Rapid Autonomous Corrosion Evaluation Services (RACES)

JTEG Technology Forum:
Corrosion, Detection, Prevention and Control

Safer, Smarter, Better | Reimagining Government Together

27 September 2022

The Problem

- "The DON spends more than $8B each year combatting corrosion of metal surfaces". – Carlos Del Toro, SECNAV
- Manual inspections, analysis of ship's topside & underwater surface along with ship tanks are:


Time consuming


Expensive


Dangerous

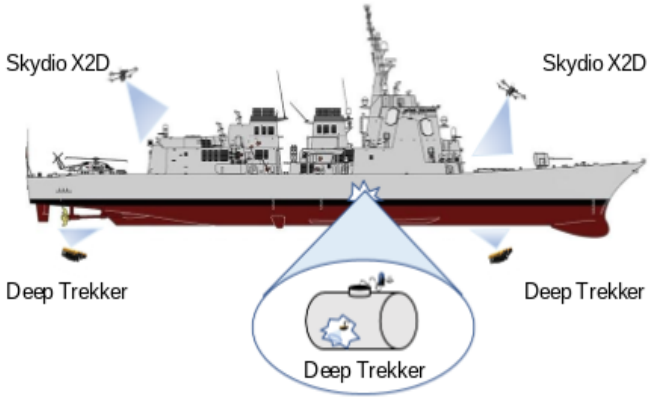
- Frequent periodic inspections are needed to efficiently plan maintenance across a naval fleet
- Periodic inspections need to be done *in situ* dockside, before the ship enters the shipyard or before leaving a shipyard after maintenance period

The Solution - RACES

- Serco has partnered with Google, introducing a turnkey rapid scanning service for conducting surface condition evaluations (rust, corrosion, damage & fouling) of **ship topside, underwater hull, and internal tanks** utilizing autonomous UAVs and ROVs.
- Ship topside and underwater hull scans completed in less than 8 hours (depending on ship size) with easy-to-understand scan reports available within 48 hours of completion.
- RACES is also available for other shipyard infrastructure inspections, such as cranes, docking stations, and piers.

The Solution - RACES

Automated Data Collection

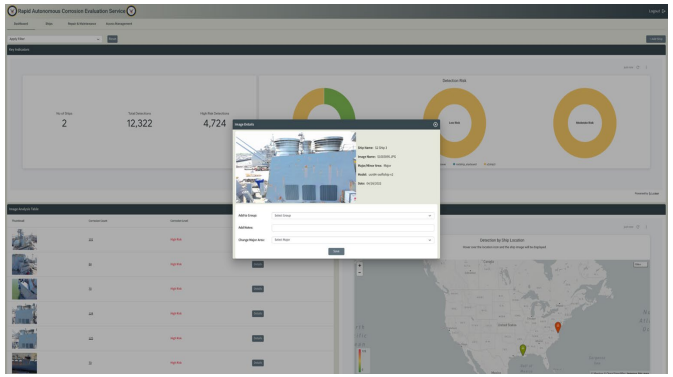


FAST: Hours not Days
THOROUGH: Covers Topside, Hull, Tanks
SAFE: Eliminates Manual Inspections

Automated Modeling

INSTANT: Big data to important data for analysis
INTELLIGENT: Models trainable to Navy standards
PREDICTIVE: Models feed predictive results over time

Actionable Information



INFORMATIVE: Explorable views per role
ACCESSIBLE: Available securely from a browser
TIMELY: Drive efficiencies in maintenance decisions

RACES is Fully Executed in *Days*

The Solution - RACES

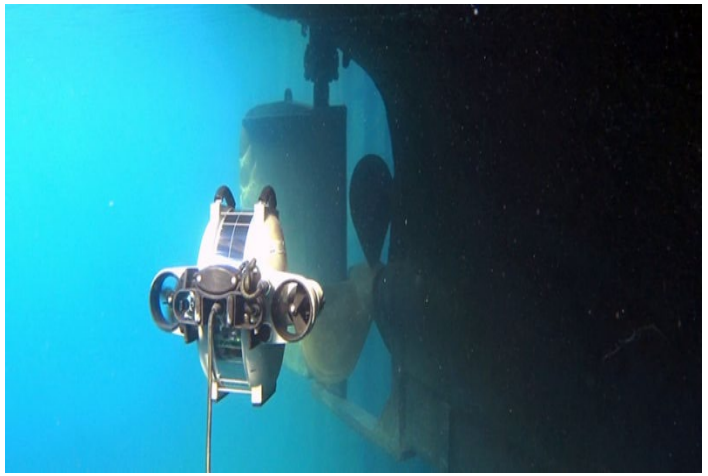
- Team unit: (2) FAA UAV - Certified Pilots, UAV kit + spare, ROV kit + spare
- Structure and ship topside scans are completed using UAV Drones
- Underwater scans are completed with ROVs
- Flooded Tank scans are accomplished using ROV. Empty tanks are scanned using UAV.
- After scan completion, data is sent to secure Google Cloud server, where Serco Scan Analysis Center runs Google AI/ML tool and generates report
  - Customizable reports available
  - NSTM 631 graded surface rust condition levels
  - Underwater fouling grade levels

ROV

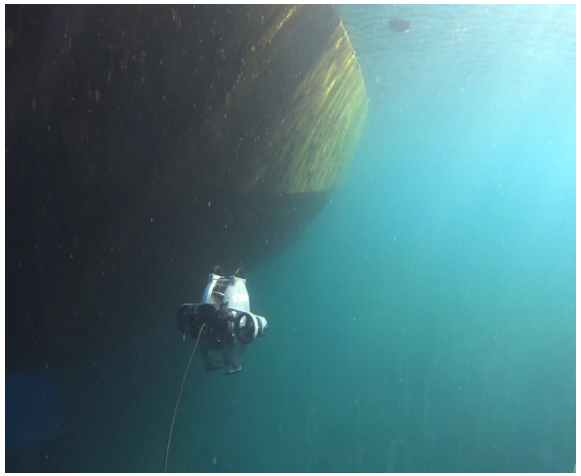
- Serco provides an efficient way to conduct hull and tank inspections for rust, corrosion, and damage using our rapid scanning solution with vendor agnostic ROVs.

- Systems are commercial off-the-shelf (COTS) and the high-resolution multispectral data collected is analyzed with a report generated for the end-user.

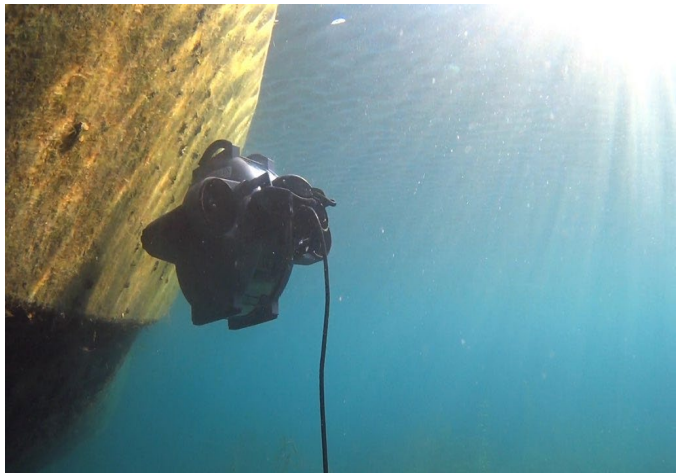
Example ROV Inspection



Rudder Inspection

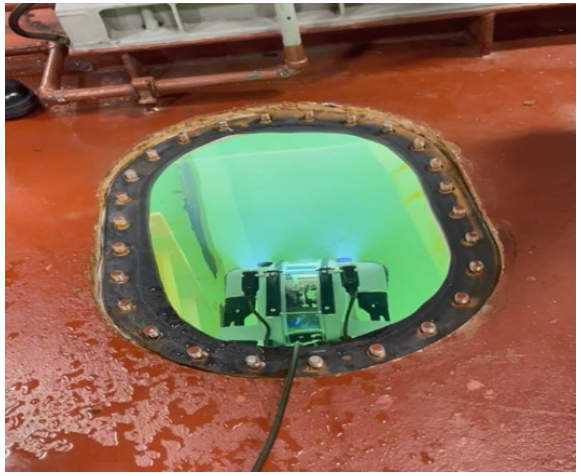


Hull Inspection



Close Hull Inspection

Sounding Tube Coating Failures



Access Tank Cover

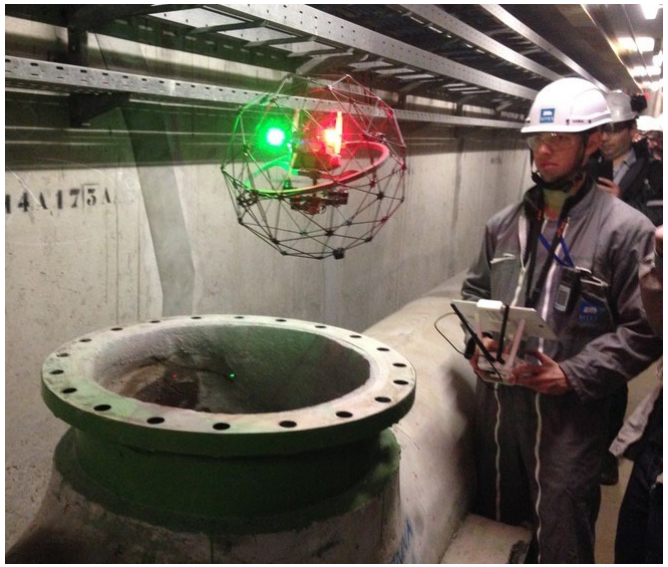
Tank Level Indicator Inspection

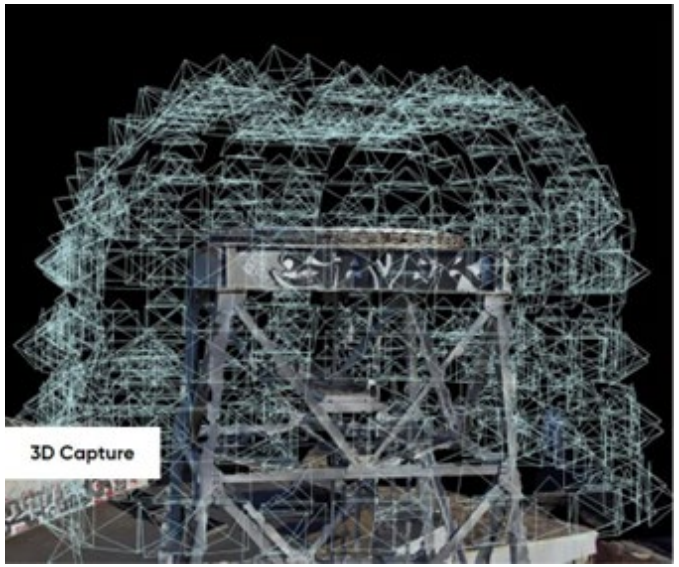
**Images from tank inspection conducted on USS BULKELEY (DDG 84)*

UAV

- Using UAVs, the Serco Team conducts full topside scanning of the hull from above the waterline to include the superstructure and mast areas

- A UAV can also be used for empty tank scanning





Example UAV Inspection

UAV Improved visual perspectives

UAV Safer Mast inspections

UAV Automated Corrosion Detection

**conducted aboard USS Bulkeley*

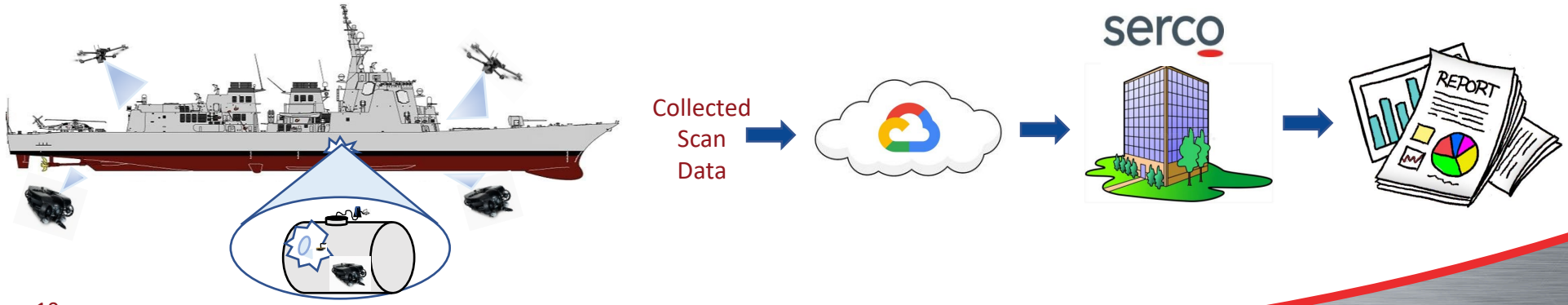
Serco Technology

- **S**ystems can be equipped with Multi-Spectral, LIDAR, and 3D Sonar sensors to evaluate surface conditions and damaged areas.

- Features include autonomous interpretation of data with graded condition status, repair priorities, and illustrations providing a comprehensible report based on Naval Ships Technical Manual (NSTM) and Maintenance Requirement Card (MRC) standards.

- Customization of AI/ML software for new designs and a tailorable dashboard with interactive 3D models.

- Scans are completed using UAVs & ROVs. After scan completion, data is sent to an encrypted Impact Level 4 (IL4) Google Cloud server where the Serco Scan Analysis Center processes the data using Google's AI/ML tool and generates a corrosion report for the end-user.



Google Cloud AI/ML Enablement

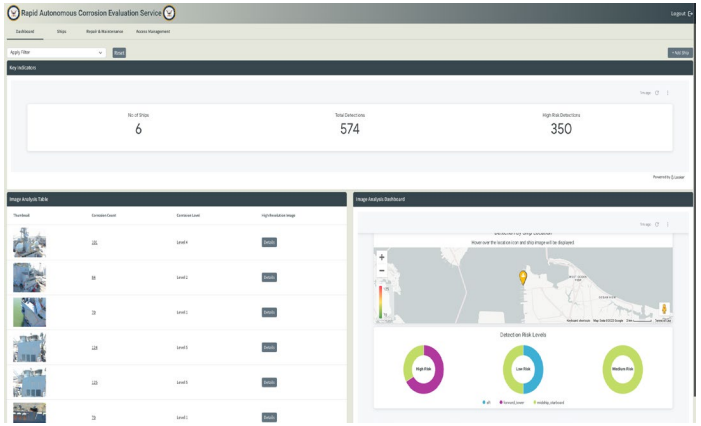
- Google Cloud technology provides a future-proof/open-standards architecture, advanced AI/ML, and easy data access/visualization capabilities
  - System supports phased upgrades to sensors and reports

- Google Cloud AI/ML experts work jointly with the Serco Scan Analysis Center to ensure models are tuned, consistent, and accurate

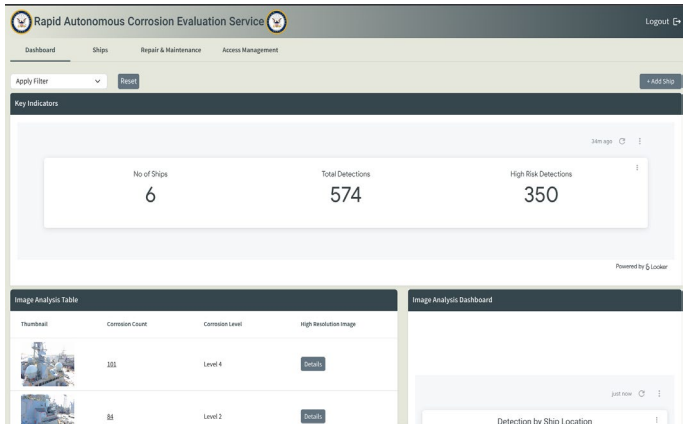
- The aggregation of data from various assets in a class (i.e., DDG) allow the ML discovery of trends, improvement of methods and results
  - External data can be incorporated to enrich models and provide context

SYSTEM CAN CREATE AN INTELLIGENT “ELECTRONIC HEALTH RECORD” FOR ANY SHIP, FINDING PATTERNS AND MAKING PREDICTIONS FOR MAINTENANCE PLANNING ACROSS THE FLEET

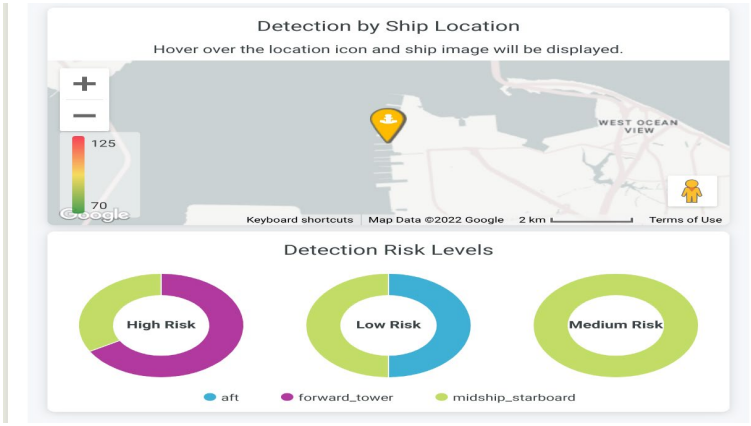
Google Dashboard Images



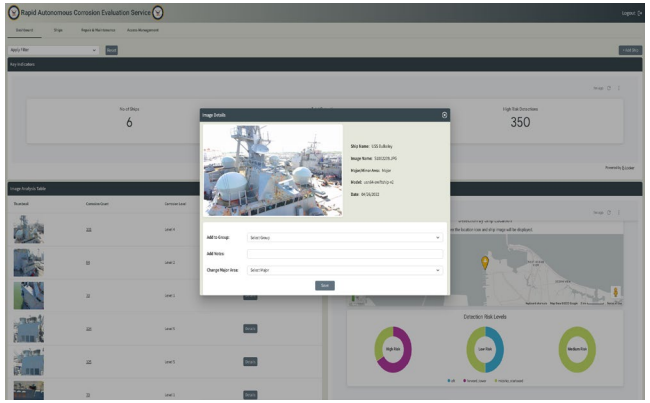
High-Level Command View



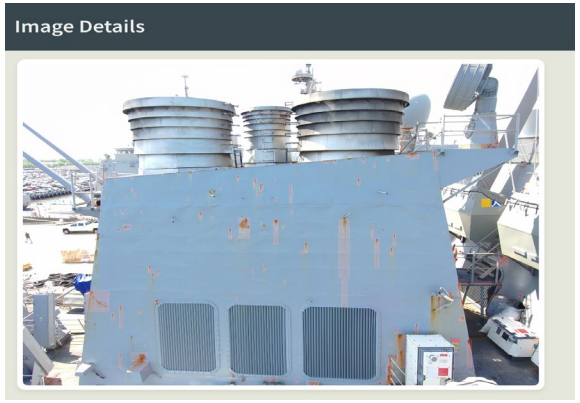
Dashboard View



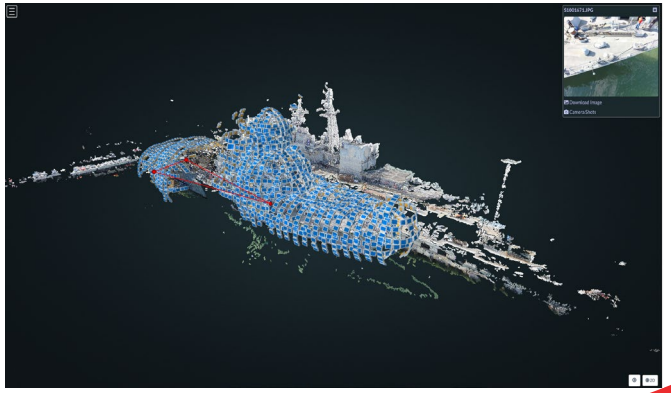
Detection by Ship Location



Pop out box image & Notes



Corrosion



3D Scan

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