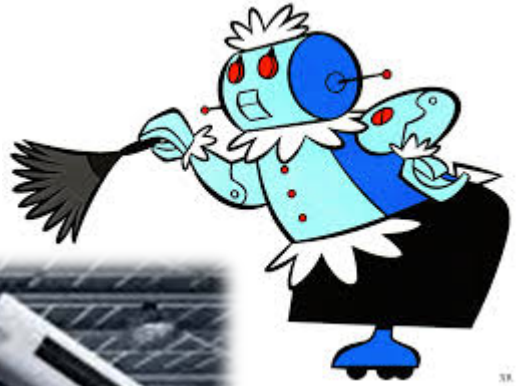
Survey of Surface Preparation and Coatings Automation Panel Briefing

June 24, 2020

Survey of Surface Preparation and Coatings Automation



PROJECT TECHNICAL REPRESENTATIVE

- Arcino Quiero, Jr., HII-NNS

INDUSTRY INVOLVEMENT

- BAE Systems JSR – Stephen Cogswell
- GD-BIW – Robert Cloutier
- HII-Ingalls Shipbuilding – Conlan Hsu

NAVY INVOLVEMENT

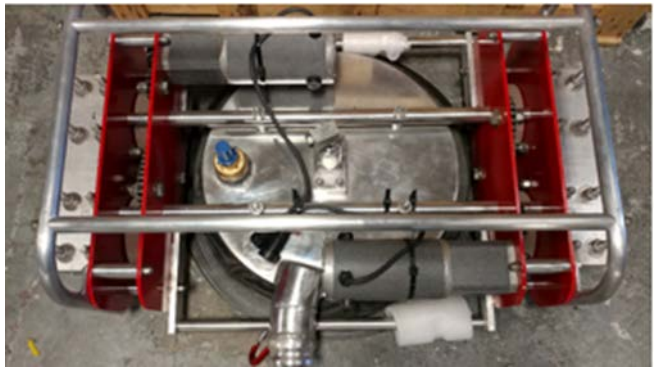
- None

Survey of Surface Preparation and Coatings Automation

SCOPE

- Establish the current state of surface preparation and coatings automation in shipyards
- Identify the current state of the art in two areas:
  - Surface preparation and painting automation in other industries
  - Use of robotics and automation in shipbuilding (all trades)
- Perform a gap analysis to identify paths forward for automating surface preparation and coating activities in shipbuilding
- Identify promising technologies for shipyard demonstration on production scale and lay out a path forward for NSRP, perhaps through an RA project

Major Activities



- Field Visits Performed/Planned
  - Allstream UHP Stingray Robotic Hydroblasting System
  - JH Fletcher/ARS Cobra Robotic Grit Blaster (2 locations)
  - Titan Robotics
  - PPG automotive applications lab
  - Manufacturing USA – Advanced Robotics for Manufacturing (ARM)
  - *Boston Dynamics (planned)*
  - *Boston Engineering (planned)*
- Workshops
  - Fall Panel Meeting (SEP2019)
  - Winter workshop cancelled
  - *Stakeholder meeting envisioned*
- Industry Outreach and Research

Field Visit Notes

- Shipyard Production Demonstration
  - Allstream UHP Stingray Robotic Hydroblasting System
    - Demonstrated improved productivity vs current system
  - JH Fletcher/ARS Cobra Robotic Grit Blaster
    - Lessons learned at first demonstration led to a successful second demonstration

- Other Industry Solutions
  - Titan Robotics
  - PPG automotive applications lab
  - Manufacturing USA – Advanced Robotics for Manufacturing (ARM)
  - Remaining Visits focus on “tank crawler” problem
  - Several meeting with various solution providers

Workshops

- State of SPC Automation
  - Attached solutions being implemented and optimized on flat surfaces (e.g., hulls and decks)
  - Rail/gantry solutions being implemented and optimized in early stages of production (production lines and shop applications); concepts being developed for use in late stage construction
  - Crawling systems are being developed for various industry uses; their use in late stage construction would be transformative for the industry






Workshops

- Needs Analysis
  - Identify needs for generic activities
  - Intended to be part of this meeting; hope to schedule survey or telecon to discuss with a "stakeholder group"

Activity	Grit/Hydro Blasting	Vacuuming	Painting	Inspecting
Payload/End Effector	Blast nozzle, grit/ water supply hose (1-2 inches), grit/water in hose, vacuum hose	Suction hose	Spray gun nozzle, paint, hose, IR sensor, solenoid valve	Camera, sensors
Forces	Weight of hose and blast arm (if there is one), resist force of grit/water coming out of nozzle (80-120 psi/4000-10000 psi), weight of robot (for climbing), magnetic force (for climbing)	Vacuum force (-5 to -8 psig), weight of robot (if climbing), magnetic force (if climbing)	Spray gun, weight of paint arm, weight of robot (for climbing), magnetic force (for climbing)	Weight of robot (for climbing), magnetic force (for climbing), weight of camera arm
Environment	Dusty, sparks, dark, tight spaces, weather, toxic waste (paint, oxides), possibly no large, flat surfaces (issues for vacuum blasting)	Dusty, tight spaces	Complicated geometry, toxic vapors, tight spaces, weather	Dark, dusty, tight spaces, moving camera arm around obstructions
Sensors	Accelerometer, gyroscope, proximity sensors	Accelerometer, gyroscope, proximity sensors	Accelerometer, gyroscope, proximity sensors	Accelerometer, gyroscope, proximity sensors
Ingress Protection Rating	IP-64	IP-54	IP-54; intrinsically safe (explosion)	IP-54
Extra Systems Needed	Compressor, collection tube (if collecting waste), electrical power for compressor	Return tube, filtration system for hazardous waste or liquids, electrical power for vacuum motor	Compressor, electrical power for compressor, QA system (wet film gauge? Some other sensor?)	None

Industry Outreach and Literature Review

- U.S. Shipbuilding Process
- Robotic Design Factors
- NSRP and NRL Projects
- Industrial Robotics
- GEOJE Shipyard
- Discussions with wide range of vendors

Robotic Design Factors

Mobolity system design

- Wheeled
- Tracked
- Double frame
- Rail
- Fixed

Adhesion system design

- Magnetism
- Suction Force
- Mechanical
- Chemical

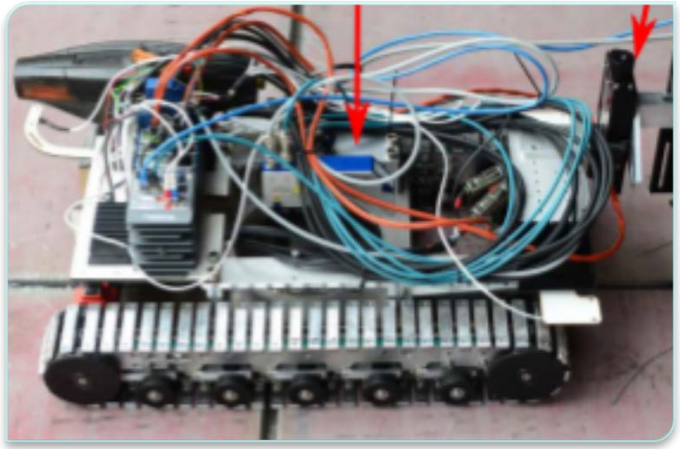
Degree of autonomy

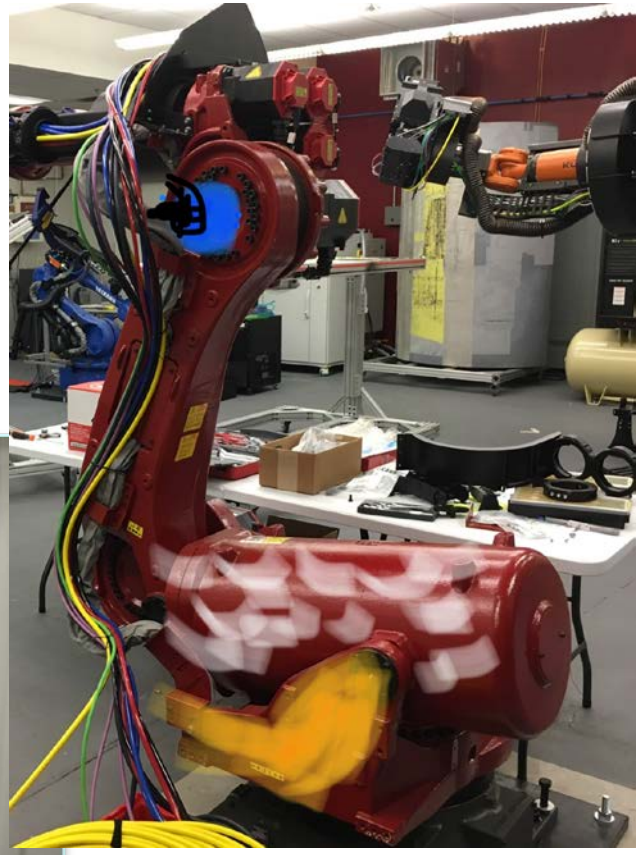
- Remote
- Semi-Autonomous
- Autonomous

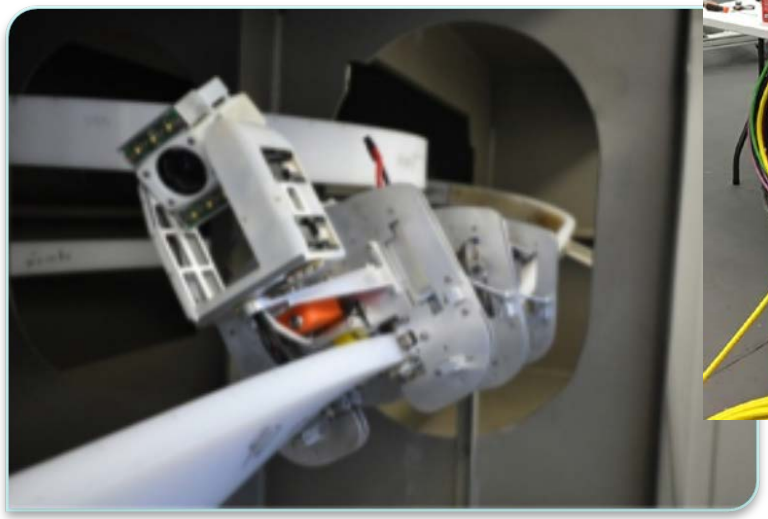
Programmability

- Single
- Multiple
- Repeatable

Mobility System Design







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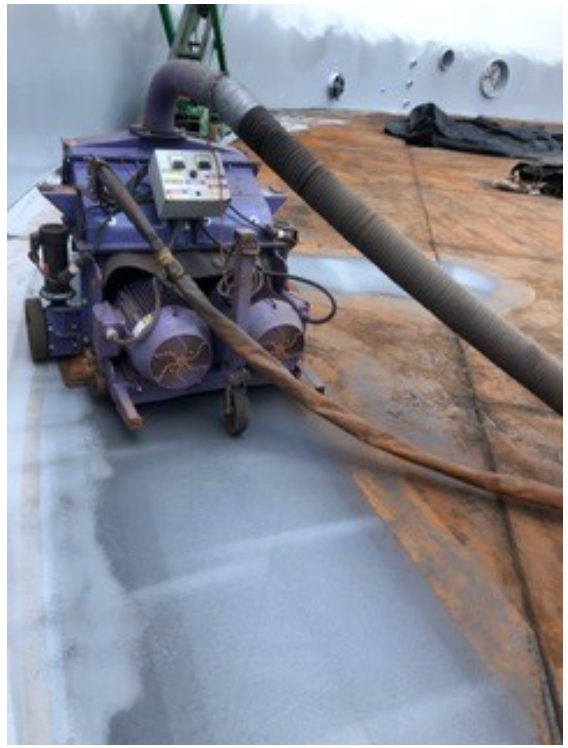
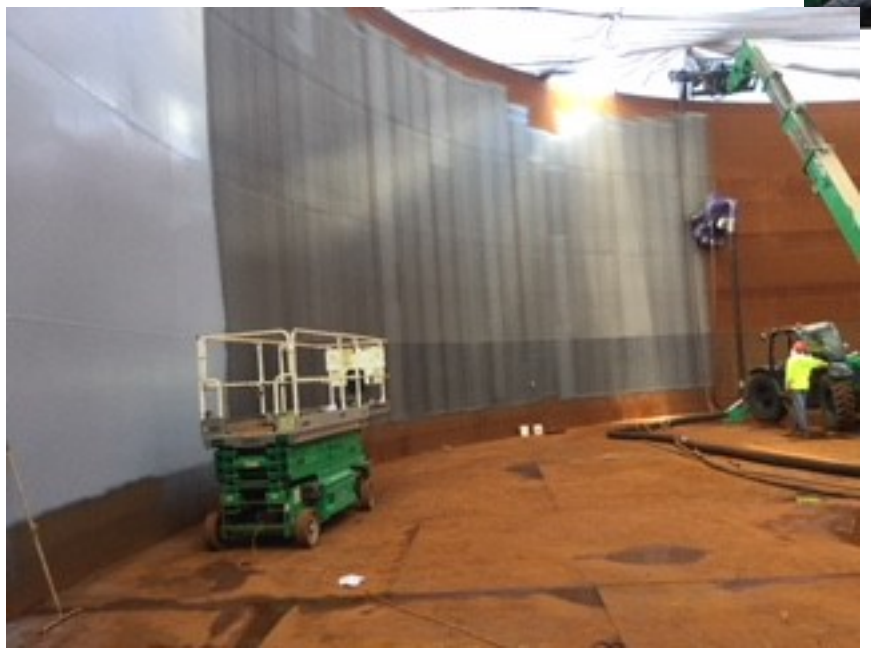
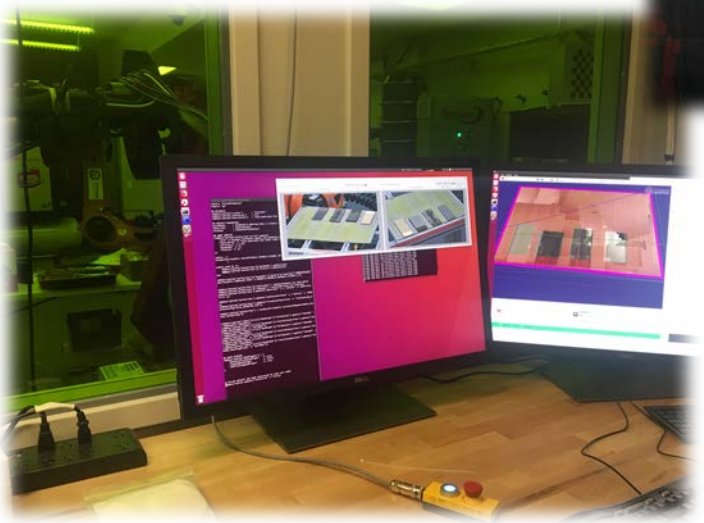
Adhesion System Design





- Magnetism
- Suction Force
- Mechanical
- Chemical

Degree of Autonomy & Programmability



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- Autonomous

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- Multiple
- Repeatable

Path Forward

- Complete final field visits
- Conduct some final information from stakeholders
- Compile literature review and report

Questions?