Autonomous Dredge Conceptualization

A Case Study At USCG Station Cape Disappointment

Academy: United States Coast Guard Academy

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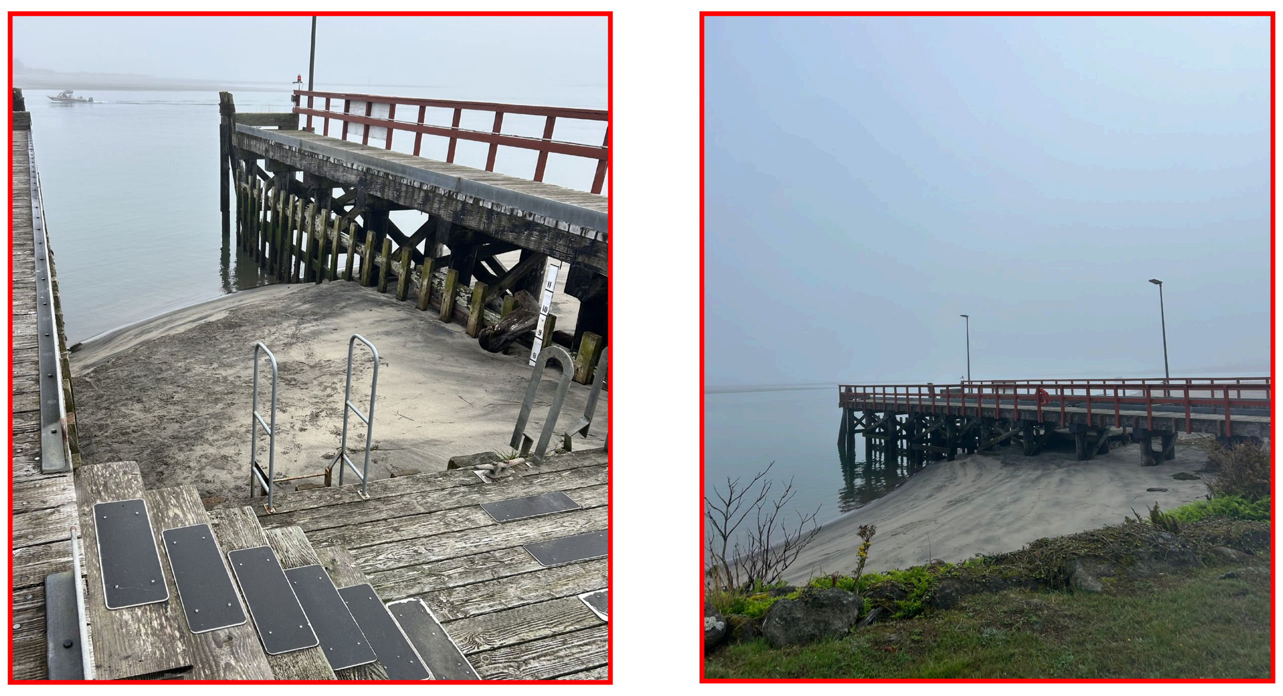
Stakeholders: USACE, CEU Oakland, STA Cape Disappointment, & National Motor Lifeboat School

Problem Statement

Rapid sediment accumulation in the vessel mooring and maintenance facilities at Station Cape Disappointment have significantly impacted operations at the Station and National Motor Lifeboat School located there. Traditional approaches to maintenance dredging have proven costly and inherent delays further impact operational readiness. A rapidly deployable autonomous dredging solution is needed to respond to emerging sedimentation problems.



Sediment accumulation in the Station haul-out facility

Benefits

This team was tasked to develop an autonomous dredge concept by the U.S. Army Corps of Engineers (USACE) to improve readiness at coastal military facilities worldwide. This technology can restore navigable access to strategic ports and forward-operating bases impacted by sediment deposition on varying temporal scales, specifically in remote locations. Autonomous dredging could benefit the public through its application in military and interagency efforts to restore vital waterways after natural disasters when traditional dredging resources are limited.

Design Considerations

Maintenance	Routine maintenance should be conducted by federal personnel without the aid of contractors, allowing for uninterrupted service even in remote locations.
Deployment Method	Designed for versatile deployment for a variety of site locations. Adaptable for facilities with load restrictions on their waterfront infrastructure.
Energy Supply	Must have a flexible power system for continuous operations that can be supported by a location's utilities/fuel infrastructure.
Operational Level of Autonomy	Upon deployment, the autonomous system must perform all dredging tasks, including site navigation, assessment, and sediment removal.
Propulsion	The design must maneuver in dynamic environmental conditions with the precision to dredge targeted areas.

Future Work

System Integration

- Research optimal detection equipment
- Develop algorithms for autonomous operations

Operational Logistics

- Research geosynthetic bags for use as temporary underwater sediment storage
- Develop autonomous deployment mechanism to optimize logistics

Prototype Design

- Test autonomy performance and propulsion system across varied site conditions
- Design modular components for efficient maintenance
- Develop dredge apparatus to prevent intake of marine life and debris
- Develop system specifications based on environmental conditions

Design Decisions

1A: changeable dredge head
1B: modular legs for repair and replacement
Maintenance 1

2A: Walk-in deployment
2B: Brackets for crane deployment
Deployment Method 2

3A: Shore tie compatible charging port
Energy Supply 3

4A: LiDAR /sonar system to guide operations
4B: Sediment disposal tube
Operational LOA 4

5A: 4-legged design to increase maneuverability and obstacle avoidance
Propulsion 5

Autonomous Sediment Removal Device