

# Automated Image Processing: Marine Mammal Monitoring Prospects\*

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Presented at the IATTC Workshop on Methods for Monitoring the  
Status of Eastern Tropical Pacific Ocean Dolphin Populations

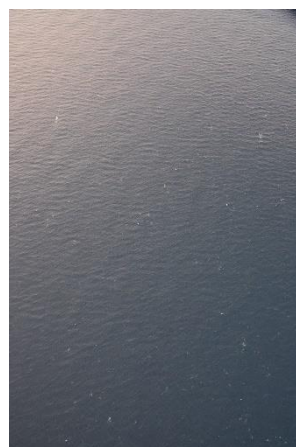
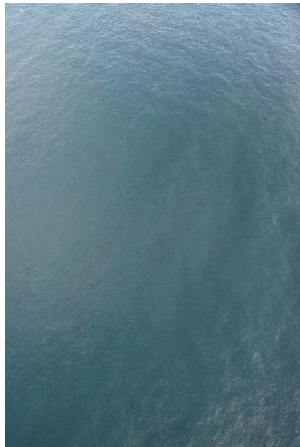
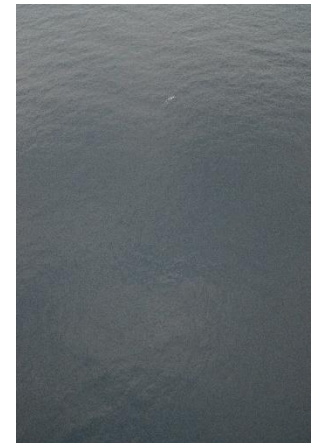
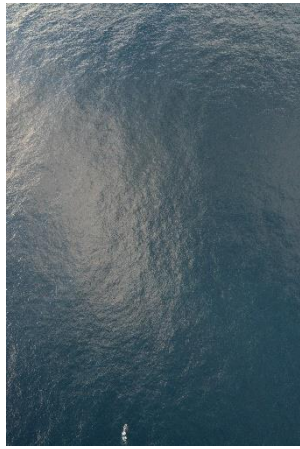
October, 2016

\* Related slides have been presented at the 2015 UAS Alaska conference, the 2015 Commercial UAV Expo conference, and elsewhere. Related products have been delivered by Brainlike to LGL Alaska Research Associates and Shell Oil. Thanks to LGL and Shell for their generous support and permission to demonstrate the use of images presented in this report. Special thanks to Darren Ireland, Kathleen Leonard, and Heather Patterson from LGL, along with Gregory Schaefer and others from Brainlike, who co-authored earlier reports and collaborated on related work.

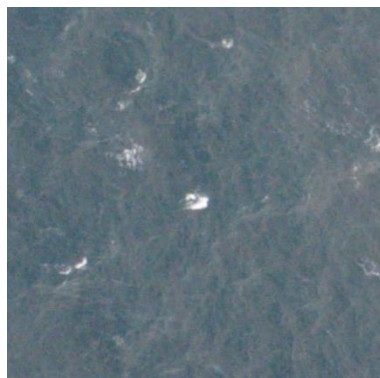
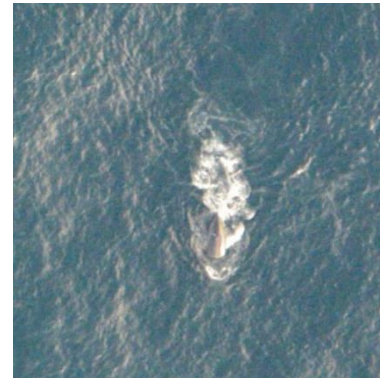
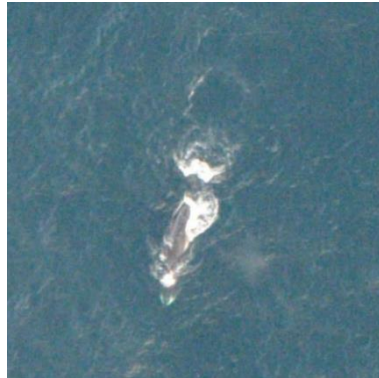
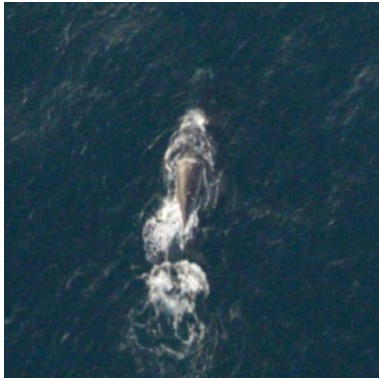


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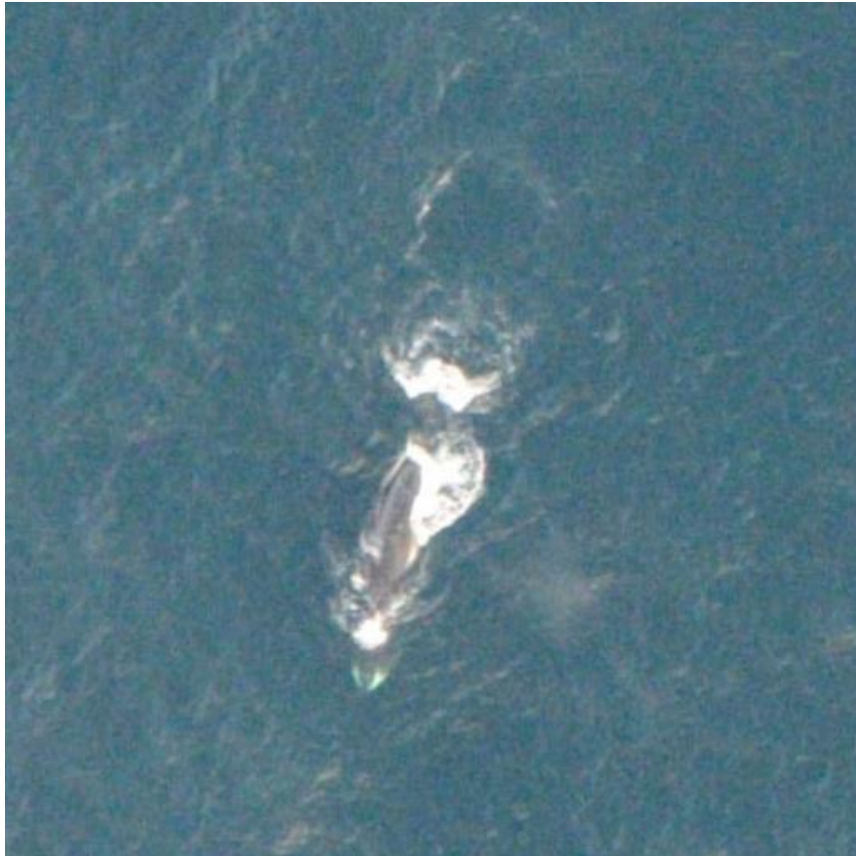
# Can you find whales in these images?



# Can you find whales in these "chips?"



# Can you classify them from these chips?



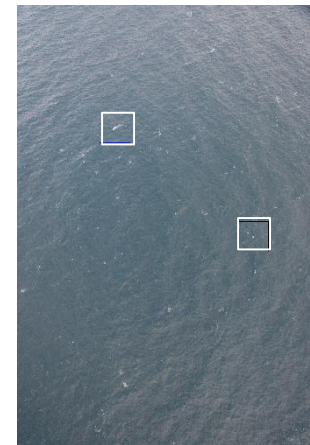
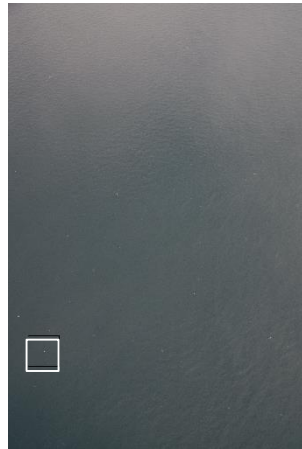
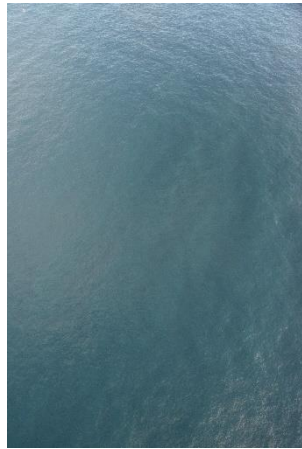
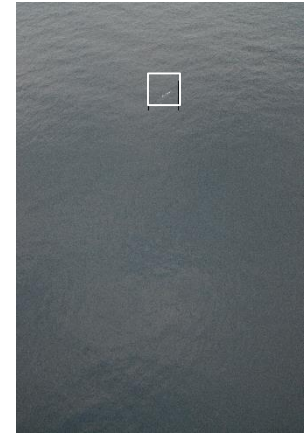
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# Can you locate them in these "alert maps?"



# How does automatic detection work?

## 1) Airborne images are obtained, e.g. (see op. metrics slide):

- 10,800 images per flight
- 200 m. altitude, 100 km/hr, 1 fps
- Nikon D800 series camera, 50 mm lens, < 2cm GSR

## 2) Images are downloaded to a computer:

- Runs automatic marine mammal detection (**AMMD**) software
- May be aircraft-based, ground-based or ship-based
- May do conventional processing or fast, special-purpose processing

## 3) AMMD software reduces image data to detection events:

- Produces small chip jpg files in a "chips" folder
- Produces "alert map" jpg files showing chip locations in an "alerts" folder
- Produces spreadsheets listing events and their metadata

## 4) An observer validates whale detections within chips:

- Quickly identifies chips containing marine mammals
- Efficiently stores and/or uploads chips for further analysis and classification

# How does AMMD add value?

## 1) Reduced detection effort and cost , e.g. (see op. metrics slide):

- Less than one second observer time per image vs. 3 minutes analyst time per image
- Three observer-hours detection time per flight versus 540 analyst-hours per flight
- Less than 100 observer-hours per 30-flight survey versus 405 analyst-weeks/survey

## 2) Actionable detection turnaround time:

- AMMD processing rates of 5 seconds per image or faster
- Chips per flight uploaded in 22 minutes versus images per flight uploaded in 52 hours
- Post-detection decision support for fishing, seismic testing, etc. within hours vs. weeks

## 3) Comparable detection precision:

- AMMD- based detection identified "most" of the whales that were detected from detailed (3 minute per image) analysis in a comprehensive study

## 4) Increased detection rate potential:

- Analysis savings can be redirected to enable more sensor coverage
- Unmanned flights with greater coverage can replace less cost-effective manned flights or ship-based observation

# What are the key operational metrics?

Camera/lens focal length (mm):	50
Camera sensor row length (mm):	35.9
Camera sensor column height (mm):	24
Camera row resolution (pixels):	7360
Camera column resolution (pixels):	4912
Raw bits / pixel:	12
Frame rate (frames/sec):	1

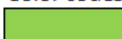


Altitude (m):	200
Ground speed (Km/hr):	100
Flight duration (hr):	3

Upload rate (megabits/sec):	25
Processing rate (secs/image/processor):	20
Number of processors:	16
Chip columns and rows:	512
chip generation rate (chips/image):	1
Manual detection rate (minutes/image):	3
Triaged detection rate (secs/image):	1

Ground resolution (inches per pixel):	0.77
Image overlap (%):	71.0
Ground left-right coverage per image (ft):	471
Ground front-back coverage per image (ft):	314
Ground coverage per flight (acres):	10,645
Ground coverage per flight (miles <sup>2</sup> ):	17

Manual detection time per flight (hr):	540.0
Triaged detection time per flight (hr):	3.0

Triage processing time per flight (hr):	3.8
Raw image upload time per flight (hr):	52.06
Chip upload time per flight (minutes):	22.6
Chip data rate (RGB megabits/sec):	3.1

	Color codes
Input	
Interim	
Output	

0.0049	Camera pixel row length (mm)
0.0049	Camera pixel column height (mm)
1.97	Camera/lens focal length (inches)
1.41	Camera sensor row length (inches)
0.94	Camera sensor column height (inches)

656	Altitude (ft)
62	Ground speed (mph)
0.0195	Ground resolution (m/pixel)
143.6	Ground left-right (row) coverage / image (m)
95.8	Ground front-back (col.) coverage / image (m)
14.4	Ground coverage / hr (Km2)
27.8	Ground speed (m/sec)

10,800	Images per flight
54.23	Megabytes/image (uncompressed)
5.42E-05	Terabytes/image (uncompressed)
17.35	Transmission/upload time per image (sec)
1.25	Triage processing rate per image (secs)
3.15	Data rate per chip (RGB megabits/sec):



# What do we mean by *Triage* ?

## tri·age

**noun** /trē'äZH/ /'trē,äZH/  
trriages, plural

1. The action of sorting according to quality
2. (in medical use) The assignment of degrees of urgency to wounds or illnesses to decide the order of treatment of a large number of patients or casualties
3. (in data processing) The rapid reduction of massive data streams to actionable information



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# What are the key AMMD transition enablers?

- ✓ **AMMD must have huge added value potential.**
  - Big cost savings
  - Much more coverage per unit cost
  - Much faster turnaround allowing timely, valuable action
  - Safer data gathering operation
- ✓ **AMMD delivery must be affordable.**
  - Inexpensive drones
  - High AMMD technology readiness level
  - Reasonable licensing fees
  - Low configuration/integration cost
- ✓ **AMMD precision must be proven.**
  - Sharp imagery
  - Validated hit rates
  - Affordable false alarm rates
- ✓ **AMMD calibration may be necessary to adjust trend estimates for differences in precision and coverage.**

# How can we help?

Brainlike Fact Sheet **3** Free Data Triage Evaluation Pixmin™ Analyst Kit

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## Free Data Triage Evaluation

Send a Message

14 **Brainlike To Present At The IATTC Dolphin Workshop**

Oct The IATTC is hosting a Workshop on Methods for Monitoring the Status of Eastern Tropical Ocean Dolphin Populations, which will bring together Brainlike and more than 20 experts ...

### What is *Brainlike*?

Our image "triage" products allow customers to focus on important events instead of wading through streams of cluttered data. Our products help analysts detect marine mammals from airborne images taken off Alaska's North Slope, while reducing average analysis effort by 99%. Brainlike currently focuses on airborne inspection and wildlife detection, but any form of data triage is fair game—especially when events must be detected quickly.

Besides reducing analysis effort and highlighting important events, Brainlike triage reduces transmission bandwidth, storage and total operating costs.