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Robotic Inspection of Geometrically Complex Tank Systems

James Dinsmore
Virginia Commonwealth University

Jay Kim
Virginia Commonwealth University

Randolph Snook
Virginia Commonwealth University

Thanh Tran
Virginia Commonwealth University

Trenton Wilhelmi
Virginia Commonwealth University

Team Members: James Dinsmore, Jay Kim, Randolph Snook, Than Tran, Trenton Wilhelmi

Faculty Advisor: Dr. John E. Speich

Sponsor: Newport News Shipbuilding

Sponsor Advisor: Richard Hillyer, Allen Valencia

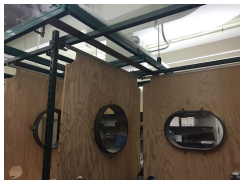
MECHANICAL AND NUCLEAR

Robotic Inspection
of Geometrically Complex Tank Systems

CAPSTONE DESIGN EXPO 2015

Introduction

- Collaboration between Newport News Shipbuilding and VCU School of Engineering
- Continuation of 2013-2014 Senior Design Project
- Automated robotic inspection system to move within confined tanks to reduce manned entry work hours
- Tank system contains individual bays with an average size of 47" X 35"
- Lightening holes for entry are approximately 20" in diameter, but range in size and shape

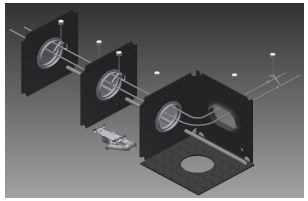


Mock-up of Bay System

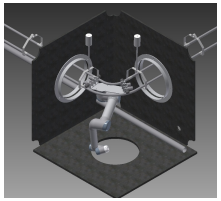
Design Objectives

- Invert the rail system to allow for manned entry without the necessity to remove the railings
- Redesign the carriage system to accommodate the inverted rail system
- Ability to traverse corner bays to allow for continuous inspection
- Remotely operated motorized control system to move carriage throughout the bay system

Rail Design



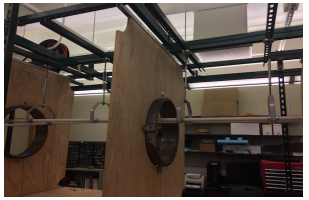
Modeling of Rail System



Modeling of Corner Rail System

- Utilizes magnets to support the rail system
- Down rod with turnbuckle to allow for height adjustment
- Hanger Bars connect the down rods to the PVC railings
- Two hanging systems per bay to provide support for robotic arm operations
- Curved pipe with radii of 6" and 14" for corner bays

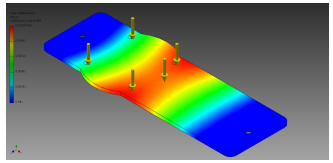
Built Hanger System



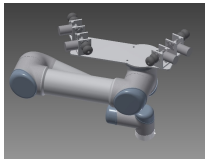
Installed Rail System

Carriage Design

- Solid plate foundation that supports the UR-5 Robotic Arm and attachments
- Pivoting wheel housing group allowing for the carriage to navigate the curved rail
- Independent drive system consisting of four servo motors to reduce slip around the curved rail
- Wheel housing group mounted above carriage deck to allow for the inverted rail design



Displacement of Carriage Deck with UR-5 Fully Extended



Carriage System with the UR-5 Robotic Arm

Future Development

- Increase stability of the rail system to allow for future applications such as blasting and coating of tanks
- Precise motorized control for exact position locating in the bay system
- Improvement in rail material for increased durability
- Further research on end effectors

VCU School of Engineering

Newport News Shipbuilding
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Make it real.

VIRGINIA COMMONWEALTH UNIVERSITY