

# AVOID DANGEROUS ROAD CONDITIONS WITH HYPERLOCAL WEATHER INFO



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## Agenda



- > Overview of Harris
- Internet of Things Sensors
- > Machine Learning's Role
- Introduce Helios Innovative Technology
  - Capabilities, Examples, Live Demo
- > Questions & Answers



## **About Harris Corporation**



#### 17,000 employees worldwide

7,700 engineers and scientists

Supports customers in more than 100 countries

Industry leading R&D investment

Broad portfolio, strong franchises, key experts, and a proven track record of innovation and success



# **Communication Systems**

Tactical and airborne radios, night vision technology, and defense and public safety networks

# **Space and Intelligence**

Complete Earth observation, weather, geospatial, space protection and intelligence solutions from advanced sensors, antennas and payloads, as well as ground processing and information analytics

# **Electronic Systems**

Extensive portfolio serving the defense industry with electronic warfare, avionics, robotics, advanced communications and maritime systems as well as air traffic management solutions for the civil aviation industry



- From sensors and software to actionable information, our solutions and products help you make informed decisions – when and where they are needed.
  - Off-the-shelf and custom solutions for advanced geospatial analysis
  - Tools for hosting and managing distributed data processing in a high-performance computing environment
  - An online marketplace that puts the best commercially available geospatial data and imagery at your fingers.
  - Innovative Geiger-mode LiDAR sensor to collect data faster and at 10x the resolution of traditional LiDAR.
  - Value-added services (VAS) that give you actionable information.



# Internet of Things Sensors: Constantly sensing but rarely seen





- The Internet of Things: Bring a buzzword to life premise is to detect new information that is normally not in the context of the device's original purpose
- The surveillance camera growing and becoming ubiquitous in our lives
- Machine learning is proving it has the ability to solve problems never envisioned with traditional computer vision.
- These are emerging in the weather/transportation space



"People only see what they are prepared to see" - Ralph Waldo Emerson

- Like politics, all weather is local
  - For many, the best forecast is still to look out the window
  - Frustration with inaccuracies and generalities of a weather forecast (context problem)
  - What happens in the atmosphere is not what always happens on the ground
  - Expected zones of impact can be very different than the actual zone of impact
- Goal: fill gaps in foundational ground data
  - Provide the largest terrestrial image analytic network on the planet
  - Use machine learning to extract numerous phenomenology
  - Fuse other discreet data
  - Add new observations types to the knowledge base
- Improve current decision making & forecasting
- Providing a solid foundation for new predictive capabilities



We know an awful lot about the weather, but ultimately – you care about the current conditions and the forecast for where you live. Not a state to the west, not a county to the west, not a city to the west, but where you live or drive. - Scott Dimmich



- Machine learning with Harris
  - Traditional computer vision techniques difficult to implement on IoTs data (resolution, spatial variations, image variations)
  - Machine learning is reframing the ability to extract environmental and traffic conditions from existing camera networks
  - Can repurpose any camera into a smart sensor without retrofit
- Maximizing infrastructure investments
  - Compliments and densifies existing mesonet site locations
  - Capability scales with DOTs hardware investment
  - Demonstrates a high value-add repurposing existing investments
  - Improved ground occurrence detection granular validation of highly variable phenomena (i.e. fog, partial snow cover)







O Planes detected, 1 FP





# Helios Technology



- Fills the hyperlocal weather data gap missed by radar, ٠ satellite, and traditional weather stations
- Road weather, visibility and precipitation, derived from ٠ ~40,000 cameras, updated every 5-10 minutes
- Web-based platform and API feed provide data and ٠ analytics for public safety, transportation, weather forecasting, and more
  - Push notifications
- Historical data archives of detection and corelated ٠ image
- Arterial roads and connected vehicle data being • implemented







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### **Connected Vehicles (Snow Plows)**





# Innovative Technology for Transportation



#### • Impacts of weather

- Real-time observing of current conditions to validate and complement forecasts
- Impacts on the transportation infrastructure
- How ground conditions differ from expected
- How have the conditions changed over time
- Understand different aspects of a scene
  - Incident
  - Congestion
  - Flow/density
  - Objects (i.e. vehicles)
  - Vegetation

#### Correlate the data for improved prediction

- Correlation of weather and traffic
- Road behavior
- Patterns/trends (anomalies)
- Look ahead conditions
- Data science (i.e. weather+traffic+impacts)

Weather Timing Impacts Roads Traffic Environmental/road conditions Traffic capacity and flow Activities and crowd patterns Tracking (size, color, direction of travel) Monitoring & change detection Unattended object detection Usage profiles Ground weather Road weather Unknown, Austria 2018-11-12T15:50Z <del>()</del>

> Trinidad, Colorado 2018-11-12T15:40Z

Traffic flow

# Helios Road Weather Detection and Alerts



- Road weather, visibility and precipitation
- Derived from ~40,000 cameras •
- Updated every 5-10 minutes

#### Precipitation







Images with different levels of visibility: good (top-left), hazy (top-right), reduced (bottom-left), poor (bottom-right).

#### Road Ice Formation (uses RWIS data)

Visibility (fog/smoke)



#### Advanced Visualization with Kibana





Heatmap: Helios full road snow measurements in the past week in Colorado: Nov 5th thru 12th, 2018

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## **Traffic Pattern Detection/Anomalies**



- Per camera traffic/congestion analytics
  - Lane obstruction detection
  - Wrong way running
  - Variable speed control
- Normal scene is established for each camera
- Single frame detection
- Per lane congestion
- Alert when anomalous condition is seen





# Innovative Technology for Transportation



Real Time Monitoring of Reduced Visibility (fog) Conditions on Florida's Highways

#### Reduced Visibility Verification with Harris

- Numerical forecast have hard time with ground fog and don't do visibility
- Helios provides accurate validation for reduced visibility situations
- Proven image processing analytics instantly relay present weather conditions
- Facilitates replacement of expensive RWIS and forward-scattering visibility sensors with existing DOT cameras

#### Reduced Visibility Prediction from PraxSoft

- PraxSoft's Primary Forecast Index (PFI) combines WSNs, numerical weather modeling and GIS to predict dense fog events and heavy precipitation which reduce visibility
- Puts primary focus on future fog and reduced visibility events (predictive) vs. generalized information from traditional road weather systems or past traffic events (reactive)

#### > Intelligence to assist you with real-time decision making





# Innovative Technology for Transportation



Real Time Monitoring of Reduced Visibility Conditions (fog) on Florida's Highways

- Study validated:
  - Harris analytics provides affordable verification of reduced visibility/fog conditions meeting or exceeding performance of existing verification technologies
  - Combined with Praxsoft's suite of sensors, site-adaptable software algorithms and weather modeling can accurately predict dense fog events and heavy precipitation which reduce visibility

#### Results:

- 2016-2017 fog season expanded group of sites achieved an accuracy of 81-91% with a false positive rate of only 7.2%
- Helios visibility/fog detection correlated and validated the Praxsoft weather model results
- Harris extended its model for night visibility detection to provide a two-way validation solution
- 2017-2018 fog season results show an accuracy of 85-93%
- Improved visibility prediction can reduce crashes, improve traffic management, decrease costs and save lives







#### Real-time localized information

- Better road coverage increasing awareness for response to the public
- Optimizes currently deployed assets
- Provides affordable verification of reduced visibility conditions meeting or exceeding performance of existing verification technologies
- Provides data at a temporal detection scale not currently available in the weather enterprise

#### Verification

- Forecasts have always suffered from poor verification, especially precipitation forecasts.
- More complete and comprehensive verification of all forms of precipitation.

#### From passive to active monitoring

- Densify your RWIS and ground truth capabilities
- Additional capability to weather-responsive management strategies
- Helios removes the human resources needed to monitor tens of thousands of cameras for threats

#### • Public warnings

- More effective risk messaging
- Improved messaging of the localized road conditions
- Data can be pushed to mobile platforms



For more information, please visit

www.harrisgeospatial.com/Helios

# **ANY QUESTIONS?**



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