An Operators Perspective on the Role of Autonomous Technology in our Domestic Trade Today

David Belisle

Algoma Central Corporation

Nov. 2019

Algoma

DOMESTIC DRY BULK

DOMESTIC PRODUCT TANKERS

OCEAN SELF-UNLOADERS

GLOBAL SHORT-SEA SHIPPING

Largest fleet of dry and liquid bulk carriers operating on the Great Lakes

Owner & Operator

Topics

- Technology needed for autonomous operation
- Navigation assistance
- Training
- Performance optimization
- Condition based maintenance

Technology Needed For Autonomous Operation

- Integrated CAMs (control, alarm & monitoring systems)
- Current environmental sensors & Information
  - ECDIS
  - Radar
  - AIS
  - Wind Speed & Direction
  - GPS: STW, SOG, COG, heading, bearing
  - Voyage plan
- Additional sensors
  - Optical cameras
  - Infrared
  - Lidar
  - Shore sensor integration
- Algorithms & Processors
  - Water not water detection
  - Object detection, identification, tracking
  - Navigation control – Artificial Intelligence?
- Telemetry & remote intervention/control
- Machine learning methods
- Big data

Not a complete list

Not practical for us to get autonomous in one step

- Navigation assistance
- Training
- Performance optimization
- Condition based maintenance

- Some tasks aren't well suited to automation
  - Mooring
  - Cargo operations

Embrace technology & benefit from development

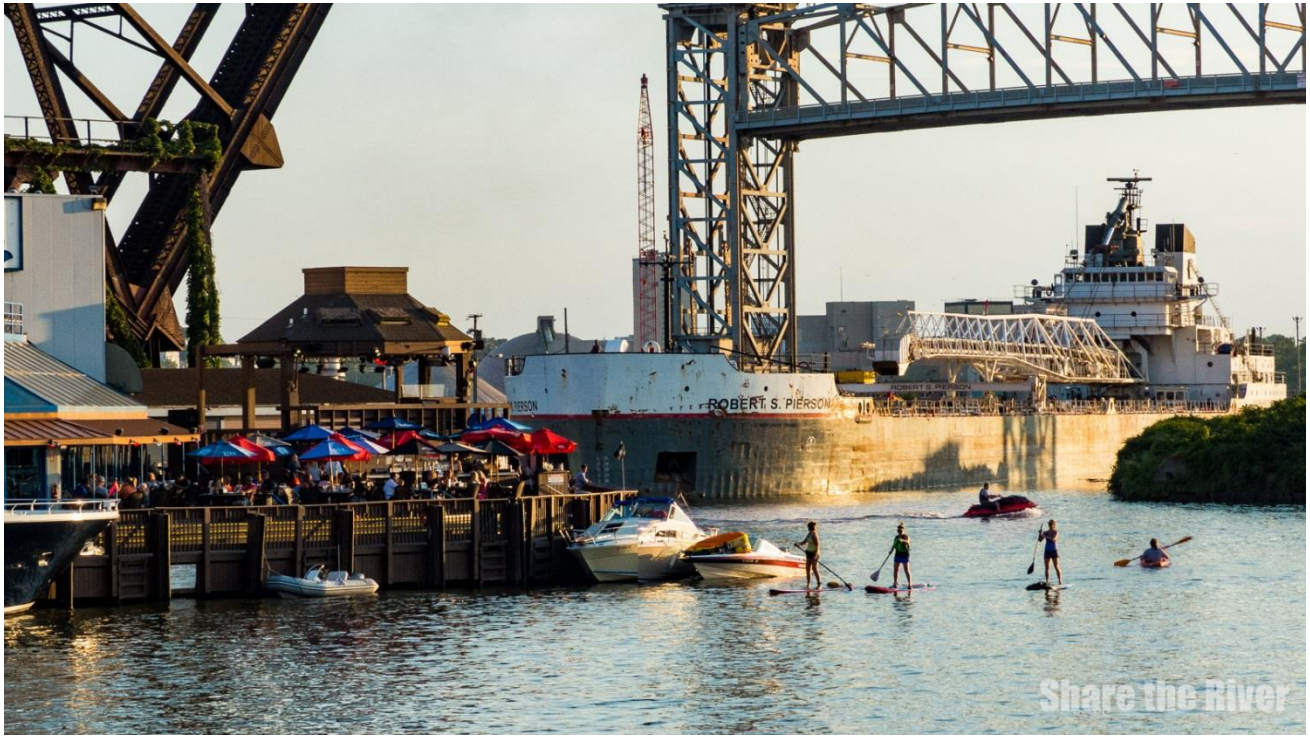
Navigation Assistance (NA)

- Object detection, identification & tracking
- Automated spotting
- Approach guidance

Improve situational awareness
and reduce stress & fatigue

NA - Object identification / tracking

Examples: MOB or Cuyahoga River



Early warning = better response


Cleveland

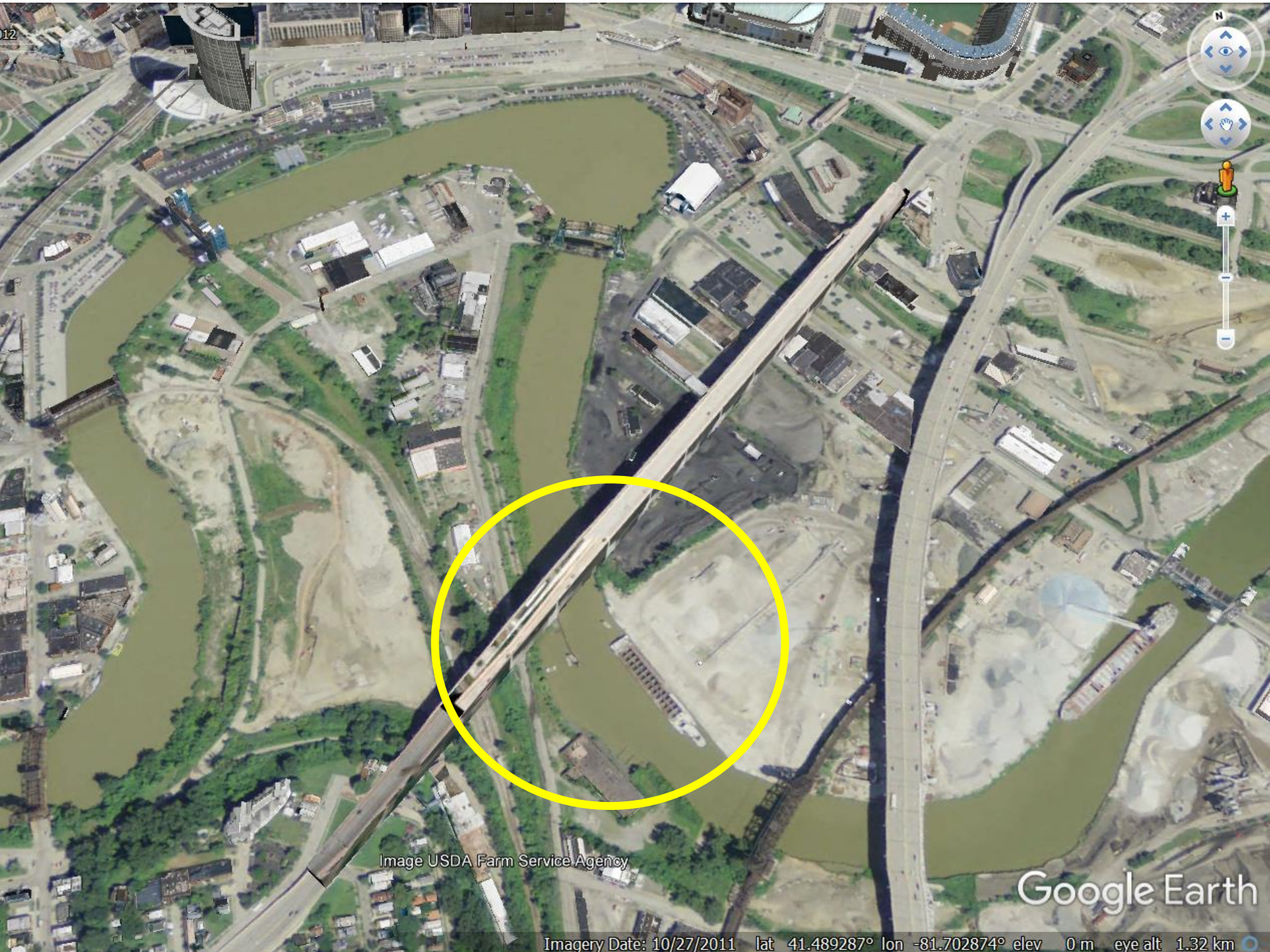
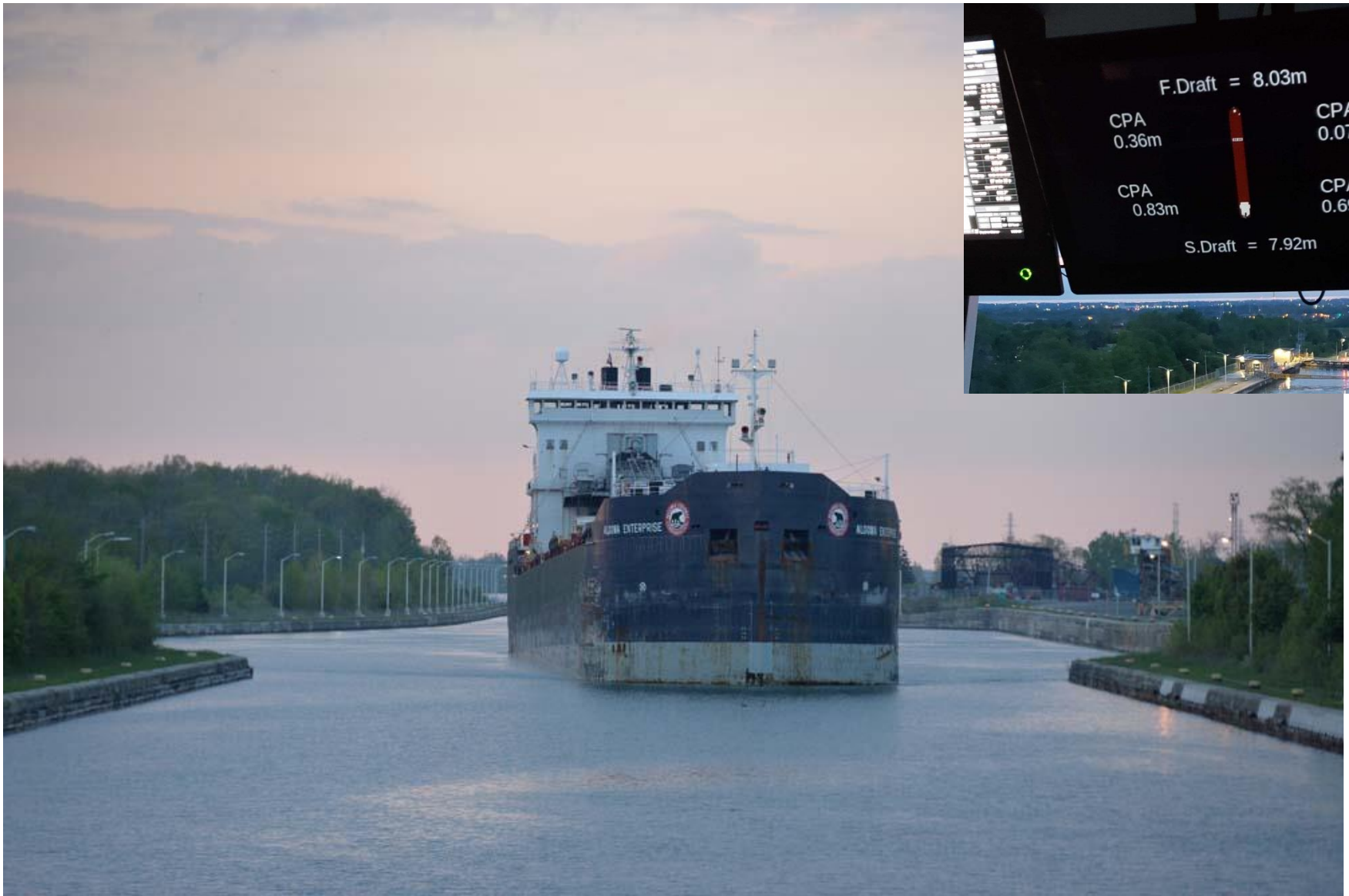


Image USDA Farm Service Agency
Google Earth
Imagery Date: 10/27/2011 lat 41.489287° lon -81.702874° elev 0 m eye alt 1.32 km

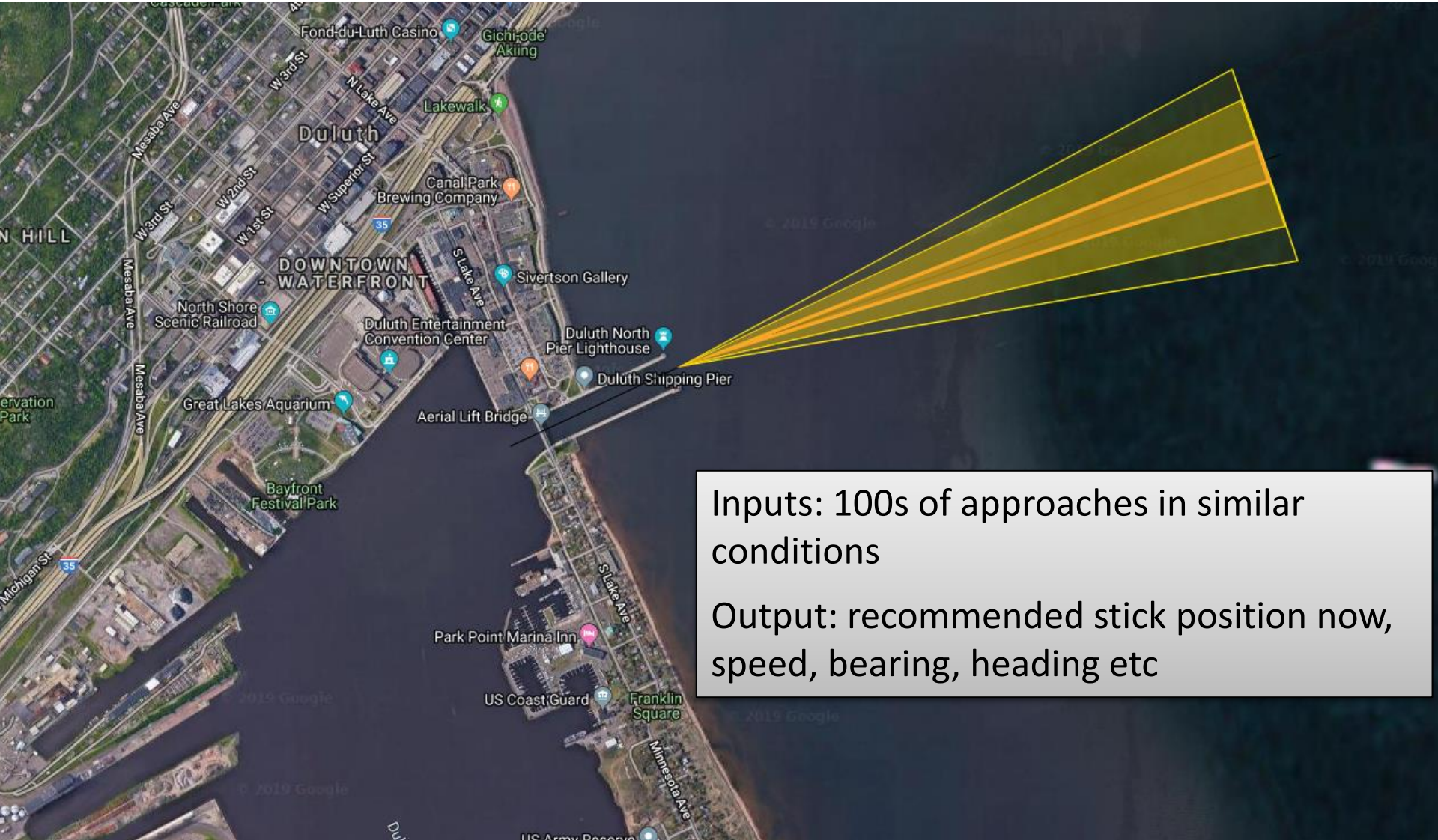
Cuyahoga River Transit Video

NA - Automated Spotting



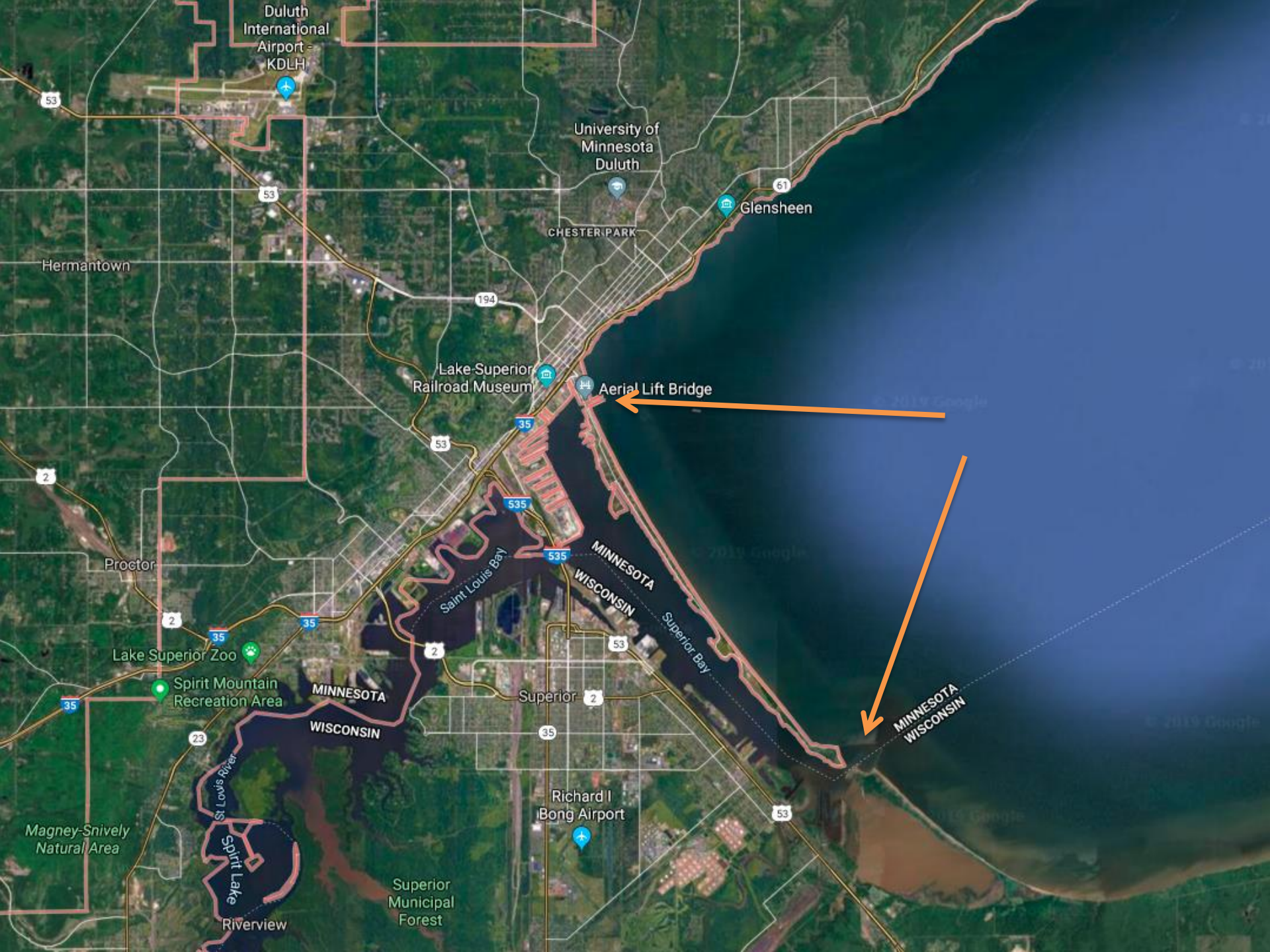
Spotting Animation

NA - Approach Guidance



Inputs: 100s of approaches in similar conditions

Output: recommended stick position now, speed, bearing, heading etc

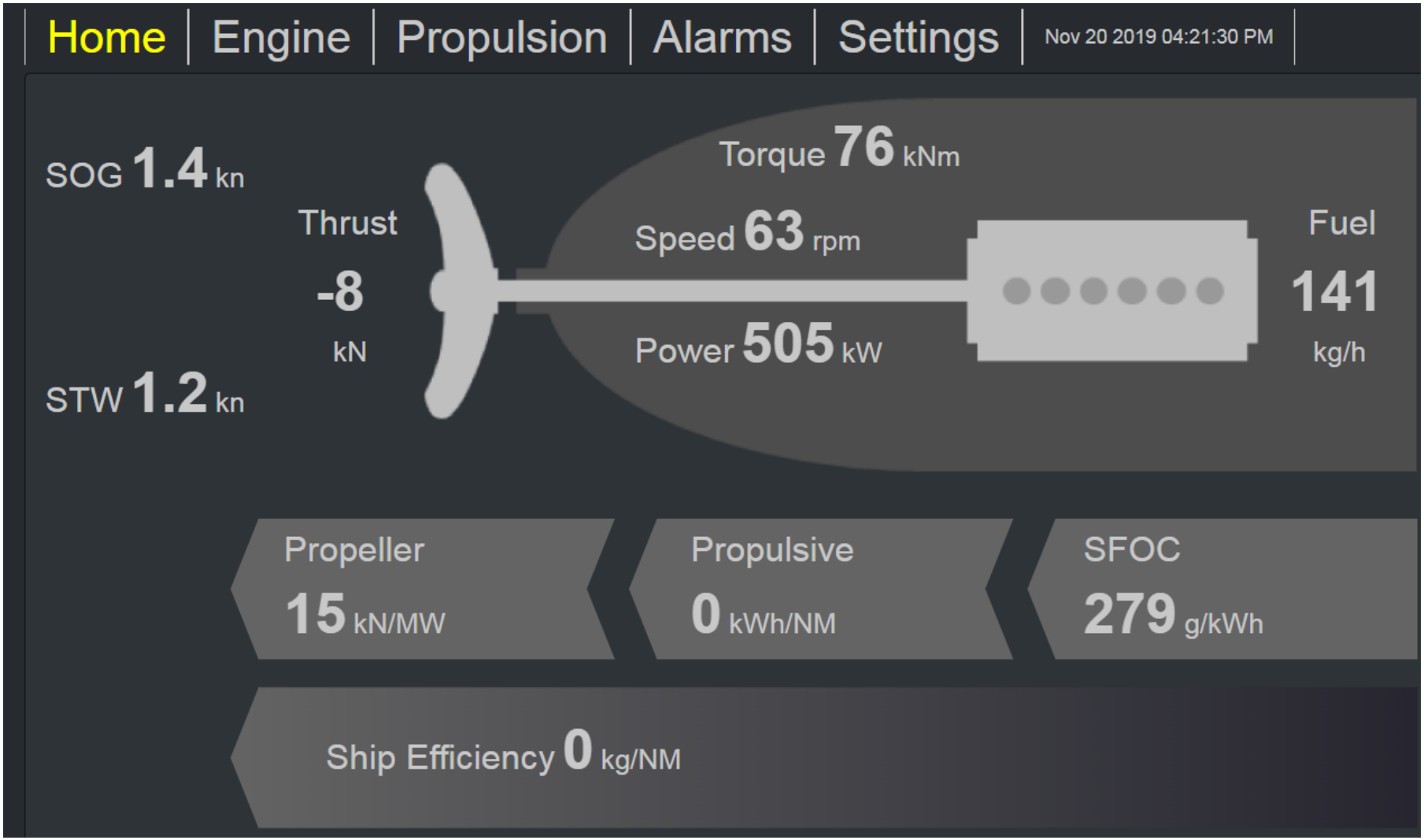

Duluth International Airport - KDLH
University of Minnesota Duluth
Glensheen
CHESTER PARK
Hermantown
Lake Superior Railroad Museum
Aerial Lift Bridge
Proctor
Saint Louis Bay
MINNESOTA
WISCONSIN
Superior Bay
Lake Superior Zoo
Spirit Mountain Recreation Area
Superior
MINNESOTA
WISCONSIN
MINNESOTA
WISCONSIN
St Louis River
Richard I Bong Airport
Magney-Snively Natural Area
Spirit Lake
Riverview
Superior Municipal Forest

Performance Optimization

- Cargo carried
  - Seaway Max draft & dynamic drafts
    (Draft Information System from 26'6" to 26'9")
- CAMS integration and telemetry allow objective real time analysis of performance not available otherwise.
  - Propulsion – pitch / engine irregularities
  - Gauging systems
- Leg analysis
  - Divide voyages into comparable building blocks
    - Transit times
    - Ship efficiency – kg/nm
    - Propeller efficiency – TT Sense optical torque and thrust sensor
    - Engine efficiency – diesel doctor engine analyzer

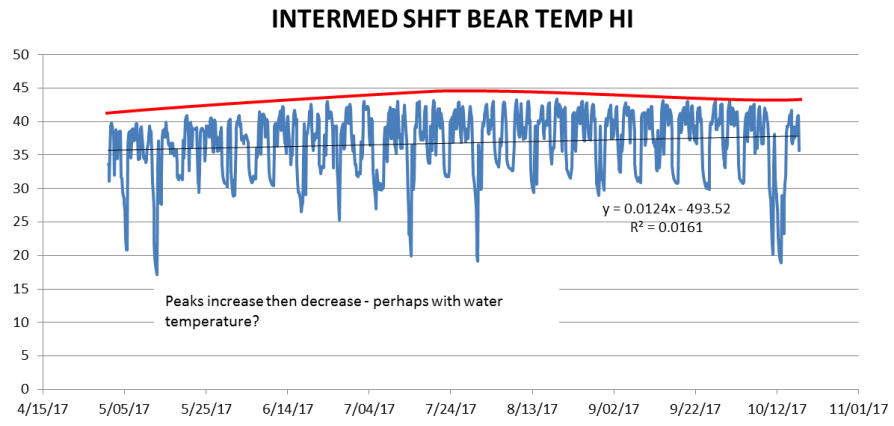
Flag exceptions allowing prompt response

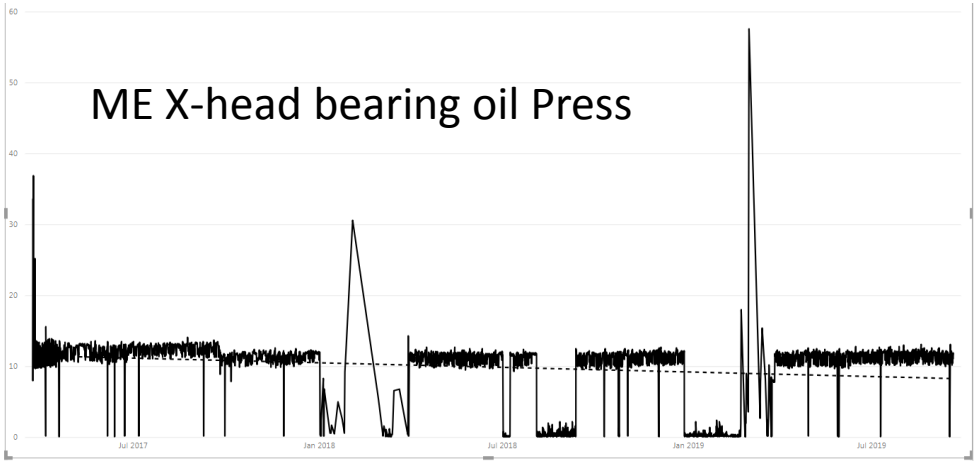
Propulsion Efficiency Monitoring



CBM: Rationalizing Maintenance

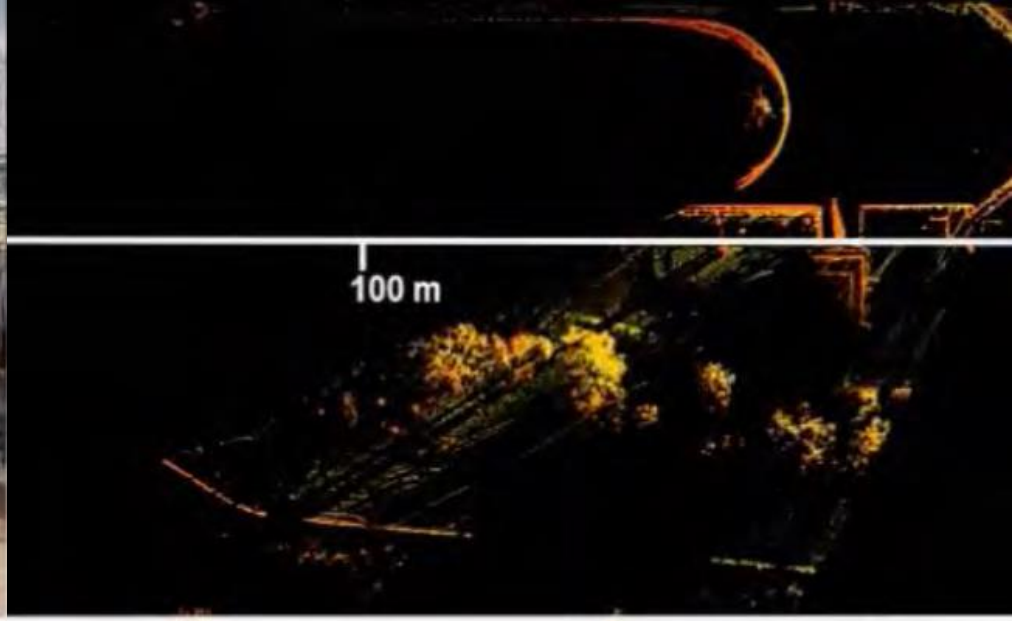
- CAM system can trend 1-3 months
- Logging data hourly for long term trending over vessel life

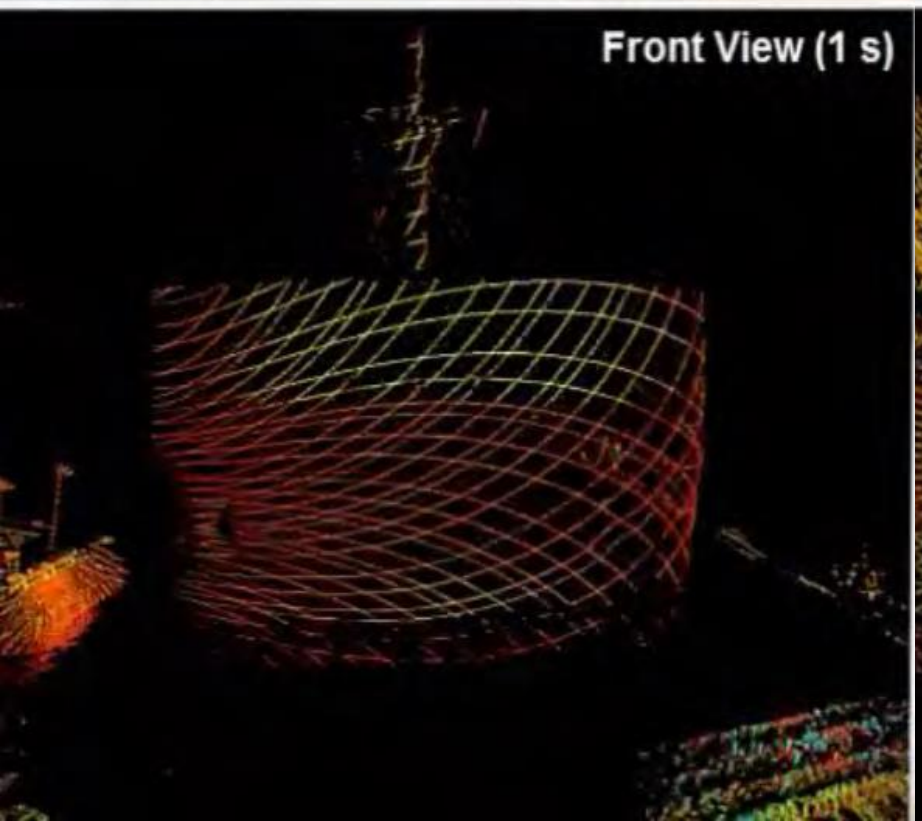


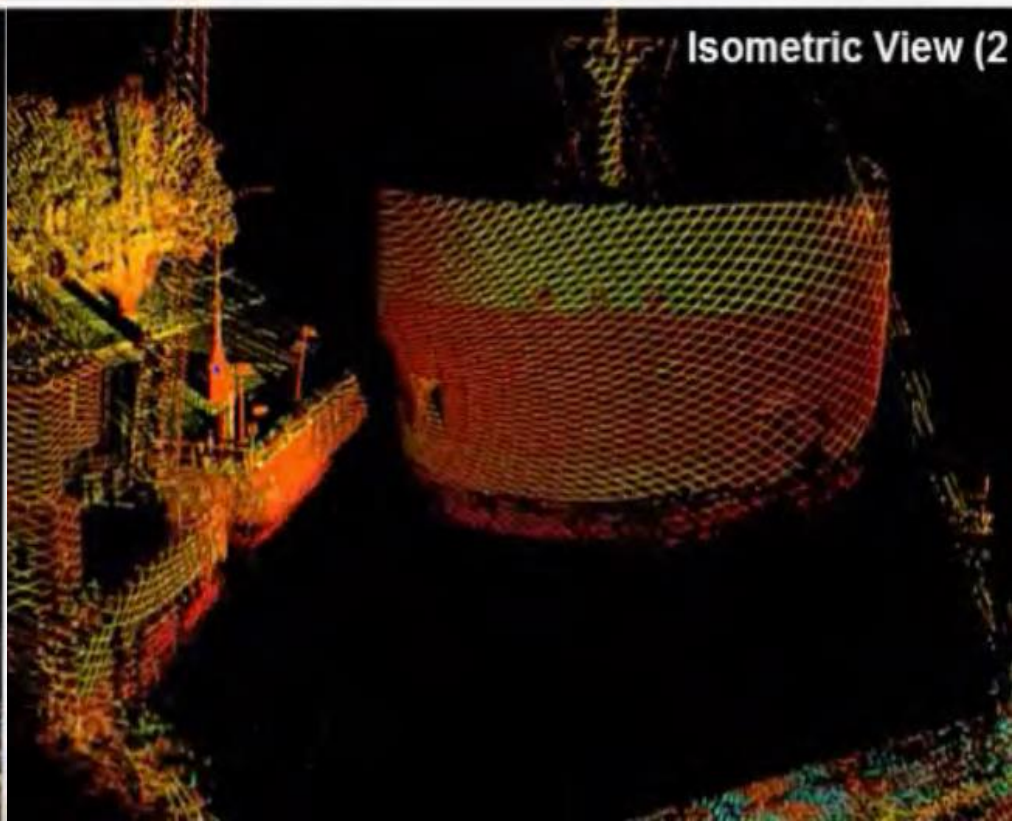


Objective info to focus resources as best served

Support Material


100 m


Front View (1 s)


Isometric View (2