mechanical superstructure reinforcements were planned using Creo and tested using resources available through the school, including an A-frame. Alterations to the structure of the frame were made using 6061 aluminum.

Reinforcements were made to the main C-beam that runs the length of the crawler in the shape of ribs and cross supports. These reinforcements reduced the vibrations and strengthened the structural integrity of the system.

Other mechanical additions included steady lift points on the superstructure. The lift points were simple U-bolts that created a consistent location where the crawler could be lifted from. The U-bolts and surrounding structure were designed to be able to lift the crawler from one lift point in an emergency situation and for easy and safe accessibility by a diver to detach the harness when deploying the crawler into the water on a mission.



SYSTEM OVERVIEW

FORKLIFT

- 200 lbs. lifting force
- Variable forks

BUOYANCY SYSTEM

- 1000 lbs. Lift Capacity
- Electrical fill / dump

ELECTRICAL

- Professional Tether
- Digital Control System
- Subsea Power Conversion

DRIVE SYSTEMS

- (2) 0.5 hp Baldor DC motors
- (4) Thrusters

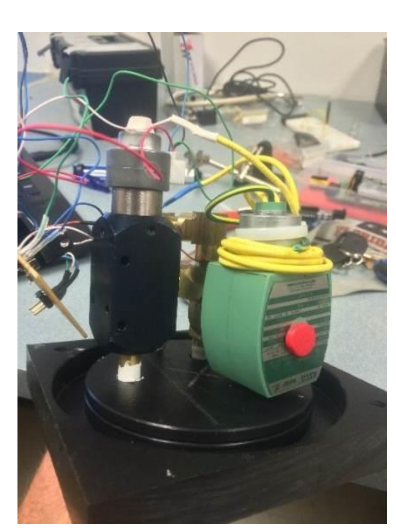
HOUSING

- 300 ft. deep pressure tested
- Possible expansion

OPTICAL

- 360 degree subsea camera

SYSTEM DESIGN: BUOYANCY CONTROL*



The Buoyancy system for the crawler consisted of four underwater lift bags, each with a lifting force of 250 lbs. To precisely control the airflow into and out of the bags, a two valve system was implemented for each bag. The inflow valve was a proportional valve controlled using a stepper motor and the outflow valve was a simple solenoid valve. The entire system has been placed inside a 4" acrylic tubing with custom starboard end-caps that are fitted with wet-made electrical connectors. The bags are independently controllable of each other to allow for more precise trim control when the crawler is "airborne" in the water column. The pitch, trim and yaw of the crawler can be controlled using potentiometers in the surface box.

The forklift is capable of lifting up to 200 lbs. of dry weight. It was altered during our generation to include a mountable faceplate and adjustable fork width for a variety of operations. These alterations allow the operator to lift a range from smaller, delicate to larger, unwieldy artifacts off of the sea floor. The forklift, as well as, the other attachments, aid alongside divers for standalone applications.

SYSTEM DESIGN: ELECTRICAL

Every sub-system on the crawler is controlled from the surface using PIC microcontrollers situated in a surface control box equipped with various joysticks, potentiometers and switches. The surface box communicates down to two pressure chambers equipped with corresponding power convertors, motor drivers, PIC microcontrollers, a heat sensor, leak detector, and pressure sensor.

The crawler traverses along the seafloor using tracks powered by a 220 V AC to 180 V DC power convertor and 0.5 hp motors. Two h-bridge motor drivers, using signals from a PIC, control the speed and direction of the motors. The power and communication for the tracks is in one pressure chamber connected by wet mates from the professional tether.

The second pressure contains a 220 V AC to 12 V DC and a 220 V AC to 24 V DC power convertor to supply power to the actuators, the thrusters and any other accessories needed underwater.

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*Publication

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Genoa Italy

NORTHROP GRUMMAN

Engineering & Science Student Design Showcase at Florida Institute of Technology