Survey of Surface Preparation and Coatings Automation Panel Briefing

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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”

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

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

Mobility system design
- Wheeled
- Tracked
- Double frame
- Rail
- Fixed

Adhesion system design
- Magnetism
- Suction Force
- Mechanical
- Chemical

Degree of autonomy
- Remote
- Semi-Autonomous
- Autonomous
- Repeatable

Programmability
- Single
- Multiple
- Repeatable
Mobility System Design
Adhesion System Design

Magnetism
Suction Force
Mechanical
Chemical
Degree of Autonomy & Programmability

- Remote
- Semi-Autonomous
- Autonomous

- Single
- Multiple
- Repeatable
Path Forward

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